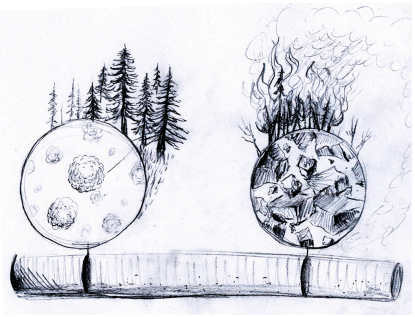
iSWOOP Programs

Roves, hikes, walks, and evening programs



Acadia National Park

Carlsbad Caverns

Indiana Dunes

Jean Lafitte

Joshua Tree

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Acknowledgments

We are grateful to the many interpreters, scientists and resource managers who have made park-based research a lively, interactive part of park visitors' experiences. We are thankful for Park Service staff who have advised the iSWOOP project, and to the National Science Foundation for its support.

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iSWOOP is a collaboration of TERC-based educators and wildlife biologists Nickolay Hristov and Louise Allen.

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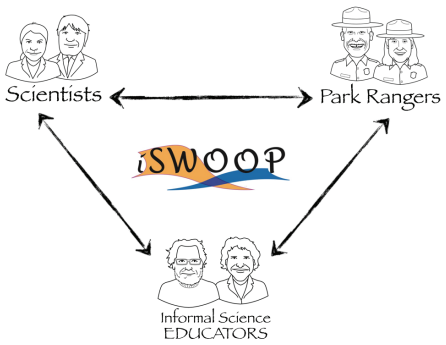
A Brief Overview

iSWOOP was designed to increase the visibility of park-based research for the public. iSWOOP relies on interpreters to connect the science behind the scenes with visitors who otherwise might walk by, through, or around the science that is so vital to increasing our understanding of the natural world. Increasing opportunities for STEM (science, technology, engineering, and math) learning among the public is a high priority for the Park Service and for the National Science Foundation. iSWOOP educators, scientists, and National Park Service (NPS) interpreters bring visitors into the loop on the science research underway on park lands. **iSWOOP programs and informal interactions led by interpretive rangers give visitors an opportunity to see aspects of the park that are not usually visible and to discuss the relevance of park-based research.**



Scientists bring knowledge of phenomena; Rangers bring knowledge of place; the public brings questions and prior knowledge. iSWOOP adds display options, visual media, and professional development,

Interpreters at five parks (Acadia, Boston National Historic Park, Carlsbad Caverns, Indiana Dunes National Lakeshore, Jean Lafitte National Park, and Joshua Tree National Park) planned and delivered formal and informal interpretive programs, incorporating these central elements of iSWOOP:

- Facilitating interactions that feature opportunities for visitors to observe, predict, and speculate
- Making research prominent through stories about research, scientists, and technology innovations
- Making research prominent through the use of still images, video, and other visualizations.

iSWOOP addresses the disconnect that NPS interpreters often feel between themselves and the research underway behind the scenes. iSWOOP helps interpreters do their jobs with excitement and confidence.

We share their program outlines as examples of what iSWOOP can look like. Interpreters have applied iSWOOP's principles and approaches in all kinds of interactions, like walks, evening programs, and stationed interpretation. Some programs have strong stories, others reveal how scientists know what they know. Others include examples of open-ended questions to spark dialogue. We hope

Reach Out!

Please! Seek out iSWOOP project leaders as a sounding board. Ask us about available resources to support your efforts (devices help with professional development, evaluation), and to let us know how it goes.

Project contact: martha_merson@terc.edu; iswoop@terc.edu

What iSWOOP Is and Is NOT

Parks get at science in many ways, through waysides, newspaper articles, social media posts, talks and walks, and even apps that help visitors identify species or contribute data to a study. How does iSWOOP distinguish itself from the science-based interpretation currently happening in parks? Below are some of the ways we see iSWOOP as different.

iSWOOP Is ...	iSWOOP Is Not ...
Personal and interactive: an approach to personal interpretation that makes science in parks an interactive and visible part of the public's park experience	Primarily using waysides, social media, exhibits, or print media to showcase park-based science
Audience-centered, two-way conversations that allow time for visitors to engage with each others' ideas	Information out,
A way to talk about science as a process that starts from questions, involves revision, and has the potential to matter to all of us	A way to remind visitors that science is largely a collection of facts about how the world works
Science in parks is inherently interesting and full of good stories--both first person from interpreters' experiences and about the researchers and what they are studying	Facts strung together and offered in an engaging way
Technology and innovative methods are key to understanding how we know what we know.	Facts shared without attention to who figured it out and how
Images are sequenced to reveal something about the resource, but also as a starting point for inquiry and discussions of relevance	Images are primarily shown to illustrate a place
Programs, formal and informal, that invite visitors to predict, observe, and speculate.	A replacement for the strategies and know-how interpreters possess already
Comfortable with silence and reflection	Pre-scripted and pre-determined
Possible because interpreters and scientists spend time together in the field and in the classroom	Minimal or limited direct contact between interpreters and scientists, such as a 1 hour bag-lunch or field work encounter without follow up

iSWOOP focused on bats and wildlife researchers originally, but can feature any scientist or resource.

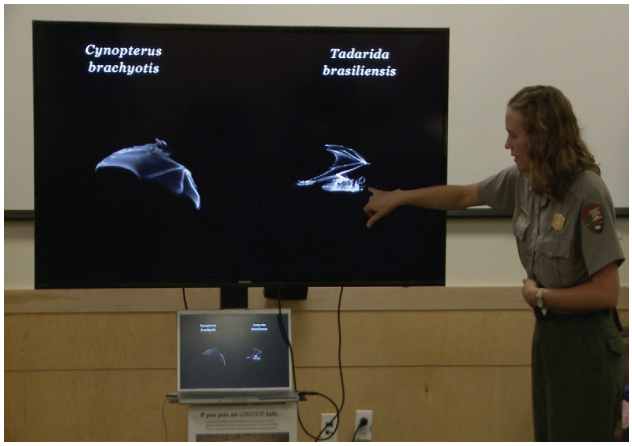
Interpreters' Creativity, Questions, and Concerns

Is iSWOOP and add-on? I don't have time. Developing a new iSWOOP program or revisiting and existing program outline to add elements of park-based research is an opportunity to be creative, to apply science communication approaches to the craft of interpretation. Yes, it takes time. Interpreters took months to refine their programs.

iSWOOP is meant to make park rangers' jobs easier. Talking about park-based research gives visitors another way to form emotional and intellectual connections with the resource—through stories about research, gaining insight into new technologies, and considering the relevance of park-based research.

iSWOOP is in synch with 21st century standards for interpretation.

iSWOOP assists in accomplishing recommendations, such as the Natural Resource Challenge (1999): "Knowledge gained in national parks through scientific research is promulgated broadly by the National Park Service and others for the benefit of society."



A ranger presents using Keynote and a 60" screen.

All visitors don't want to learn science. True, park visitors have a variety of reasons for their visits and they can make their own decisions about what they would like to do. However, we believe everyone should have easy-to-find, welcoming opportunities to engage in conversations about park-based science. If visitors have to go out of their way to partake, we risk reinforcing inequities that already exist in so many places (that discourage certain people from pursuing science). Of course forcing or inflicting interpretation is never the goal.

Technology—Is it necessary? Depending on the formats that scientists work in, interpreters might have to learn new software or integrate an iPad into their interactions with visitors. A tablet makes it possible to share a high-speed video or demonstrate visualizations of sound during informal interactions. Hands-on practice helps make new tools feel like a natural part of an interaction.

The iSWOOP Model: Components and Outcomes

Programs by Type

Park	*Title of the Program*	*Type of Program*
Acadia		
	Jordan Pond	Pop up
	Written in the Rocks	Walk
	Searching for the Forest Primeval	Evening Program
Carlsbad Caverns	In the Blink of an Eye	Stationed Interpretation
Indiana Dunes		
	On Fireflies	Stationed Interpretation
	Life in an Indiana Marsh	Walk
Jean Lafitte	Conversations about the Wetlands	Rove
Joshua Tree	I Speak for the Trees	Walk

Program Strengths

National Park	Questions, invitations to observe & predict	A story about a scientific researcher	Insight into how we know what we know	An invitation to speculate or find personal meaning
Acadia				
Jordan Pond	X	X	X	X
Written in the Rocks	X	X	X	X
Searching for the Forest Primeval	X	X	X	X
Carlsbad Caverns				
In the Blink of an Eye	X		X	X
Indiana Dunes				
On Fireflies			X	X
Life in an Indiana Marsh		X	X	
Jean Lafitte NHPP				
Conversations about the Wetlands	X		X	X
Joshua Tree				
I Speak for the Trees	X		X	X

Photo Credit: NPS

JEANINE FERRENCE

Acadia National Park

Jordan Pond

Did you see anything interesting?

Program type: Pop Up

Duration: 10-20 mins.

Theme: In order to make good management decisions, it's really important for us to know why something in the environment, like the lake, is changing.

Program Strengths

Questions that invite participation, observation, prediction

A story about a scientific researcher

Insight into how we know what we know

An invitation to speculate or find personal meaning

Jeanine Ferrence has a background in biology, and nearly 30 years of experience as an interpreter. Though she has worked seasonally at Yellowstone and Shenandoah and was a district supervisor at the Delaware Water Gap, she has spent 11 summers as the interpretive coach at Acadia. Jeanine homeschools. She says, "I'm pretty sure my superhero name is MO-OMM!!! (Two syllables and three exclamation points is how it sounds when my kids need my immediate attention).

Jeanine's Take on iSWOOP

I think it's increasingly important for the public to be scientifically literate in order to make good choices in their lives and, unfortunately, I think a lot of people reach adulthood feeling like they can't do science and as a result not trusting or even trying to understand the science behind contemporary issues. I love that iSWOOP addresses that head-on and demystifies science by creating opportunities for visitors to consider a specific, relevant piece of research and go beyond the results to explore the how and the why of the science.

Jeanine's Favorite Part of iSWOOP

I think my favorite part of iSWOOP is how it connects the science to the landscapes and resources that visitors are already interested in. As interpreters, we are already used to thinking about how to make a landscape or a resource relevant to our audience; incorporating the story behind the science helps to make scientific research relevant to visitors in the same way.

Questions, hypotheses, graphs, giant research buoy, two-way conversation. I'm interacting with visitors on the Jordan Pond path overlooking the research buoy in the lake. It seems to work quite well because people are so curious about it. I just ask if they saw anything interesting on their walk and about half of them say, "Yeah, we saw that white thing in the lake. What is it?" and we are off and running. A few say how beautiful and clear the lake is, and all I have to is mention that it's not as clear as it used to be and they are hooked. Much fun!

Program Strengths

What to look for	Where to look	Notes
Questions that invite participation, observation, prediction	**5, 69**	What role does science play in good decision making? Did you happen to notice the buoy on the lake?
A story about a scientific researcher	**26, 40**	Mention of scientists and discovering changing water transparency and DOCs
About how we know what we know	**51, 59, 81**	how the buoy got funding for Jordan pond what and how data is collected via buoy
Invitation to speculate personal relevance	**39, 108**	Asks what makes water murkier Discussed how long the study will last and continued funding

Jordan Pond Buoy Pop-up Program

Tangibles: buoy, Jordan Pond, mountains, rocks, water, wildlife

Intangibles: change, conservation, science, curiosity, knowledge, water quality, climate change, air quality, interconnectedness

Essential Question: *What role does science play in good decision making?*

Outline:

I. Hooking visitors interest
   a. *How was your walk today? Did you see anything interesting?* (Phase I: Building Community)
   b. Follow up based on visitor response:
      i. If they comment on how beautiful and clear the lake is, go to the clarity graph section and lead the conversation to who noticed the change, how they got the project started and what the buoy does
      ii. If they ask about the buoy, go to the buoy section and then lead conversation to who put the buoy there and why
      iii. If they don't mention the buoy or the clarity of the lake, ask if they noticed the buoy. If they seem interested, proceed as if they'd asked about the buoy.

II. Explore the clarity graph
   a. This <u>is</u> a really clear lake; in fact it's one of the clearest lakes in Maine. The lake is 150 feet deep (the park's deepest pond) and you can see about a third of the way down into it (30-50 feet).
   b. This is a **graph** that shows the clarity of Jordan Pond over time. The scale on the left indicates how deep into the water researchers can see - the deeper they could see, the higher on the graph the point is. The scale across the bottom shows time; the data points on this graph show how clear the pond was from about 1980, when we started doing water quality monitoring in Acadia, to about 2008. *What do you notice about this graph? Or in what year does it look like Jordan Pond was at its clearest?*

III. Scientists
   a. This is **Bill Gawley**, he's in charge of air and water quality monitoring here in Acadia. And this is kind of the perfect job for him because I look at A&WQ monitoring and it looks to me like it would get pretty tedious, but he loves it. He says that he never knows what he's going to find and that keeps it interesting for him. Plus, he loves being outside and this is a pretty beautiful place to work.
   b. And this is **Jasmine Saros**, she's a lake ecologist at the University of Maine. (add brief bio here)
   c. In 2013, one of Jasmine's students was analyzing all the data that Bill and his team had collected and she noticed the same thing that you did, that right around 1996, the clarity of Jordan Pond peaked at just below 15m/49' and then it started to decline. It turns out that water clarity in several of our lakes all started declining at the same time.
   d. In order to make good management decisions, it's really important for us to know <u>why</u> the lake is changing. *Do you have lakes in your area that have changed? What types of things can cause a lake to start becoming murkier?* (Phase 2: Sharing Personal Experience)
   e. There are lots of things that can cause a lake to change, but of all the things that Bill and his team had been measuring, the only one that seemed to be changing along with the transparency of the water was the level of DOCs, which was rising. So in order to understand why the lake is

becoming less transparent, we need to figure out why DOCs are increasing and we have a couple of hypotheses.

i. One is that it may be climate change and that would be a bad thing.

ii. But another possibility is that we might be seeing the effects of the Clean Air Act. What we may be seeing is the lake recovering as rain becomes less acidic.

iii. It's really important for us to know which it is. *What kind of information do you think we need in order to figure that out?* (Phase 3: Exploring beyond Ourselves)

f. In order to understand what's happening in the lake, we need to know a lot of things.

g. From 1980- 2013, our lakes and streams were monitored on a monthly basis. A lot of them still are, and that's really important because it gives us a general idea of what is happening with water quality across the park; it gave us good enough information to notice that water clarity in Jordan Pond was declining. But it's not detailed enough information to start unravelling what is causing those changes; when you are just checking in once a month, you are missing a lot of information. As a metaphor, think about the weather… If you only checked the forecast once a month and planned what you were going to wear based on that, you might miss some important details that you needed to know, right?

h. But we don't have the staff to monitor all the lakes and streams that we have here in the park more frequently than once a month. So for a long time, Bill and other resource managers here at Acadia were trying to figure out how they could get continuous water quality data. And they were talking with Jasmine about it. And they all knew that there was technology available that would allow for on-going water quality monitoring, but they also knew that that equipment is very expensive and we couldn't afford it … until 2013. In 2013, our Friends Group, the Friends of Acadia, asked for ideas for projects that they could submit a proposal for to be funded by grant money from Canon USA and they ended up getting about $55,000 that enabled this buoy to be put into Jordan Pond.

IV. Buoy

a. *Did you happen to notice the buoy on the lake?*

b. *So if a lot of Acadia's lakes started changing around the same time, why do you think they decided to put the buoy here? Why not put it where not so many people have to look at it?*

i. One of the challenges of conducting scientific research is that the more variables you have, the harder it is to figure out which one is causing the changes that you see.

ii. Jordan Pond is surrounded by park. There's no lawn fertilizer, or leaky septic tanks, or agricultural run-off flowing into the lake to confuse the issue. The only things that are impacting the lake are the natural system and the large scale factors like air quality and climate change that we wanted to study, so that makes it an ideal study site.

iii. They put the buoy here because they could get the best data here. But when they put it in, it was red and yellow and it was kind of an eyesore, so they changed the color to make it less obvious.

c. That buoy is collecting information that we hope will help us figure out why the lake is changing **(buoy pics)**

i. The buoy is put into the lake each spring (around May) and it stays there until fall taking measurements about every 15 minutes.

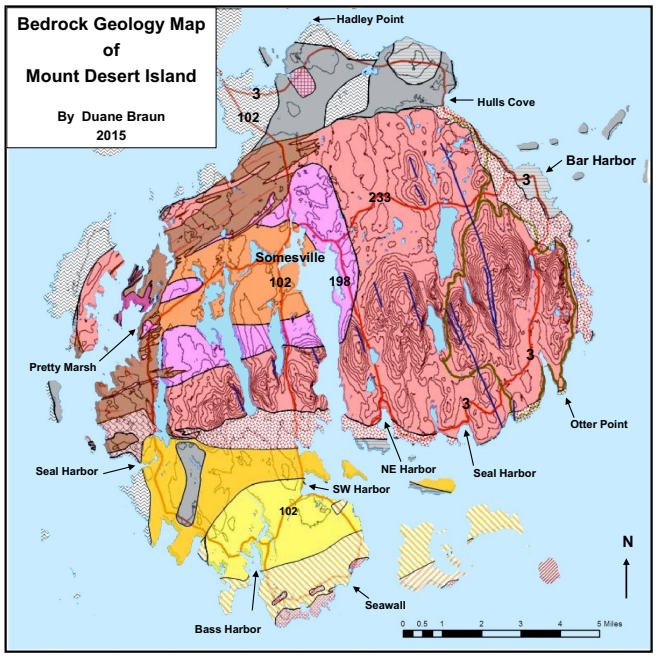
ii. It measures temperature every meter to 16m, dissolved oxygen, light, pH, conductivity, organic material, chlorophyll, and salinity.

iii. Before the buoy, we were getting measurements once a month; now, the buoy collects 1400 measurements a day. That's a huge increase in the amount of information that we

are learning about Jordan Pond and it allows us to see a lot of things that we would have missed with just the monthly testing.

d. The buoy is paired with a weather station located on the Jordan Pond House
    i. The weather station measures air temperature, wind speed and direction, rainfall, barometric pressure, and light.
    ii. Together, the buoy and the weather station allow us to see not just the daily or seasonal patterns in the lake, but also the immediate effects of weather events like rainstorms
    iii. This is a graph **(DOC & rainfall graph)** that shows rainfall events in blue and the amount of DOC in the water in red. *What do you notice about what happens in the lake when it rains?*
    iv. One thing that you may notice is that when we get rainfall events, we also tend to get a spike in DOCs. But it's not a perfect relationship, especially late in the season. There are times when it rains and the DOCs don't go up and there are times when the DOCs go up, but it hasn't rained. We don't know why that is. Maybe all of the DOCs have been washed into the lake by then and there's nothing left to be washed in by additional rainstorms or maybe there are other factors. The bottom line is that we don't have enough information yet to know what's causing the change. Both climate change and air quality improvements are long term trends and we are going to need more than a few years' worth of data to sort out which factors are affecting the pond.
    v. So how long are we going to keep this study going? As long as we can. Sometimes odd things happen. In 2014, Bill checked the data one morning and found nothing. It turns out that lightning knocked out the buoy, as well as the water company's equipment. He said that he didn't know what he'd find when he got out on the lake, maybe a floating blob of melted plastic. But apparently, it was the lake that was hit and not the buoy, so while they had to replace some sensors, they were able to get it up and running in about a month. If that happened now, we wouldn't be so lucky, because our funding from Canon has run out. Our Friends group is looking for sponsors to help pay for the upkeep on the buoy, but for now, we are working on borrowed time.
    vi. If you are curious to know what we figure out, there's a website that you can check back on later (jpbuoy.com or link to it from FOA website).

e. I asked Bill what his next question would be after he figured out what is happening with Jordan Pond and he said he wanted to know how this fits into the big picture and if the same thing is happening in other lakes. And he's not the only person who is curious about Acadia. In any given year, we have about 80 scientists doing field research in the park and there is other science happening at SERC, in the park's archives, and elsewhere on the island, as well as studies by the park's research management staff. So we are learning a lot of new things about the park every year. *What role do you think that science should play in decision-making here in Acadia?* (phase 4: Synthesis and Closure)



Mackette McCormack

Acadia National Park

Written in the Rocks

Program type: Walk

Duration: 1. 5 hours

Theme: While walking along the natural Seawall on the southwest side of Acadia National Park, visitors will learn basic geologic principles that helped create the island and see the landscape through the eyes of Mount Desert Island's geologists and researchers.

Program Strengths

Questions that invite participation, observation, prediction
A story about a scientific researcher
Insight into how we know what we know
An invitation to speculate or find personal meaning

Mackette McCormack studied elementary education at the University of Northern Colorado Before becoming an education ranger at Acadia, Mackette was a classroom teacher. Starting in 2011, she spent summers rangering at the Black Canyon of the Gunnison. Mackette says, "Now I spend most of my time working with students in grades K-8. In Acadia we have spent the last 3 years working alongside iSWOOP and scientist Jacquelyn Gill finding creative ways to invite the audience into the conversation of climate change from a lens of paleoecology."

Mackette McCormack's Take on Highlighting Park-Based Science
The entire world is built up of these science principles that are just working together in different branches to combine to give us knowledge of science. My dad would say it's all about the geology. And geology is all chemistry! Once I did an astronomy program and one guy said, "It's all about physics." Kids see interconnections in this iSWOOP program in an authentic way.

When I do programs, I ask visitors what they would do for research. You have to show them how it's beneficial to humans. Sometimes we don't know 'til we study it. That's the challenge. Neil deGrasse Tyson says that learning can make the world a better place. One way I see this is with Director's Order #6, which says, teach to the highest level of science. So we have to know what that is. For everything from plants to arthropods, we need to know. We are part of that ecosystem, and we are charged to protect. (2018 Aug interview with Mackette and Margaret; Clip 7; Min 11)

Story is a natural part of our lives. To understand a researcher's story gives you a human face to something that seems abstract like charcoal or pollen. (2018Aug; w/Mackette & Marg; Clip 4) … iSWOOP helps you ask more questions of your own process and helps you learn what you are missing, where your gaps in knowledge are.

Program Strengths
The program uses scientists, their passions and challenges as a jumping off point.

What to look for	Where to look	Notes
Questions that invite participation, observation, prediction	**63** **189**	Visitors are invited to draw a quick sketch of what they picture when I say "scientist." Later she asks, "In your life, who has helped you solve problems?" and says, "Think about who that might have been for the Brauns."
A story about a scientific researcher	**69**	We begin to get a story of two retired geologiests who move to Maine and pick up the challenge of mapping Mt Desert Island (where part of Acadia is)
About how we know what we know	**110** **126** **149**	Ranger M introduces some ideas about science here: science starts with a nagging problem and question; science is a process of revision and refinement. See stops 3 & 4 for how we know what we know
Invitation to speculate or personal relevance	**234** **237**	Visitors have an opportunity to talk about the relevance. Ranger M asks: Should we care about the past? Then she asks: What research do you feel the parks should be focusing on?

Written in the Rocks-2017

Summer Program Acadia National Park
Ranger Mackette McCormack

Basics

- Description – While walking along the natural Seawall on the Southwest side of Acadia National Park visitors will learn basic geologic principles that helped create the island through the eyes of current MDI geologists and researchers.
- Duration and Type of Program – 1.5 hour walk
- Age – All ages
- Difficulty – At sea level with no great elevation changes but walking along cobble beaches which can be challenging.
- Accessible – No
- Prep/Post - 5 minutes/5 minutes
- Location – Tree across from the natural seawall parking area.
- Driving time/parking – 40 minutes from the Visitor Center, parking at the pull off near the sea wall or at the picnic area if the pull off is full. Nearest bathrooms at Ship Harbor Trailhead.

Safety

- Weather – Check weather and follow protocol.
- Water – Do not go in the water. Program most effective at mid to low tide.
- Sun/Heat – Encourage sunscreen, shirts, and hats in the intense sun. Encourage hydration.
- Cold – Encourage extra clothes in the cold. Shoes stay on.
- Sand – Don't throw sand. If you're shaking your hands clean, do so close to the ground.
- Rocks – Be careful on slippery rocks. Use caution when walking on cobblestones. Use hands if necessary. Do not pick up or throw rocks.
- Wildlife – Do not let participants touch dangerous animals like jellyfish, big crabs, etc.
- Pollution – Do not let participants pick up contaminants such as bottles or trash.

Materials

- Magnifying lenses
- Hard Boiled Egg (optional)
- Earth Ball
- Play-Doh
- Geology Map- Lidar, New and old geology maps
- Rock Samples
- iSWOOP iPad with visual library
- Various Images –Glacier, Beehive, Beehive before/after Glaciers, Eight Major Plates
- Pencils and paper
- First Aid Kit and Radio

Pre-Program

Check the weather and tides. Program safer and easier at low to mid-tide. Sharpen pencils and put together paper and notecards. Grab radio and program reservation sheet. Arrive approximately 15 minutes before program.

Right before the program: Welcome visitors and give them name tags and pencil and piece of paper. Ask visitors where they are from, what they are excited to see in Acadia.

PROGRAM GOALS:

- To increase the visitors' knowledge and appreciation of Acadia's geology
- To create a sense of stewardship towards the park's geologic resources.
- Increase understanding and appreciation of the research currently being conducted in Acadia National Park

Procedure

(4:00) Begin Program- Tree Across from Parking Area

Introduction: I am Ranger Mackette, ect. Excited to explore a less known and appreciated part of Acadia with you- Seawall. This area is part of the "quiet side" of the island and we are going to be looking at this natural seawall through a unique lens- the lens of a scientist. So you all have a piece of paper in front of you and I would like you to start by drawing a quick two minute sketch of what you picture when I say "scientist". No wrong answers, I am just curious what the word scientist evokes in your mind.

Take a moment to share pictures and answers.

Today we are retracing the steps of two modern scientists here in Acadia National Park. Duane and Ruth Braun. (Pass around picture of D and R) These two are both "retired" geology professors. Any retirees in the crowd? What does a typical day look like for you? For these two their retirement began like many other people, they moved to a quiet beautiful place in the country and they began pursuing hobbies. As former geologists one of their hobbies was studying rocks. The class started out simple by learning and reviewing some basic geology. Which is exactly what we are going to do at our next stop.

Stop 2(*4:10*): Rock ledge, directly in front of the tree

What is great about geology is that it is literally all around and observable. Some of those observations however are easier with a little background knowledge so that is where we are going to start.

Layers of the earth:
Cores, mantle, crust

Rock types

- **<u>Play-Doh Demonstration</u>** –
  - Pass out a small piece of *play-do* to everyone. Have the participants sculpt anything they want to out of their play-do. Imagine that all of these sculptures are different types of sediment. Remember, sediments are pieces of matter that can be moved around by water and which can drop or deposit**.**
  - Ranger takes back one piece at a time, layering them, representing layers of sediment that deposited out of the water column onto the seafloor in an ancient ocean (~5,000 year layers). Overtime the layers become heavy, water was forced out, and the layers solidified (lithification) into the first type of rock: sedimentary rock. Show play-do sedimentary rock. (Show sedimentary rock Bar Harbor Formation)
    What does metamorphosis mean? Change. Around 500 mya, this rock went through a lot of heat and pressure as the earth's crust moved. So, it changed, and the heat and pressure warped/squished/stressed the rock, making it a metamorphic rock, our second type of rock, along the trailing edge of Gander. Squish the play-do to form wavy/swirly lines. (Show them a type of metamorphic rock- Schist)
  - *This metamorphosed into schist due to compression of the rift as Gander pivoted away from Gondwana.*
  - Igneous Rock has the word ignite so these would have been rocks building and being created inside a volcano. Very hot but not the same intense pressure of a metamorphic rock. Like cooking-different temperatures for the same recipe create very different tasting foods. Most abundant rock type here. Including Cadillac Mountain Granite, and Southwest Harbor Granite.

    These 4 rocks make up a large majority of the bedrock seen on Mount Desert Island. So while Ruth and Duane were taking their senior geology class they noticed that the information they were being given was not quite right. Look at this map from the 1960's. If I tell you this map was completed in under a week what potential problems might there be with that? (Accuracy)
    Duane and Ruth thought so too. They knew enough about geology to see that some of these bedrock layers could not be correct. They also knew the geology world- if something had already been mapped and other parts of Maine still haven't been mapped then it will be years before this area is re-evaluated. They contacted the park to volunteer their gifts. They offered to attempt to create a new accurate map of all of the bedrock on the entire island.
    What challenges do you think they faced?

Transition: Think of a time you have been in a challenging situation- what were some steps you took to work through that problem?

Stop 3 (*4:25*): Relative Age Dating

Have people share their thoughts on methods and ways to problem solve.
One of the problems the Braun's faced was one that was common not only to them but to early geologists in the 1900's. It was determining which rock was the oldest and therefore which one was the bedrock. And like many of you shared there are many strategies to solve a problem. Here the answer came by finding indications written in the rocks. One such indication can be seen directly in front of us. Here was can clearly see 3 types of rock, Seawall Granite, Gabbro dike, and cranberry island volcanic extrusion. Knowing the older rock is cut by the younger rock the Braun's were able to gain an idea of which of these rocks would have come first. Seawall granite cuts cranberry island volcanic, which is cut by the basalt dikes. Therefore the Cranberry Island volcanic rock is the oldest, followed by the dikes and the newest is the Seawall granite. This is the shatter line where we are changing rock types. And to find this Duane pretty much has to go back and forth along the coast line plotting and GPSing exactly where each of these points are on the island. Usually this is a zigzagged line that can be 50- 200 feet in opposite directions. And shatter zones do not cleanly obey property lines. Ruth's gifts include being conversational and getting permission from practically everyone on the island in order to walk across the zig zag borders. Duane also likes to make the joke that if you want to stay healthy as a 70 year old- study geology!

So let's follow the Braun's to the next location they might have found of interest.

Stop 4 (*4:30*): Trees with the basalt dykes

As we look out, what are some obvious things we see here?
What the Braun's saw were multiple examples of the oldest rocks here in Acadia. So we talked earlier about the earth having crust and tectonic plates that were constantly subducting and orogenic. Here in Acadia about 450 million years ago there was the north American plate that collided in to Avalonia. This created the Appalachian Mountain Range and then another terrane came in- the gander terrane. This created even more stress and uplift which created what is now Acadia. With those two terranes we have violent volcanic eruptions. And the volcanic ash that they spewed created the porcupine islands while other volcanic activity created the Cranberry Islands. And what was the rock type made by volcanoes? (Igneous) So most of the rocks we see here are 420 million years old but some of the rocks don't fit. Some of the rocks look nothing like the Cadillac mountain Granite or Seawall Granite, how do we explain those inconsistencies? Let's find out at our next stop.

Stop 5 (*4:40*): Cobblestone out crop

So the Braun's go to every corner of the island and they find cobblestone beaches, smooth granite surfaces, and giant obscure boulders. How did they explain that?

Glaciers!
Charles Lyell “Present is the key to the Past”
Ipad- glacial ice ages for the last 2 million years based on the earths wobble. This change is something that has happened cyclically. And we here in Acadia we have seen the glaciers recede and return at least 5 times.
-Foot demo of the glaciers over time
- cobble stone deposition
-glacial erratics
- creation of the fjard
- smoothing the mountain ranges and creating roche montanees.

Glaciers are responsible creating this unique coastline and this beautiful natural seawall. Ruth and Duane were able to look at this and separate the different rock types found further north such as lucerne granite. They were able to take the evidence of what they saw to make a more accurate map and put the pieces together in a logical way.

But they couldn’t have done this alone, who is someone in your life that has helped you solve problems? Think about who that might have been for the Brauns.

Stop 6 (*4:55*): Lidar stop near the picnic area

LIDAR, which stands for *Light Detection and Ranging,* is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. These light pulses—combined with other data recorded by the airborne system— generate precise, three-dimensional information about the shape of the Earth and its surface characteristics.

- USGS created lidar of Mount Desert Island and the entire coastline of Maine in order to determine height of the coastlines. Did this to measure dangers in terms of climate change but for the Braun’s this was two fold purposeful information: “no biological infestations”
- Makes it abundantly clear where the glacial activity took place which allowed Duane to find many of the tills and where the marine muds would be the bedrock.

Duane and Ruth were not alone in this process. They relied heavily on other lab members to radiodate the age of the rock layers, they sent data to the other geologists for reference and validation. The two were not an island but together with the help of others they helped create an island map.

Stop 7 (*5:00*): End of the picnic area

Show the final map. After over 250 days of field work, and countless hours of research and data collection the two published “Guide to the Geology of Mount Desert Island and Acadia National Park”. What before was a half finished story has

now become a rich tapestry of geology. But what I found most interesting when talking with them was this area here.

We are currently looking at a misfit layer of rocks. Here we see pyroclastics, or pieces of volcanic ash and matter that were thrown into the air during the beginning of the volcanic activity. But wait- all of the other rock we see here is granite from inside of the volcano that eroded away. But this would have been the oldest volcanic ash from the outside of the volcano. This should have eroded away almost immediately. So what's the story here?

We don't know. What is beautiful about science is that even when one question is answered there are literally millions more to discover. The Braun's gave me a list of twelve questions they would love to continue trying to find the answers for-when exactly did the glaciers have their final retreat? What did the volcanoes here look like? What are the layers of the Ellsworth Schist? And that is just for these two philanthropic scientists!

We have 17 scientific studies happening in the park- all of which have questions ranging from plants affected by climate change, phosphorous content in bodies of water, alpine plant regrowth, bat studies and more.

So what should parks be doing research on? From a scale of 1 to 5 how important do you think researching the past is?
Should we care about what happened in the past?
"All models are wrong, some are useful"- Statistician E.P. Box. Should we be spending our energy on trying to predict the future?
What research do you feel the parks should be focusing on?

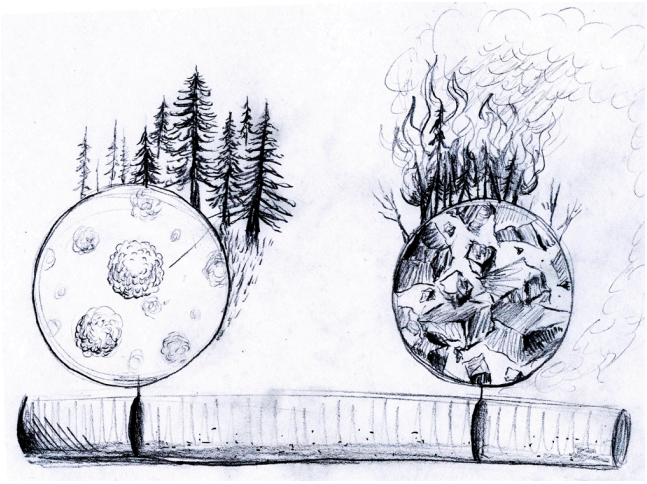
Early in the 1900's it was decided the parks did not have the ability to focus on the depth and quality of research that was necessary to top notch science. The solution was to allow scientists access to our parks to collaborate with park rangers and to educate the public to the highest level of scientific discovery. As we finish wrap up our conversation I want you to pull out your picture of a scientist again.

Stop 8 (*5:20*): Overlooking the beach (conclusion)

As we look out to the ocean, I hope now we see with a new lens- one that notices cobblestones and makes a correlation to glaciers, or dark gabbro intrusions and sees igneous rocks and volcanoes. And I hope that when you look at your picture of a scientist you see them through a different lens. How might you change your picture of a scientist after learning about the Braun's and the science that takes place in the park?

Scientists are not just stuck in a laboratory or unattainable people with overly large vocabularies. Sometimes they are passionate retirees, who enjoy finding patterns in the landscape. Sometimes they are people who are not happy with the status quo and question the norm. Sometimes they are hikers. Sometimes they love to spend time

looking at data. Sometimes they are children participating in citizen science, and sometimes they are you or me. All of us have the ability to go out and look at our world differently and ask questions, all of us have the ability to make observations over time. All of us have the potential to be scientists.



Credit: ASAP New Media Services, University of Maine

MELINDA McFARLAND
Acadia National Park

Searching for the Primeval Forest

Program type: Evening program

Duration: 45-60 minutes

Theme: Research helps us uncover the history of forests in Maine and gives us a better perspective on the change that people and forests can impact on each other.

Program Strengths

Questions that invite participation, observation, prediction
A story about a scientific researcher
Insight into how we know what we know
An invitation to speculate or find personal meaning

Melinda McFarland has worked as a seasonal Interpretive Ranger for the NPS since 2011 at Montezuma Castle, Tuzigoot, and Timpanogos Cave National Monuments, Jean Lafitte National Historical Park and Preserve, Acadia, Mesa Verde, and Great Sand Dunes National Parks.

Melinda spends a lot of time at community meetings and town halls discussing the relationship between trails, outdoor access, and the health and wellness of communities. She has also been a consultant for Friends groups. She is interested in scientific studies about the relationship between climate change and birds, integrating the information into bird walks that she leads. Melinda does not have a scientific background. She says that she was always a little hesitant facilitating scientific programs but has learned to be a better science communicator through iSWOOP.

Melinda McFarland's Take on iSWOOP

If I could go back to the start of my first iSWOOP season, I would tell myself not to get overwhelmed in the amount of information. Once I started reading articles and books about forests, larger themes started to jump out that I could apply to frame the research. I would also tell myself that the research can be one aspect of the program; don't get consumed by it. I think the most important thing to know is you don't have to find the research itself fascinating to have a successful program. Find that one aspect – the fit with park, a little-understood part of the research process, a compelling character, something – that sparks your interest or a thought and build on that.

Melinda's Favorite Part of iSWOOP

What I found really rewarding was being able to help visitors look at Acadia in a different light. I find a lot of visitors see the parks through the trope of "natural cathedrals," forever preserved. The research iSWOOP provides forms a bridge to really talk about our impact on the landscape. It was powerful to have research and concrete examples that make it easier to discuss these complex ideas.

The idea that parks have not always looked the way they do today and will not look that way in the future hit home. People seemed really intrigued. The most impactful visitor interactions were when visitors used the research as a catalyst to think more critically about the world. They made connections between the effects of climate change at Acadia and where they were visiting from or even other national parks. The research also served as a foundation that visitors could build upon. After hearing about the research, visitors were able to ask more in-depth questions than other programs I led in the season.

Another thing I learned was the phrasing of the questions was extremely important. I had to really think about if the question was setting up the audience for a "right" or "wrong" answer. By creating more open-ended questions and getting rid of the possibility of wrong answers, it created a more welcoming environment for visitors to share their opinions.

Program Strengths

What to look for	Where to look	Notes
Questions that invite participation, observation, prediction	**34, 42, 49, 109, 144, 273**	Does anyone have a favorite tree? What is our relationship to trees or forests? Have you gone to the woods to think? How many of you would enjoy doing more homework during the summer? Did anything strike you? What stands out?
A story about a scientific researcher	**171, 308**	George Jacobson, Caitlin McDonough MacKenzie
About how we know what we know	**179, 317**	Coring; Methods for using lists of the flora of a location, comparing across time periods to find region wide patterns
Invitation to speculate or personal relevance	**238, 426, 436**	Has the spruce-fir forest always been the dominant forest in Maine? If the forests of Acadia change, will our relationship with this park change? Will names like Hemlock Road be just a memorial to the forest of the past? How much change are we willing to accept and ultimately what do we value? What steps can we take to encourage change that will benefit the environment?

Searching for the Primeval Forest

Theme: Research helps us uncover the history of forests in Maine and gives us a better perspective on the change that people and forests can impact on each other.

Four Parts:
1. History of peoples and forests: a changed and altered landscape
2. Finding the Primeval Forest through research - a different perspective
3. Current changes in Acadia's forests.
4. What that change means to us.

S1: Intro: Image of Mount Desert Island from Above
- Ice breaker of interaction: Can anyone point out where Blackwoods is on this map?
- What I find most intriguing about this image is how forested this island is. Even where we are sitting tonight "Blackwoods" demonstrates the dynamics of these woods. The forests are so thick, the woods look black..

S2: Title Card: Searching for the Primeval Forest
- Beyond the granite mountains and the shore, trees and forests have been one of the primary resources that have shaped the history of this island.
- Through the program visitors will discover the stories of how people have changed the forests, how research helps us discover the forest primeval, and ultimately delve into our complex relationships with these natural places.

<u>Part 1: History of people and forests: a changed and altered landscape</u>

So to start to figure out our relationship with forests, I like to ask:

S3: Does anyone have a favorite tree?
- Favorite trees can be a singular tree or a type of species: My favorite trees are the pinyon pines of southern Utah. I have taken refuge in their shade on hot days and pondered at the amazing shapes sculpted by the desert. Plus they have delicious pine nuts.

This brings us to a larger question:

S4: What is our relationship to trees or forests?
- Interaction with visitors

S5: Word Map

(A technique to show how complex and varied peoples relationships to trees are)

- These are answers that past programs have come up with. I'll add your answers to the map as well.
- Did any of these ideas surprise you? It's amazing how complex and varied our relationship are.

Transition: People have always had a relationship with the forests. Just as much as we change the forest the forests can change us. To start thinking about this lets examine two species of trees found in the Northeast:

S6: Ash Tree and the White Pine

S7: Native peoples of Maine

- When we think of people and their relationships to forests, it starts as soon as people arrived onto the landscape. In Acadia and Maine these native people were the Wabanaki.
- From archeological records Wabanaki utilized Mount Desert island year round, moving in and out along with resources and seasons starting around 10,000 years ago and have had a significant presence in the woods of Maine.
- They utilized the forests for resources to survive, we can see that through the example of shelter:
- Wigwam at Sieur de Mont: Birch Tree!

S8: Native Artists

- Beyond providing necessities like shelter and warmth, trees can also provide the materials for expression. Materials for art and story telling: foundations for culture
- Creation story for the Wabanki people, came out of the bark of the ash tree
- Birch bark canoes and the ash basketry
- Traditions that continue to this day

Transition: We have talked about the ash tree as a symbol for the native people and their relationships with forests, but there is also a tree that signaled in the European history of this area: White Pine

S9: War Ships

- During the 1600s the large powers of Europe were looking to expand empires and in order to do that they needed the biggest Armada = the largest ships. To build those they needed the resources and they had stripped their countries of those resources. But in the northeast forests they found those: masts made of white pines.

S10: King's Cross

- Start of forests seen as resources. Extraction for power and economic gain.
- This also set the tone for rebellion, a revolution built around taxes of resources
- Control of the resource, shaping the country and the state we are currently in.

S11: Logging in Maine

- Post revolution, trees and forests remained an important economic resource of the area.
- It also helped make this area suitable to early settlers, starting the European settlement of MDI and shaping what this island landscape looked like
- Lumber mill in Somerville

Transition: At the same time that lumber was a prominent industry not only in Maine, but on MDI, there was opposition to this idea that the worth of forest were only for economic gains, but they could enrich the soul or be worth something greater.

S12: Thoreau Quote

- This idea was exemplified by the writers in the mid 1800s: like Thoreau
- Have any of you gone to the woods, on a hike or a walk around a park to think about things to ponder? I planned a lot of this program on the trails of Acadia
- This is an idea that is still consistent today. And from your answers to what forests mean to us, one that persists today.

S13: Hudson River School: Asher Brown Durand

- This idea to confront the lesson of nature were also seen in an artist movement known as the Hudson River School.
- These were artist that were looking to get away from the confines of the crowded cities and to learn from the sublime lessons nature had to teach,

S14: Frederick Edwin Church

- They also served as advertisements to the area: bringing in a variety of people each searching for their own relationships with this forested landscapes.
- How many of you saw images, photographs, of Acadia before visiting?
- These painting just like photographs today inspired people to get away from their everyday lives to take reprise in the woods.

Transition: These “ads” attracted visitors who had the leisure time to travel and also pursue natural history hobbies like science and botany…an example of a group of these individuals are:

S15: Champlain Society

- This group of undergrads were some of the first people of set up to discover more about the landscape.
- They were inspired to come out and live among nature - setting up tents and exploring the area. Live as “rusticators”

S16: Champlain Society - Specialities

- They also each had their own roles in the society, a speciality they were learning about Charles Eliot as Captain
- Edward Rand – ecology They kept log books - documenting what they

experienced over the years they spent summering on MDI

- How many of you would enjoy doing more homework during the summer? (Keep asking questions to keep audience engaged)
- Although I would love to spend more time on the Champlain Society and what they accomplished, there a couple key take aways:

1. The passion that individuals have in discovering and the creative spirit to understand places: understanding their relationships with these places in a scientific way.
2. Through the research and summer spent on the island, Charles Eliot would seek out a way to preserve the places we enjoy seeing today.

S17: Creation of Acadia and the standard of research in the foundation document

- Charles Eliot's story
- With the park's creation, not only was research placed into the foundation document:

S18: Image of Jordan Pond

- But this piece of MDI was preserved for us to explore. A land set to rejuvenate and forests left to take their natural course.

Part 2: Finding the Primeval Forest through research - A different perspective

Transition: The Champlain society gave us an idea of the forest was like 140 years ago, but we know that weren't looking at unspoiled wilderness. How do people discover something that is no longer here? If you were a scientist where would you start?

That is the question that Dr. George Jacobson had: S19: Dr. George Jacobson

- He became fascinated with ecology by doing what a lot of us do when we come to the national parks. Hiking and just spending time outdoors. So when he went to college and was introduced to paleoecology his world changed! (Quote)

But how to do you find the forest primeval? What do you think hold the records of the forest of the past pre-human contact?

Pull out the sediment core sample!!! Has anyone heard of a sediment core before?

S20: Types of coring

- You can core a variety of ways, but in Acadia they have focused on two ways:
- Bog and Lake coring

Coring done in

Acadia: S21:

Video

S22: Coring Sargent Mountain Pond

If we are looking for pollen in the sediment cores what might the pollen tell us?

S23: Pollen

S24: Ragweed pollen

- An example of how each pollen looks different - the outer coating has a variety of bumps and ridges.

S25: All the pollen in the air

- During spring all the pollen blows in the wind and settles ….

S26: Settlement of the pollen in ponds

- Leaving a nice record so then you extract the core and then you just have this in your hands. (The sediment sample).
- Thousands of years layer after layer. How do you get to the pollen information?

S27 - 28: Separating out material - looking for clues to the landscape

- Discuss the separating out of material, taking slices - you find other things other than pollen.
- Jacquelyn's research will focus on the fungus and animals
- Charcoal and fire

S29: Counting each of the pollen

- Looking for different shapes, separating them out and counting. And you do this over and over and over again. How many of you would like that as a summer job?

S30: Timeline Core

- And one slice at a time you start to build a time line. What plants started to arrive first? We know that after a disturbance you just don't get a giant forest.
- "Profile" and radio carbon dating

S31: Tundra to forest -

- In fact right after the glacier left this area the landscape was a tundra. There wasn't even a forest! It looked like the above picture. How did we go from Tundra to Spruce Fir Forest? The pollen tells us that plants arrive at different times. Especially after a disturbance.

S32: Primary Succession

- Lichen - moss - ferns - grass - shrubs - trees
  Have the visitors shout out each one.
- These pioneer plants, slowly build up the soil through weathering, trapping of particles, and the transformation of living matter into soil. Organic matter generation after generation

- So once you have a forest established, depending on the climate conditions, the tree species may change.

S33: Question Slide: Has the Spruce-Fir forest always been the primary forest of Maine?

S34: Spruce Trees
- What kind of images do you think of when you think of pine, spruce, or evergreens?

S35: Maples Trees
- What images do you think of when you think of maples, or oaks?
  Oak and pine = temperate species with low tolerance if extreme cold but a high tolerance of drier conditions - adapted to frequent fire, can establish from seed after fire
- Spruce and fir = grow in the shade, cold wet conditions

S36: Chart - Explain the chart.
- In looking at the date produced from coring what patterns do we see?
  Ask pointed questions if no visitor interaction: When is spruce more abundant? Is there a shift?
- Spruce were some of the first trees to arrive - showing that the climate was colder and wetter
- But then a shift happened: spruce had been largely absent here. The climate for most of that period had been too warm and dry to spruces to reproduce successfully, and forest fires were quite frequent favoring taxa like pine and birch.
- With oaks come more fire - more fuel
- But where are we sitting now? What trees have you noticed while in the park or do you think of when you think of Maine?
- In the last 1,000 - 500 years we have turned back to the spruce - fir
- George Jacobsen and Molly Schauffler's study showed the spruce remained abundant along the cool, moist coast
- They cored here in Blackwoods!

Let's visualize it another way:

S37: Tree progression animation:
- Did anything strike you? What stands out?
- It's interesting to think of trees moving north - quite quickly as the glacier recedes.
- Shifting ranges 100s to 1000 miles across the north east.

S38: Jack Pine
- One of the things that I found especially interesting listening to George Jacobson talk is that Jack Pines used to be Georgia. They no longer occur in Georgia but they do occur here now in Acadia. In fact they are at their most southern range. It shows how things shift and change, in accordance with the

changing climate conditions.

It is interesting to think that they areas that we have come to depend on looking a certain way have changed. That the forest primeval looked different than the forests of today.

S39: So what does the forest primeval tell us?

1. Nature changes, sometimes a lot, sometimes very fast.
2. Climate change dramatically alters the abundance and distribution of species across the landscape. Is the climate change we are experiencing today the same as in paleoecology times?
3. However, other environmental factors also play important ecological roles, including human impacts. (This last point is something to ponder) What impacts are humans having today?

Part 3: Current changes in Acadia's forests.

Examining the past thousands of year, ranging from post glacial landscapes to the forest of European settlements brings us today.

How many of you think that the forests of Acadia are changing?

The forests are changing, not just the trees but all also the plants in the understory. One of the things you have to take into consideration is the human element of change in modern forest.

S40 - 41: Caitlin McDonough Mackenzie
Caitlin has looked into plant distribution on MDI using historical records of Edward Rand. (Remember that guy from way back in the beginning)

- She compared Edwards Rands plant records, herbarium specimens, and log books to look and compared them to the species today.
- Learn about Rand, reminded how young they were in taking on this task.
- Read favorite quote.
- It also demonstrates how the historical research done on MDI can in the end help determine what future landscapes may look like.
- Methods: Utilizing *Flora of Mount Desert Island* and the list of vascular plants and then comparing to the 2010 book compiled by biologist Mittelhauser. Then compared to Concord MA to find region wide patterns

This is what she has found so far:

- Doctorate: Vegetation over the past 100 years has seen a loss of 16% of plants recorded in 1894 by Edward Rand
- Decline of 25% of all plant species
- Gaining a lot of non-native plant species
- Losses of the orchid family - but there may be an over representation in historical records due to over collecting

S42: Pie Graph - Change is happening

- Plants are shifting and changing in abundance from the list of Edward Rand.
- Caitlin compared the species of Rand and the list to those of Theroux and Concord, MA
- There were the same patterns - a decline of native species and an increase in non-native species
- This shows that there is something larger at work = RELATIVELY FAST CHANGE!
- This is a trend that is happening across the Northeast Region. So if changes are happening how …

S43: Pie Graph of New Species Recorded

- Specifically Trees:
- Native: Red Spruce, Jack Pine, Sugar Maple, Gray Birch, Green Ash
- Non native: Scots Pine, European Mountain Ash, Big-leaved Linden, Little-leaf Linden; Invasive: Norway Maple
- Difference between non native species and invasive species is that non native species do not cause environment or economic harm - they do not disrupt the natural functions and processes of our native ecosystems. Invasive do.

S44: What is causing the change to the plant communities and the forests? (Rhetorical Question - getting visitors to think but to not answer)

S45: One researcher is building on the lessons of paleoecology and looking on the larger environmental changes of Acadia's forests: Nick Fisichell of Schoodic Institute.

S46: Tree Test - Larger Environmental Impacts

- Why does research focus on trees?
- Paleoecology data
- many tree species are keystone species and therefore shift in forest composition and structure will affect other trophic levels within the ecosystem
- Growing trees from seeds in raised beds at four different elevations to see how they respond to stress factors for three years. Some of the trees that are planted are not found in the park but come from southern areas of the U.S. They might be able to survive an increase in temperature a bit better.
- Climate change affects all tree life stages, from seed development, germination, and emergence to seedling growth and recruitment to survival of overstay trees.
- It was great to talk to Nick and he was so excited to send pictures of the seedlings and the seeds that they are using so I had to include them:

S47: Seeds: all occur in the park

S48: Seedlings

- As park managers, there has been a long history of letting nature take it's course. Why might park managers have to take an active management role? Is anything impeding the natural movement of forests today?

- And we come full circle with this research - think about what types of trees the pollen had in warmer and dryer conditions?
- Of these three seedlings if you were park managers preparing for the future would you spend time planting spruces or the oaks and maples?
- This is a hard question to ask and these various research projects can help the park understand where the landscape is going.

Transition: We have talked about the large impacts that are affecting the forests, climate change, but there are also teeny tiny things that if introduced can cause large impacts
as well. Insects! None of these species are found in Acadia but are moving their way up the northeast.

S49: Asian Longhorn Beetle and Hemlock Woolly Adelgid (wide range of species vs. specific species)

- As people and goods are transported all over the world, insects and other factors can be introduced that change the forest dynamics. Here are two examples:
- ALB: kills a variety of hardwoods, threaten to devote forests that protect public drinking water quality and natural communities, also the maple syrup industries
- HWA: first reported 1924, Hemlocks provide micro shade /cool environments, especially along stream beds - found in Maine

S50: Emerald Ash Borer

- Has the Emerald Ash Borer affected anyones neighborhood?
- Think about the effects that one tree removed from the forest can produce, but also think about the cultural impacts the loss of species can have.
- We talked about the ash trees utilized in Wabanki basketry, but also maples used in syrup.

S51: Buy it Where you Burn It!

- There as steps we can take to protect the forests:

But the last thought I want to leave you with, is as you are out in the park think about how the change in Acadia woods might alter our relationships with place. We are fortunate enough to have historical and modern day research that provides us with a base for what the primeval forest looked like and how it changed. We have also seen how individuals have taken that information and utilized it for the preservation and creation of Acadia National Park. So the last action that needs to be taken is by us: As you walk the trails of Acadia (S52), relishing in the green hues and beautiful scenery, stumble across apple trees that signal human impact (S53), or if you come for the fall foliage (S54) to find peace and quiet in the changing seasons:

Ponder, if the forests of Acadia change, will our relationship with this park change? Will Acadia be Acadia without a boreal forest? Will names of trails like Hemlock Road be just a memorial to the forest of the past?

How much change are we willing to accept and ultimately what do we value? What steps can we take to encourage change that will benefit the environment? As a famous speaker for the trees stated: (S56) “Unless someone like you cares a whole awful lot, nothing is going to better. Its not. Thank you for visiting Acadia and I hope you have a great rest of your visit.

ELLEN TRAUTNER

Carlsbad Cavern National Park

In the Blink of an Eye

Program type: Stationed interpretation

Duration: 10-20 mins.

Theme: Using advancements in technology, biologists who work in partnership with Carlsbad Caverns continue to increase our knowledge about the Brazilian free-tailed bats that live here.

Program Strengths

Questions that invite participation, observation, prediction

Insight into how we know what we know

An invitation to speculate or find personal meaning

Ellen Trautner is an avid caver and dedicated to the preservation of Carlsbad Caverns. After working as an interpreter at Carlsbad Caverns, she is now a cave technician.

Ellen's Take on iSWOOP

Ellen says, it's often the case that there is a slight disconnect between current research and interpreters. Because of that, visitors' understanding of science may suffer from misinformation or complete lack of information. She says: "It's exciting to share the research that goes on with our visitors. The more that visitors understand the significance of the science, the more they will value the park and the resources it protects. National parks need to be relevant to the public to ensure their continuing support, and this program is one way to achieve relevancy with its visitors."

Ellen's Favorite Part of iSWOOP

I have a strong interest in hearing about and disseminating scientific research, especially as it is occurring. I think this is an often-overlooked but fascinating aspect of national parks – the natural laboratories that they've always been. I appreciate the opportunity to learn more concrete ways to tell people about the research that is occurring here.

Program Strengths

What iSWOOP does is it equips the interpreters to make those connections with visitors about science and technology.

What to look for	**Where to look**	**Notes**
Questions that invite participation, observation, prediction	**18, 24, 50**	Have you ever seen a bat? Do you want to see one? Do you wonder how bats live? What are some of the difficulties of studying bats? Comparing fruit bat and free-tailed bat in flight
A story about a scientific researcher	**84**	Conclusion mentions scientists who study these might only be there at night when we can't see them, but they want to share with us.
About how we know what we know	**36, 45, 49**	High-speed cameras and motion capture. What are the advantages of using this technology? Or, how could scientists use this image to answer questions about bats?
Invitation to speculate or personal relevance	**56**	What sort of questions might you have about this bat's flight? Any reasons for doing motion capture on a bat?

In the Blink of an Eye

Ranger: Ellen Rohn Trautner

Topic: Bat research

Theme: Using advancements in technology, biologists who work in partnership with Carlsbad Caverns continue to increase our knowledge about the Brazilian free-tailed bats that live here.

Goal: Visitors will understand and appreciate how technology aids bat researchers and connects the stakeholders, themselves, with that research.

Objectives

1) By the end of the program, visitors can identify at least one technology that helps us learn more about bats.

2) By the end of the program, the adult members of the audience will appreciate the fact that they are the stakeholders of the research happening in public lands.

3) One week after the program, at least half the audience members can identify one new thing they saw at the program or learned about scientists.

Introduction (loop of bat flight video playing on the screen)

Has anyone here seen this Bat Flight in person before? (If yes, and they are willing to engage, follow up with details: when, where, etc.) For those of you who haven't, does anyone want to? (If during BF season, remind them the time of the evening program and that it is free.) For most of us, this is how we experience bats. They wake up when we are going to bed, and so we only see them for a short time. But what if we have questions about bats? What if we want to learn more about them? Does anyone here ever wonder about the lives of bats? We have some scientists, bat biologists, who have many questions about our bats and want to study them. But what are some of the difficulties of studying bats? (Get some feedback—encourage them to look at the video and make observations: they're small, they fly away, it's getting too dark to see them, etc.)

(Repeat visitors' ideas so everyone can hear them.) It can be hard to get a good look at these bats. Free-tails can fly up to 60 miles an hour! But what if you can slow them down?

Next slide: high speed camera's image of bat flight!

Encourage visitors to come closer, examine the video. Allow time for reactions (usually excitement!)

Ask them if they've ever seen bats like this before.

Explain the high speed camera. 3,000-5,000 frames per second, allows great detail in slow motion.

Does this help with observing bats? (Follow up on yes and no answers. Sometimes visitors observe that the bats are still flying out of the frame, so you can't watch just one individual. If not, I'll suggest that point, which leads to… next slide!)

Next slide: Bat in wind tunnel.

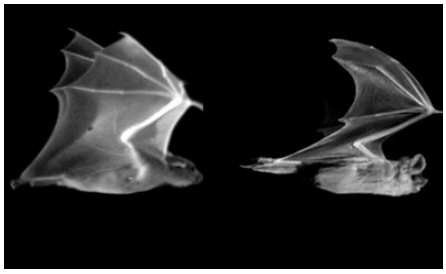
Bats can learn to fly in wind tunnels! Explain wind tunnel, high speed camera again, how scientists have gotten this image.

What are the advantages of using this technology? Or, how could scientists use this image to answer questions about bats? (Allow time for answers.)

Sometimes it's helpful to compare and contrast in order to come up with observations, questions, and answers, for example…

Next slide: Fruit bat and free-tailed bat videos side by side

Explain that these are two different species of bats. Do they notice any similarities and differences?



Follow up on each observation. For example, wing size: explain the relative size of each species (fruit bat is like my fist, free-tailed is like my thumb). Wing shape: different flight needs, one species has food that flies away from it! Use of echo location: only insectivorous bats have this adaptation.

Different species of bats have different needs, and so they have evolved different patterns of flight. If scientists want to examine this phenomenon more closely (and some of them do!) they can take this technology even further. Has anyone heard of motion capture? (Allow time for answers)

Next slide: Dancer with motion capture balls

Explain how cameras track the reflective balls or dots on moving people/objects.

Animators, physical therapists, and scientists, among others, use motion capture!

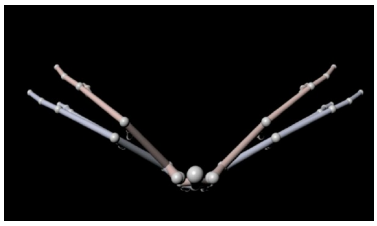
This gives us a very realistic computer model of motion that we can then manipulate in order to make more observations and test hypotheses.

Next slide: Bat flying in wind tunnel

What sort of questions might you have about this bat's flight? Any reasons for doing motion capture on a bat? (Allow time for brainstorming)

The biologists who study our bats here have been using motion capture to explore the mechanics of bats in flight.

Next slide: Computer model of bat, flying at 2 speeds



Explain orientation of bat, why it has two pairs of wings.

Start video loop, ask them to make observations. (Faster speed has greater range, flexes more, etc.)

Observations are key to scientific research. They lead to questions, which leads to us searching for answers. In recent decades, with advancements in technology, we have the ability to answer a lot more questions! Of course, that will generate even more…

Last slide and conclusion: Loop of bat flight, normal speed

It used to be that anyone who wanted to study bats only had this to work with. There are many obstacles to studying bats, but technology is helping us overcome them. We can watch bats fly in slow motion and see how much is happening in the blink of an eye. We can study the motion and mechanics of bats in flight on computer models. There are other technologies as well, such as thermal imaging cameras, infrared cameras, etc., which can help us "see" bats in their completely dark home. The cool thing is: this research is taking place right here, in your national park. The scientists who study these bats might be here at night, or in parts of the cave, where we can't see them, but they want to share what they're learning with all of us. After all, we are all stakeholders in this science. It's happening in our public lands, and we are a part of it. Thanks to a new program called iSwoop, scientists are getting the opportunity to share their work with all of us who visit our parks. These images all came from the biologists who partner with Carlsbad Caverns. And now, they are partnered with you, too.

On Fireflies

Photo Credit: Great Smoky Mountains N.P.

MORIAH CARMEL

Indiana Dunes National Park

Program type: Stationed interpretation

Duration: 10-20 mins.

Theme: By turning on the lights to create what we perceive as a safer and more productive nighttime landscape, we risk losing both populations of nighttime creatures and the magic of innocent childhood pastimes like catching fireflies in the dark

Program Strengths

Insight into how we know what we know

An invitation to speculate or find personal meaning

Moriah Carmel studied chemistry at Valparaiso University. In teaching or interpreting, Moriah wants to help people come to their own discoveries. Moriah says, “I’m a curious person. I talk to people informally and make cool connections. In terms of science in parks, I’m a participator collecting data, a cheerleader, and a communicator.”

Moriah's Take on iSWOOP
iSWOOP as a concept is wonderful. It's not so obvious when you try to do it. It seems easy; then, when you go to plan, you find it might take more time and effort. I felt like the way I approached questions has undergone the most change. That's what has been most valuable. We talk about questions a lot when planning to present. Recently, we were planning a program on fish, and I was thinking of open-ended questions about fish. I was searching for questions that had more than one right answer. I attribute that to iSWOOP's influence. I came up with questions like: Why do you think the Great Lakes are important? What is your favorite feature of Lake Michigan?

Moriah's Favorite Part of iSWOOP
I consider myself to be a scientist and a researcher. It was really exciting to learn about what is going on in the park. Over time, I became comfortable talking about Dr. Bob's research with others. I didn't know anything about amphibian research when I started. It was new for me.

Program Strengths
This outline has a personal feeling to it. Imagine talking to a small group, sharing a memory from your childhood as a lead-in to the researchers investigating how insects can light up the night and how humans' activities might interfere.

What to look for	Where to look	Notes
Questions that invite participation, observation, prediction	**26, 31, 34, 49**	The program starts with a memory and an invitation to share: Did you have similar experiences? Certain questions invite observation: What do you observe about the night (sky)? Showing the night sky ALR levels (see figures below), ask: What might the image represent? What do you notice about these images? What can you say about the ALR levels and major US cities like Chicago?
A story about a scientific researcher	**45**	Mention of how researchers were curious about why jellyfish glow and this question prompted research on jellyfish that led to the discovery of a protein that makes the jellyfish glow.
About how we know what we know	**37, 46**	What researchers do to determine why firefly populations have been decreasing
Invitation to speculate or personal relevance	**47, 61**	We talked about how scientists use bioluminescence (to make cells glow-in-the-dark). Discussed the night sky community nearby. Could also discuss ways to reduce light pollution.

iSWOOPing a Stop on a Hike—an Interactive Station on Fireflies

Theme: By turning on the lights to create what we perceive as a safer and more productive nighttime landscape, we risk losing both populations of nighttime creatures and the magic of innocent childhood pastimes like catching fireflies in the dark

Topic(s): Bioluminescence, fireflies, light pollution

Goal: Enjoy the dunes after dark and discuss the various animals/insects that thrive in the night

Objectives: Appreciate animals that thrive in the night; Consider the impact of habitat loss and light pollution

Audience: Mixed age
The audience were people who came for the Full Moon Hike, and the age ranged from families with small kids to senior citizens.

Prep/Supplies

- Visuals--a cell illuminated with a Green Fluorescent Protein (i.e. a glow-in-the-dark cell)
- Figures of ALR levels
- Other, e.g., pictures of researhcers or instruments
- Jar

Opening the conversation
I started by telling a story about me as a little girl, sitting on my front porch on summer nights catching little insects which light up. I asked visitors to guess what I was catching, and of course, they said fireflies!

Interaction
Questions for visitors:
Did you have similar experiences when you were growing up?
Visitors reminisced about catching fireflies when they were kids.

I then asked visitors to make observations about the night sky (there were no fireflies out that night).

We talked about research being done to determine why firefly populations have been decreasing (see attached articles at the end of this document). We talked about habitat fragmentation (and how this affects lots of organisms, i.e. frogs) and light pollution. I asked visitors if they know of other bioluminescent organisms (hoping that someone would say a jellyfish).

In this program, I then showed a visual of a cell illuminated with a Green Fluorescent Protein (i.e. a glow-in-the-dark cell) and asked visitors to make predictions about what the picture might be of. Then I talked about how researchers were curious about "why do jellyfish glow" and this question prompted them to do research on jellyfish, discovering a protein that makes the jellyfish glow. We talked about how scientists use bioluminscence as a research tool (to make cells glow-in-the-dark). ***HOWEVER***, Instead of this section, if I were to do this program

again, I would include a picture of the night sky ALR level figures, asking them to make predictions about what they think the imaged show. I would first use the photo of NWI (figure 2) and then of the whole US (figure 1). Notice correlation between high ALR levels and locations of major US cities (e.e. Chicago, LA, etc).

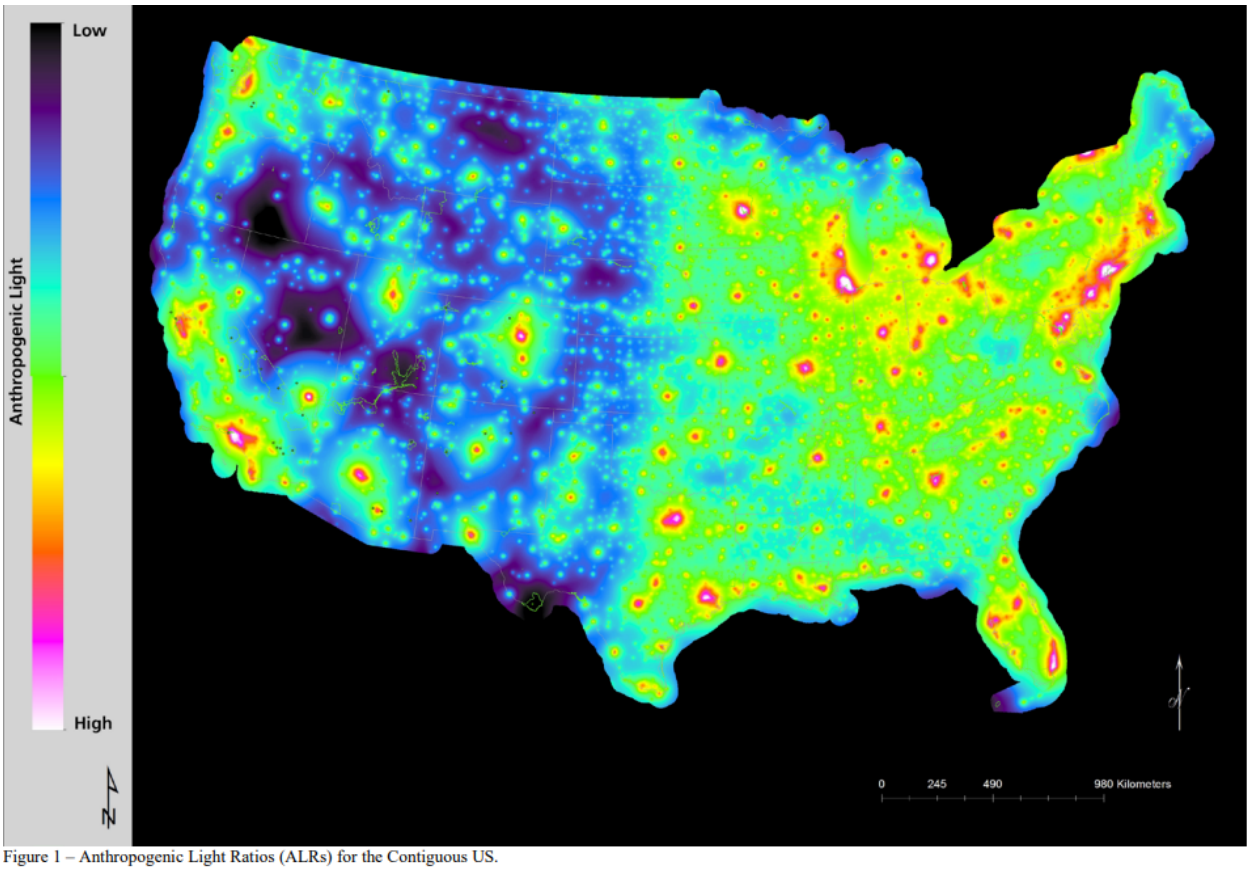


Figure 1 – Anthropogenic Light Ratios (ALRs) for the Contiguous US.

Figure 1: Anthropogenic Light Ratios (ALRs) for the contiguous US

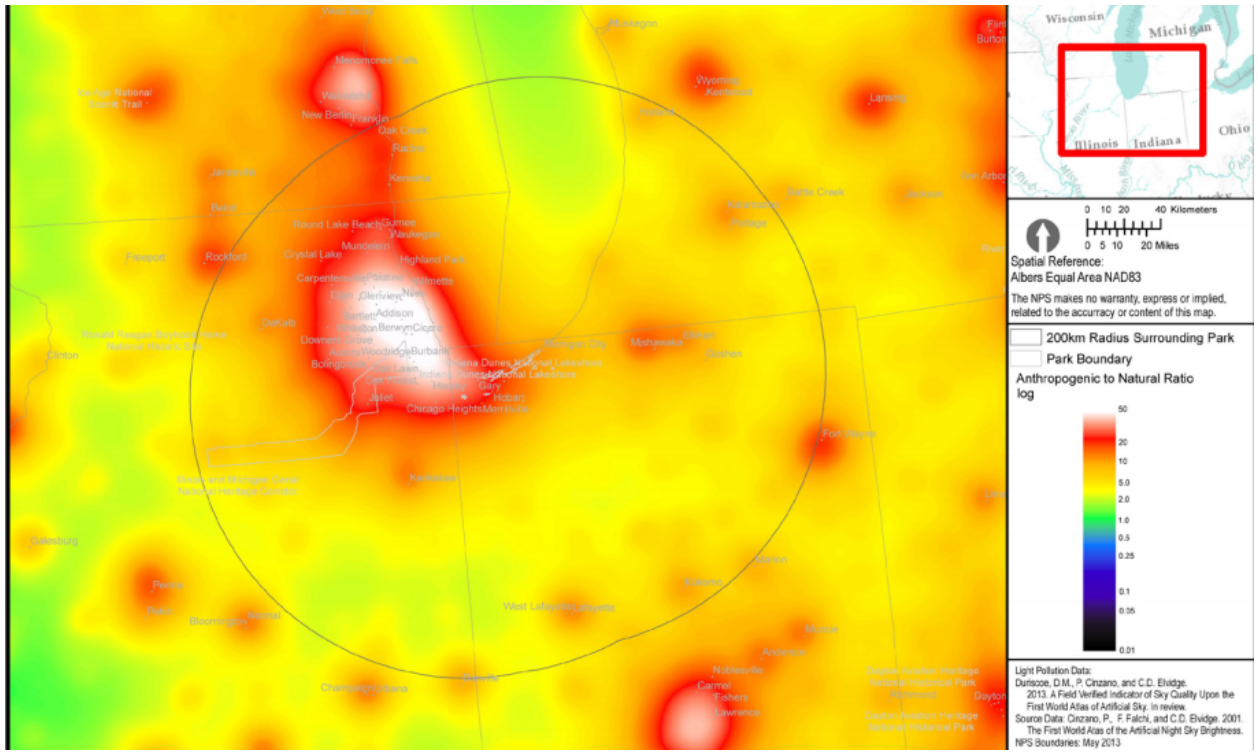


Figure 2: Regional ALR near Indiana Dunes National Park

Conclusion

Discussed the night sky community in Beverly Shores. Could also discuss ways to reduce light pollution (see resources below for more info).

Visitors' Reactions

They were interested to hear about firefly decline and how habitat loss affects lots of organisms.

Resources

I have included a variety of resources regarding fireflies and light pollution. I also pulled out some pertinent information from each article to summarize the findings.

Good document which shows ALR levels in NWI and whole US! Has wonderful graphs:
https://irma.nps.gov/DataStore/DownloadFile/534134

- One way the Natural Sounds & Night Sky Division (NSNSD) scientists measure the quality of the photic environment is by measuring total sky brightness averaged across the entire sky and comparing that value to natural nighttime light levels.
- This measure is called the Anthropogenic Light Ratio (ALR).
- Lower ALR levels reflect higher quality night sky conditions -- An anthropogenic light ratio of 0.0 would indicate pristine natural conditions, while a ratio of 1.0 would indicate that anthropogenic light was 100% brighter than the natural light from the night sky.
- As you can see from figure 1, there is a correlation between high ARL levels and locations of large cities (e.g. Chicago).

- Conclusion that the authors made from the paper: “Although the park night sky quality is partially degraded due to the proximity of the multiple population centers, Indiana Dunes National Lakeshore provides important dune and aquatic habitat for nocturnal wildlife and a unique opportunity for millions of people to enjoy night sky resources.”
- This resource is also interesting because you can find a similar report for any other National Park, so visitors could go on irma and compare their memories from other national parks.

This paper summarizes the effects of light pollution on animals and what steps are recommended for effective use of night time lighting:
https://irma.nps.gov/DataStore/DownloadFile/615778

- The International Dark-Sky Association (1996) provides some solutions that minimize light pollution without compromising safety or utility:
    1. Use night lighting only when necessary. Turn off lights when they are not needed. Timers can be very effective.
    2. Where light is needed, direct it downward.
    3. Use low pressure sodium (LPS) light sources whenever possible.
    4. Avoid development near existing observatories, and apply rigid controls on outdoor lighting when development is unavoidable.

More in depth research article about light pollution:
http://www.georgewright.org/184albers.pdf

- The natural sources come from stars, the Milky Way, airglow, and moonlight. Human-made sources include streetlights and other outdoor lights, concentrated largely in towns and cities.
- Not from this paper! But from another: “Large urban areas and cities emanate a vast amount of light during the night, causing sky glow. This in turn covers the dark sky and hides the view of stars, planets, and the Milky Way” (https://irma.nps.gov/DataStore/DownloadFile/578540).

More info about how to use nighttime light effectively:
https://irma.nps.gov/DataStore/DownloadFile/153206https://irma.nps.gov/DataStore/DownloadFile/153206

More general info aboutlight pollution from Nat Geo:
https://www.nationalgeographic.com/science/2019/04/nights-are-getting-brighter-earth-paying-the-price-light-pollution-dark-skies/
*P.S. it also has a really good image showing/explain what sky glow is!

Information about the declining population of fireflies
https://web.extension.illinois.edu/fmpt/ec/150912.html

More primary/secondary research on fireflies and artifical light:
https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.4557
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0191576

- “All of these essential signals may be masked by ALAN, which has been suggested as one of several factors contributing to a worldwide decline in firefly populations (Khoo, 2014; Lewis, 2016; Lloyd, 2006)”

- "North American *Photinus* fireflies engage in courtship dialogs that involve precisely timed flash signals encoding species identity and sex"

Facts about fireflies, citizen science:
https://www.firefly.org/
- "Enter the Vanishing Firefly Project of Clemson, a bare-bones effort that began the same year and asks people to step outside, peer into the darkness and, for a single minute, count the fireflies that sweep through their field of vision."

https://www.clemson.edu/cafls/research/baruch/firefly_project/

If you want a longer read, this is a really good book about fireflies:
Silent Sparks: The Wondrous World of Fireflies

Article about how night skys impact visitor' experience:
https://www.sciencedirect.com/science/article/abs/pii/S0272494418302913?via%3Dihub

Basic information fireflies and light pollution:
Scientists have for years been warning that the world's estimated 2,000 species of fireflies are dwindling, partly because expanding cities are altering water flow patterns and yielding more light pollution, which researchers say can hamper the mating rituals of the insects.

"Firefilies create a magic that transcends space and time"

"Fireflies are indicators of the health of the environment and are declining across the world as a result of degradation and loss of suitable habitat, pollution of river systems, increased use of pesticides in agro-ecosystems and increased light pollution in areas of human habitation," according to the Selangor Declaration, named for the Malaysian site of a 2010 symposium about fireflies. "The decline of fireflies is a cause for concern and reflects the global trend of increasing biodiversity loss."

The International Dark-Sky Association defines light pollution as "the inappropriate or excessive use of artificial light." That can take many forms, including glare, or excessive brightness; sky glow, which drowns out the night sky over urban areas; light trespass, or stray light falling where it is not needed; and clutter, or confusing groups of bright light sources

ANOTHER GOOD ARTICLE ABOUT LIGHT POLLUTION
https://irma.nps.gov/DataStore/DownloadFile/582058
Fireflies are another group of grassland species that can be adversely affected by artificial night lighting (Lloyd 2006). Because light is used for firefly communication, both for sexual behavior and in some interspecific interactions (where females attract males of other species to capture and eat them), any disruption of the ability to see light will have adverse effects. Artificial light washes out the signals used for communication and is potentially contributing to the decline of fireflies and other organisms that rely on bioluminescent communication (Lloyd 2006, Hagen and Viviani 2009, Bird and Parker 2014).

In other situations, light that includes longer wavelengths appears to attract few insects and does not disrupt orientation of sea turtle hatchlings. For this reason, yellow lights are

commonly identified as being wildlife-friendly (Figure 17). These same lights, however, reduce the foraging activity of native beach mice (some species of which are endangered) along the Florida coastlines where turtlefriendly lighting is recommended (Bird et al. 2004). Fireflies are vulnerable to impacts from yellow light because it is this part of the spectrum that is used by those species flying after dusk (Lloyd 2006).

Stray light, fireflies, and fireflyers James E. Lloyd Fireflies (Lampyridae, Coleoptera) that use their chemiluminescence for sexual communication have a number of attributes that make them good as well as unique subjects when considering the effects of artificial light in natural environments. First, fireflies may be expected to have inappropriate “innate” responses to foreign light similar to those that occur in other organisms, but because of their conspicuous luminescent signals, some alterations may be more easily monitored and quantified. Second, because much of firefly life activity is mediated through their own pinpoints of light in otherwise dimly lit or dark environments, firefly relationship to light is virtually unique in the terrestrial world; thus, foreign light will have even more serious consequences for them, and they provide a special case for study. Fireflies may be useful as model systems for the study of the long- and short-term consequences of ecological insults that occur in combination. Third, because of their unique place in human culture, fireflies can be used as subjects as well as icons when educating and enlisting the help of the public, especially children and older students, and for reminding them of the continuing attention that is required to improve and then maintain healthy natural environment
https://www.urbanwildlands.org/Resources/ECANLProgram.pdf

JOE GRUZALSKI

INDIANA DUNES NATIONAL PARK

Life in an Indiana Marsh
A Wetlands Walk Featuring Amphibian Research

Type of program: Walk

Program duration: 2h

Theme: Moist and muddy and sometimes smelly, wetlands are both a nursery and a supermarket.

Program Strengths
A story about a scientific researcher
Insight into how we know what we know

Joe Gruzalski has a degree in geology from the University of Illinois and has worked as a science communicator at the Museum of Science and Industry in Chicago. As Joe tells his visitors: “You could study the science, history, and culture of the dunes for a lifetime and just begin to understand the complexity of this place.”

Joe Gruzalski's Take on iSWOOP

Joe says: "I thought the whole premise of iSWOOP made sense—the idea of connecting the public with what's going on in the park is powerful. I need to get the public to understand science is happening. Science is always happening. I think one of the strongest ways to get this across is having access to as much narrative content and images of the researchers as possible. At the Museum of Science and Industry, we did improv exercises every morning. Their approach in teaching is about conversational learning, back and forth, making it engaging. Focusing on communication—it's what I'm all about. I was excited."

Joe's Favorite Parts of iSWOOP

I've always recognized visuals' importance and accepted that a picture is worth 1,000 words. I had never thought much about how drastically a low-quality visual could affect a visitor's experience. How will your audience decipher what you're trying to say and leave with a lasting impression if your visuals are too busy or too blurry? It's the visual equivalent of interpreting with a boombox in the background. Reducing the static is so important to get your point across. So if a visual is worth 1,000 words, it's important to consider whether all 1,000 of them are relevant to the story you're trying to tell. You can be more successful when you have a visual library that is clean looking—because it grabs and keeps attention.

Program Strengths

This program covers a lot of content, weaving in introductions to a few different researchers and the nagging questions that have led to innovative methods for studying frogs.

What to look for	Where to look	Notes
Questions that invite participation, observation, prediction	**70, 96, 223, 288, 289, 311**	How would you go about counting frogs? What are some sounds that stood out to you? What are some questions that come to mind? What sounds are important to you? What sounds do you choose in your environment? If you were to turn this soundscape into a song, what genre would it be?
A story about a scientific researcher	**187, 302**	A few stories are embedded in this program, starting with Cowles and the purpose of the park and then the amphibian researcher, Dr. Bob, and his collaborators.
Insight into how we know what we know	**227, 317**	Participants act out some of the methods and experiment with visualizing sound in real-time (using the Analyzer app). They see a visualization of frog song (captured by a sound meter and translated with special software). Being able to play the frog calls easily with the images of the different species surprised people. Some people had no idea how many species live here.
An invitation to speculate or find personal meaning	**388**	At the end some questions about visitors' reactions: What surprised you? What will you remember?

Life in an Indiana Marsh

A Wetlands Walk Featuring Amphibian Research

Key

Each roman numeral is a new stop on the hike

Blue is dialogue

Green is visuals

Brown is additional supplementary material

Black is rubric/ideas/action/questions

Possible themes

Moist and muddy and sometimes smelly, wetlands are both a nursery and a supermarket.
Indiana Dunes is a perfect place to get to know wetlands

Program Goal

Inspire visitors to appreciate and care for wetlands and their wildlife
By the end of today I expect you'll know a little more about the amphibians that live in the Dunes, the people who study them, and what makes their habitat special.

Objectives

Visitors will express interest in visiting other wetlands in the park
Visitors will be able to list challenges to studying amphibians
Visitors will be able to list methods amphibian researchers use

Miller Woods to Beach (2 hours)

I. Outside DC (10 minutes)
Walk to boardwalk (5 minutes)

II. On boardwalk (10 minutes)
Walk to old RR (15 minutes)

III. On Old RR (15 minutes)
Walk to spot before bridge (20 minutes)

IV. Spot before bridge (15 minutes)
Walk to ridges before lake (20 minutes)

V. Ridge (10 minutes)

I. **Introduction**

a. **Ranger Intro:** Who you are, short background info, photos, why you love the park, why you love what you do, favorite things about the park, etc: Hello everyone and welcome to the Indiana Dunes National Lakeshore. My name is Ranger Joe and today we're going to explore this part of the park known as Miller Woods. Quick show of hands- who likes science? I love science. I've always been drawn to nature; I have a degree in geology from the University of Illinois, and I've worked as a science communicator at the Museum of Science and Industry in Chicago. I love learning; you could study the science, history, and culture of the dunes for a lifetime and just begin to understand the complexity of this place. I also love sharing what I've learned; which makes being an interpretive or education ranger a perfect choice. And the best part is that I get to do these things at my favorite place on

Earth. Visuals of me/ some of my favorite places in the park (especially other wetland areas).

b. **INDU**: As we hike, I'll want to hear what brought you personally out to the park today. Indiana Dunes is known for its Lakeshore, but today we'll be talking a lot about Indiana's wetlands. People don't tend to want to sunbathe here in the wetlands, but my hope by the end of our hike is that you are going to be so intrigued and such a fan of wetlands, that you'll want to visit all the types we have in the park.

Set the Dunes as a park of discovery, curiosity, natural processes and diversity: It's my privilege to welcome you to Indiana Dunes National Lakeshore. This is a national park- like the Grand Canyon, Yosemite, or Yellowstone. It has long been a place of curiosity, diversity, and inspiration.

c. **Participant Intros—Kick-off Question:**
Before we head out, I'd like to go around and have everyone say your name. I'd also like you to answer this question "What do you think of when I say 'National Park?"

d. **Research**
INDU's long history of research: Parks are all these things you mentioned and more. Research. I rarely/never get a visitor to say "research." Research has been conducted in and around the Dunes for over 120 years. An early researcher and scientist by the name of Dr. Henry Cowles studied plant life in the dunes, coined the process of plant succession, and is considered a father of modern ecology. In fact, in 1913 Dr. Cowles led a group of distinguished European scientists on a tour of America. The four places they requested to visit were the Grand Canyon, Yosemite, Yellowstone, and the Indiana Dunes. Visual of Henry Cowles
INDU's current research: This legacy of scientific research and inquiry continues today. Every year, scientists apply for permits and conduct research in the park. In fact, today we'll be highlighting the research of a scientist named Dr. Bob.

Science goggles: Although we've learned a lot about this place, there are still so many things we don't know. We're constantly learning. Science research is as important now as ever as we face a changing climate. So whether it's your first trip here or your hundredth, I hope that today we can look at Miller Woods through a set of new lens. So lets strap on our science goggles *motions putting on goggles* and discover something new.

II. **Wetlands diversity; type, size**

A. Definition and Diversity
Discuss and define wetlands. Build on prior experience and knowledge.
What do people mean when they talk about wetlands? Is it any puddle?
Affirm answers and continue: That's right! A wetland is an area where water covers the soil, or is present at or near the surface of the soil for part of or all of a year. Show soil horizon and water table. They can be very large like the Great Marsh- extending for miles and miles on the east end of the park. Or they can be small, like some of the ponds we'll come across today.
What else comes to mind when you think of wetlands? How do you know when you are in a wetland? What might you encounter at a wetland [smells, animals, scientists?]?
A: Various answers

Follow up with--are you thinking of a specific place--either one you've been to or one in a movie or TV show? A memorable wetland moment?
A: Various answers
Yes! There are many different types of wetlands. (Show visual of different kinds- maybe dunes region specific?) What sets wetlands apart is their water source, water chemistry and the organisms that call them home.
Satellite image (visual)
Here is a satellite image of Miller Woods. If you were standing next to someone visually impaired, how would you describe this image? What's noticeable? Could you describe any patterns in this landscape?
Answers: *hopefully they can eventually point out the pattern of parallel water bodies.*
Exactly! The wetlands we'll be hiking around today are called "inter-ridge wetlands" because they exist between all of these beach ridges of sand that run roughly parallel to the shoreline of Lake Michigan. (Add visual simplifying satellite screen shot to show ridges and swales)
These beach ridges have been forming over the last 4000 years, with the youngest ridges closest to the lake.

B. Life Forms in a Wetland
Wetlands are special places. They're filled with life. What are some organisms that call wetlands "home?" Show image of a wetland.
Affirm answers and continue.
Yes, various organisms! Wetlands are often packed with living things. (Who lives here? Visual) This is especially true here in Miller Woods, where you have varying amounts of water and sunlight that allow for a huge variety of plants which in turn support many other living things.
If we dip this net into the water and scoop, what would you expect to find?
Activity: Ask for a volunteer to use the dipnet, and briefly observe and identify what is found. Explain how wetlands can be thought of as supermarkets. Plants and macroinvertebrates are the base of the food web. Many organisms come to feed.
Today I want to tell you about our amphibians; our frogs, toads, and salamanders. There are 17 different kinds of amphibians that call the Dunes their **home**. Amphibians certainly use wetlands as supermarkets… but they also use them as nurseries. You can imagine the challenge of using the same space as a supermarket and a nursery.
Maybe you can think of a time when you had a feeling that things weren't right in your home. Maybe you heard a dripping pipe, smelled some leaking gas, or felt your AC wasn't working. What do you do when there's an indicator something isn't right?
A: investigate, call someone for help, take action, etc.
Take a moment and use your science goggles to see if you can observe any signs that could mean something in our wetlands is not going well.
Could mention invasives. Otherwise pretty quality wetlands. But we can't observe every threat by just looking. We're going to have to investigate further.

Visual of native amphibian of ranger's choice. Highlight a native amphibian with some captivating adaptations to mention/show. Like a camouflaging tree frog. Or a limb/tail regrowing blue spotted salamander. Talk about what the adaptation is for. Let's continue our walk. As we're walking I want you to think: What makes a frog well adapted to living in wetlands?

III. **Amphibians**

A. Adaptations

Before we left our last stop I wanted you to think about how frogs are specialized for living in wetlands. What are some adaptations you were thinking of?

A: various adaptations (tails to legs, webbed feet, eyeball location, additional eyelids, gills to lungs, sticky tongue. Specialized skin, sensitive breathability.) Are they like the first breathable fabric? Model for all kinds of naval gear, our idea of what to wear when deep sea diving? Set up for the fact that they are sensitive to pollution (mentioned later.) Visual showing frogs/amphibians amazing adaptations? Video of using tongue to catch prey?

Yes! Frogs' bodies have been naturally selected over millions of years to be the efficient, jumpy, wetland dependent organisms we know today. Fossil records tell us that amphibians were the first vertebrates to walk on Earth, over 300 million years ago- thriving before, during, and after the reign of the dinosaurs. Amphibians are the masters of living on land and in water- amphibian literally means "two kinds of life" in Greek.

B. Lifecycle

I'm sure many of us our familiar with a frog's life cycle. They start off as eggs, hatch as tadpoles, and then transform or metamorphose into frogs. (Life cycle visual) This is something many of us have learned at a young age. It seems like a fairly simple cycle, but today I want to impress on you that amphibians experience many hardships to survive, especially today. So like other transformers, there's more than meets the eye.

C. Dr. Bob, Amphibian Researcher

But if everything were simple and easy, life wouldn't be so interesting. And that finally brings me to the start of my story. We all have our own interests. Things that make us curious, things were passionate about, things we want to learn about and understand better. For a scientist named Bob Brodman, his passion is amphibians. (visuals of Dr. Bob) For the past 24 years, Dr. Bob has devoted his life to understanding the amphibians that live in and around the Indiana Dunes. Dr. Bob loves amphibians. Imagine a grandma bragging about her grandchildren, Dr. Bob has that same love, that same enthusiasm, and that same passion for amphibians.

D. Why study amphibians?

Ask the group: Why study amphibians? What have we got to learn?
Affirm various answers. Encourage visitors to build on each others' answers. Yes, did anyone else think of that or want to say more about that?
As it turns out, amphibians are in trouble. You might say, amphibians are in "hot water," or in some cases, no water. Since the 1800s, Indiana has lost 85% of its wetlands to agriculture and development. And this isn't just in Indiana or the Midwest. Amphibian populations are declining around the world. In recent history, there have been 38 amphibian species confirmed extinct, with around 120 more, some not seen in decades, flagged as "possibly extinct." Global amphibian decline was established in science literature around 1991. So what do you do when someone or something you love is in trouble? You help them out. Dr. Bob wanted to know how our amphibians were doing, and he knew that having data on their population numbers was a crucial part of the story. He recognized the urgency, so just three years later in 1994 he began his systematic research monitoring amphibians here in Duneland. Today, about one third of all the amphibian species in the world are threatened with extinction. They're the most threatened group of

animals on the planet. We know they're in trouble, but we're still learning why they're in trouble. (a visual to show how imperiled they are? Amphibians compared to mammals, birds, fish, etc?) Pie chart showing all amphibians' statuses?
http://www.iucnredlist.org/initiatives/amphibians/analysis/red-list-status

But why should we care if amphibians are declining? Many amphibians are small, so you may think they have a small impact to the habitats they live in. Research suggests just the opposite. In some ecosystems, amphibians are considered "keystone species" which means they influence their systems significantly more than most other organisms in that system. If you were to collect all the frogs, salamanders, and tadpoles in a habitat and put them in one pile, scientists would call it the amphibian "biomass." In many systems, amphibian biomass is greater than the biomass of other animal groups. So although they are small in size, their total numbers have a massive impact on the ecosystem- like being an important food source for all kinds of predators. Amphibians are linked to land and water. Their health is linked to the health of both the systems they live in. Scientists consider amphibians to be "indicator species," like canaries in coal mines, their decline represents a decline in the health of the of their habitats. **If Earth was a car, amphibians would be our check engine light.** And it's been on for over three decades.

In addition to being significant contributors to their habitats, amphibians have proved to be helpful in human medicine. Explain: Visual of medical/research applications.

E. Original data collection methods: establish troubles with this method. The number of amphibians in a habitat is critical data on their overall health. If you wanted to get the number of frogs living in an area, how would you go about getting that number?A: various answers- counting, maybe sound.You can certainly count. In fact, right now this is the only way to get population data for salamanders. And some data is better than no data. The more people counting the better, and luckily Dr. Bob has had many students from his college help him count over the years (visual showing him and students in the field). Last year I had the privilege to go into the field with Dr. Bob and some of his students to help count. They set out these wire mesh traps that tadpoles and frogs can swim into easily, but have trouble swimming back out of. We went around to the traps placed in the water of certain wetlands and counted the number for each different species. We simultaneously counted all the frogs, toads, and salamanders we came across on dry(ish) land between the traps of different wetlands. Dr. Bob's skill in identifying the species of amphibian from the tadpole stage is really impressive. He pointed out subtle differences that clued him in on what species we were looking at. But if you're only searching and counting amphibians, you won't necessarily get the whole amphibian story. You could be missing a lot of them when you're physically counting. So, another method that has been widely used for years is to listen for frog's calls.

Each species of frog has their own unique call, and none of our 10 frogs say "ribbit." For most species, only the males make calls- trying to attract females to do the thing that is every organisms' goal- to reproduce.
Here are some of the species that live here and the calls they make. Go through some frog calls on the iPad
I told you that frogs make calls to find a mate. I also told you that every species makes its own unique call. But how do they do it? (Visual of frog call mechanism? + explanation)

Activity: Explain this method of monitoring. Have someone be a researcher/monitor taking note of abundance and location as the rest of the group spreads out and uses the various props to make different frog calls. Others can be distraction noises later to make it more difficult.

What were some struggles for the monitor? What if there were a lot more frogs?

Imagine how difficult it is to try to distinguish different species that are all calling at the same time. Also keep in mind that with this these methods of finding and counting or listening and counting- it requires someone to physically be present. What if there was a better way to monitor frog populations?

IV. Sound

A. Introducing Walt: While Dr. Bob and his students continued listening for and counting amphibians in the early/mid 2000's, a research ecologist named Walt Sadinski saw the need for a more efficient way to collect amphibian population data- using sound (image of Walt). Walt worked (then and now) for the U.S. Geological Survey in Wisconsin and during that time the survey had been trying to develop something that is now known as an "acoustic recorder." In 2000, Congress began funding federal agencies to monitor amphibian populations on public lands and determine factors affecting their status. The "acoustic recorder" device Walt and the USGS were trying to design would record sound at a site, and store it so it could be analyzed later using computer software. This technology would allow many sites to be monitored at once, which would help scientists gather critical population data for our declining midwest frogs. The USGS had initiative but their biologists hit obstacles and after multiple failed attempts Walt realized that this was a problem they needed engineers to help them solve. Walt knew Cornell University's bioacoustics research program was working on developing a similar technology to identify birds with sound, so he traveled to New York to see if they could help with ideas. Walt met with the team and explained what he needed: an affordable device that could be mass-produced and computer software to interpret the data. The research team showed him recorders they built. Walt saw potential, but their recorders required a large amount of money. He knew that if the technology was too expensive, it wouldn't be accessible to many researchers. Walt felt as if he hit another wall.

B. The Soundscape: We're going to leave Walt at that wall for a moment because I want to bring our attention to the sounds of Miller Woods. We've learned about this wetland environment, but now I want to focus on the acoustic environment. The combination of all sounds in a certain place, both natural and artificial, make up something known as a soundscape. I've set a timer for 1 minute, so get comfortable, close your eyes if you'd like, and soak in the Miller Woods soundscape.

What are some sounds that stood out to you?
What are some questions that come to mind?

Learning about and understanding soundscapes is the backbone of an entire branch of ecology known as ecoacoustics or soundscape ecology.
Biophony, geophony, and anthrophony

What sounds are important to you? What sounds do you choose in your environment?
If you were to turn this soundscape into a song, what genre would it be?

C. **Ian and acoustic recorders:** Let's get back to Walt. We left Walt worried at that wall he hit when he found out Cornell's acoustic recorder technology was too costly. Lucky for a lot of amphibians, Walt leapfrogged over that wall with the help of a new friend named Ian Agranat. Walt and Ian were introduced through Cornell's bioacoustics team; Ian was working on creating his own device to recognize bird calls. Some of his favorite sounds include a lively saxophone in a blues band, the sound of silence, and the song of a wood thrush. Play wood thrush song / video. Ian quickly became interested in Walt's project. Ian's background includes computer engineering, programming and business. In 2003 Ian created a company called "Wildlife Acoustics," which he says is the combination of his two passions: high technology and nature. A few months into Walt and Ian's meeting, their connection resulted in Ian's company creating the first acoustic recorder in 2007. Now that they had an affordable recorder, they needed to arm researchers with it. Collaborators from other government agencies as well as privately funded groups like universities were needed so that a network could help leverage resources and large pools of money weren't needed. Dr. Bob became an early collaborator on the project. Today, Dr. Bob and his students do a combination of monitoring, using visual counts as well as annually deploying acoustic recorders. Today there are tens of thousands of these devices monitoring amphibians as well as birds, bats, and marine animals in over 85 countries.

D. **Soundscope and soundscape:** Acoustic recorders allow scientists to access soundscapes of specific locations at specific times to determine what species of frogs are calling and how many there are. Ian and his company soon engineered software that enabled computers to analyze the data and look for specific "voice prints." Just like our fingerprints leave unique physical imprints, frogs' calls leave individual acoustic signatures. The software was upgraded again to allow for convenient summaries of data. These batches of data are used to quickly recognize events at a location like when a certain species first started calling. Acoustic recorders' and their accompanying computer software revolutionized the way researchers monitor frogs.

E. **Playing with visualizations**
Introduce the analyzer app to visualize sounds. Amphibian sounds
Voice prints
Vocal range slides
Visualizer app

V. **Threats and Climate change**

A. **Threats:** Remind group about what they said they do when something isn't right (get more information, take action, ask for help). Amphibians have been signaling that something isn't right. Luckily, we've started listening.

Habitat loss: I mentioned earlier that Indiana has lost 85% of its wetlands. This substantial decrease in places to live has probably taken the hardest toll on our amphibians.

Habitat fragmentation: Often a result of habitat loss, habitat fragmentation is another obstacle for our amphibians. Example with Long Lake? *discuss edge effect*

Pollution: Amphibians are very vulnerable to many kinds of pollution.
Chemical- their skin makes them susceptible; harm in reproductive health, defects. Sources: pesticides/herbicides, salt from roads, industry

Sound- their dependence on calling for reproduction makes them susceptible; harm by increased predation. Anthrophogenic sounds like trains and planes can hide lurking predators. Ex about frogs that sing in harmony for 1. competition and 2. cooperation (if they all sing

together, it's more difficult for predators to single out individuals.) But trains and planes can make them lose this harmony- a soundscape ecologist observed it took them 45 minutes to resync in which he watched two coyotes and a great horned owl pick out some frogs.

Light- less understood, but light pollution could certainly disrupt their calling times/cycles and confuse them? Research more.

B. Dr. Bob's Research conclusions: On top of these threats is the looming danger of our changing planet. Dr. Bob has compared his amphibian data here in the Dunes to climatic data of northwest indiana.

i. Dr. Bob's graphs on climate trends. Indiana getting warmer and wetter. Frogs are calling earlier. 20 days sooner. Threats- not enough food out, stress of another cold snap? Talk about how some living things gauge springtime on weather while others gage it on the amount of sunlight. If these don't sync up, what could this mean? Example of our karner blue butterfly?

ii. Highlight most susceptible species, discuss our cold-loving species like blue-spotted salamander and wood frog.

a. **Scenarios:** highlighting the importance of timing with amphibians (coming out and not having food?) as well as the scenarios of dried out wetlands and tadpole die off, flooded wetlands and increased predation. Nature is synthesis of every species' own cycle influencing other cycles.

b. Fear that next generation of scientists will venture into a wetland and instead of being greeted by the trills and chirps of frogs, are faced with a numbing silence.

c. **What we can do:** We mentioned earlier that when something's wrong with our home, we get it fixed. Amphibians, wetlands, and the animals that depend on them don't have that ability. Frogs can't call someone to fix the flow of water between a wetland that now has a road running through it. Toads can't reduce their carbon footprint. Salamanders can't stop people from filling in a wetland.

d. But we CAN help. Their survival depends on us. I challenge you to (turn these into a handout to give at end of program):

Be a wetland ambassador. visit all the wetlands, appreciate them, tell other people how special they are.

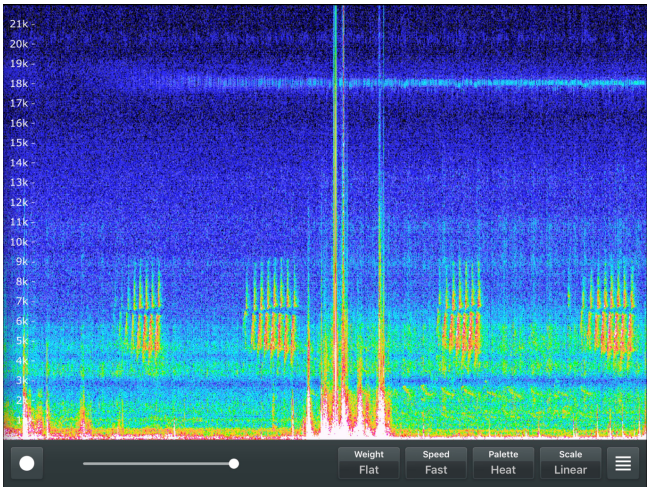
Be a wetland defender. If there's development going on, stand up for wetland preservation. Think about how you can help make sure wetlands get water (that rainwater doesn't all get collected as run-off in sewers as it did in Houston, until it didn't work anymore).

Be a wetland protector. Help protect water quality. Minimally use detergents and products like repellants and sunblock that end up in the water. Think about pesticides and fertilizers ... Think about it at home and at work. Ask schools to switch to more organic, less harmful types. Help protect its soundscape.. reduce your sound emissions. Protect its dark skies… minimize your light pollution.

Be a wetlands fan. Tune in to frog radio in the spring and summer and share it with someone else.

e. **Wrap up:** What inspires you about amphibians? What surprised you about anything you heard today? What do want to remember or think you will remember?

Thanks for exploring this part of the Indiana Dunes National Lakeshore with me today. Now you can be an ally for amphibians and wetlands and help keep these fascinating species and habitats around for generations to come.



EMMÉ ELLIOTT

Jean Lafitte National Historic Park and Preserve

Conversations about the Wetlands

Program type: Wetland Rove

Duration: 10-20 mins.

Theme: By focusing attention on the call of an umbrella species, the Prothonotary warblers (also known as swamp canaries), and by using the Sound Analyzer app to capture a visual of the "sweet, sweet" call, we become attuned to the species inhabiting the wetland.

Program Strengths

Questions that invite participation, observation, prediction
Insight into how we know what we know
An invitation to speculate or find personal meaning

Emmé Elliott has a degree in ecology and has worked for Audubon Louisiana and the Resource Management department of JELA. Emmé says, "I also worked a retail job. I don't have formal interpretative training, but combining a science background with extensive customer service and other soft skills translates pretty well to working for Interpretation." Emmé Elliott used the Sound Analyzer app on the iPad to capture and visualize sounds (spectrograph images) like the call of a Prothonotary warbler.

Emmé Elliott's Take on iSWOOP

While an interpreter in Spring 2019 at Barataria Preserve, I roved with an iPad down Palmetto trail listening for and recording sounds of all types: Prothonotary warblers, other birds, frogs, alligators, 5-year-olds, and general noises. The idea of park-based science and a lot about scientists' work was new to people I spoke to. They didn't know you can use geolocators or nanotags on birds. They didn't know that different scientists study different stages of a bird's life cycle and that those cycles are intimately connected. Very quickly, people understood the basics and were able to make predictions, such as: Many of the nanotag backpacks won't be recovered or monogamy may increase nest success (e.g. if males have a large territory and are feeding chicks in two nests, the nestlings might not get as much nutrition and so won't be as strong).

Emmé's Favorite Part of iSWOOP

Roving with the iPad was quite a bit of fun. One day, I put on waders and went into the swamp to look in nest boxes. People were seriously interested. People clustered on the boardwalk, watching me in the swamp and the alligators. I do think of myself as a science communicator. Working on education programs helps with that. There's been a lot of opportunities to talk about the environment.

One of my favorite experiences was encountering a group of three. We walked most of Palmetto trail together discussing park research, the future of the park since it's vulnerable to the effects of climate change. One downloaded the Spectrumview to their phone. We walked, then stopped and observed our screens in particularly noisy areas. This was a perfect way to loop into JELA's biodiversity and into the concept of Prothonotary warblers as umbrella species – if we protect the bird, we protect the other species, too. We were all on an Apple product, and it was all very millennial.

Program Strengths

What to look for	**Where to look**	**Notes**
Questions that invite participation, observation, prediction	**39**	- What do you think your street would sound like? - Do you live by the woods—what do you think your woods would look like in this form?
A story about a scientific researcher	**47**	Experiences as Katie Percy's intern wading in among alligators
About how we know what we know		Maps to show the birds' range and sites where Katie Percy's study is underway. Images of the nanotags and geolocators and showed migration maps based on the data collected from them.
Invitation to speculate or personal relevance	**75**	The group wondered if with increasing climate temperatures if Prothonotaries or other birds that currently winter in habitats closer to the equator would begin to winter in places like LA and Florida.

Conversations about Barataria's Wetlands: Guidance on roving, some tips, starters, and notes

Objectives: Visitors have the ability to explore swamp sounds, connect what they heard to what they saw, recognize an umbrella species, learn the high points of Katie Percy's research on the migration of the Prothonotary warbler, and appreciate that species have different diets and life cycles, but all live in the same swamp community.

Equipment: iPad with photos and Sound Analyzer app. The app let people wander around and see what they were hearing, making an already immersive experience even more so. Visuals used: I used maps to show the range so people can understand the scope and get a sense for all the sites where Katie Percy's study is underway. I used pictures of the Prothonotaries (adults and chicks), their nests, eggs, migration maps, and Louisiana site map.

Talking Points for gauging interest, inviting prediction and speculation. Some people want to quietly walk in or just enjoy nature.

- If not completely closed off, offer a little more info than they think they want--e.g. "keep an eye out for the warbler nestboxes up ahead." I've had visitors who seemed uninterested see me later on the trail, and ask me questions.

Use humor, for example, ask: "How are you enjoying our pleasantly mild 106-heat-index spring weather?" People aren't used to venomous snakes and alligators two feet away. Humor puts the nervous at ease.

- "You look ready to see some alligators. Which is great, because you're two feet away from one right now--yes, that log is alive. It's exciting. It's enthralling. It's the science of camouflage--and you know what else is science? Those bird boxes two feet away from the alligator, that swamp scientists have to walk to. In the alligator water. You can hear the birds now."
- "Hey, look at the venomous snake right off the trail! It's right next to the frog you're hearing. Let's talk about swamp organisms while that snake leaves us alone and you freak out."

Ask them what *their* homes sound like. Answers I've gotten:

- Cars and interstates
- Cicadas
- Lawnmowers
- "I don't really listen, much."

Be straightforward. Once you've got an interested audience, say that you're trying to get some good screen grabs of the sounds. Invite them to walk with you or to download the app.

- What do you think your street would sound like?
- Do you live by the woods—what do you think your woods would look like in this form?

Personal connections.

- Observe what's printed on clothing--a lot of people wear souvenir shirts to national parks, sometimes from other national parks, and that can be a useful starter
- Sometimes, visitors are interested in *you*, and that's cool. I tried to keep it interesting and related to the wetland.
    - "By the way, I've walked in that alligator water. I was our scientist's field intern for a summer and had experience on the project of my own. You didn't ask me, but I'm going to volunteer it, anyway, and tell you about my alligator water stories. Why is that important, you ask? Well, because birds are that important. See that yellow bird screaming in the tree right there? That's the bird of the hour."
    - I usually answer questions like: How did you get this job? With some information about the work.
    - You're with Americorps? (a lot of people have served in Americorps and are usually really interested in your work). Americorps has allowed me to learn from park scientists, so I can talk about that.

- Use of applications. I have many on my phone under the "Work" folder and was happy to show people. College-aged students are the usual demographic here and getting them pumped up using tech/apps/linking to social media/etc for scientific (park) research is great because half of them are newly graduated and remarkably disenchanted
    - Audubon
    - eBird
    - iNaturalist
    - Voice Memos (to record sounds if they're interested)
    - Frog ID, etc.

Representing someone in uniform.

Reflections

- Many images worked well with both kids and adults: pictures of eggs, chicks, adults feeding chicks and the migration maps were really effective.

- Visitors were enchanted by the bird itself. They were surprised by how bold it seemed to be, as a lot of warblers are shy. They asked about climate change affecting the birds' habitat (and also about Louisiana's coastal issues in general). We talked about the nesting behavior of PROWs, and how they like snags and cavities, of which Louisiana has an abundance. One group predicted that with increased hurricanes knocking down trees and increased salt water intrusion killing off others, Prothonotaries may like Louisiana habitat now, but it might become a problem in the future.

  The same group wondered if with increasing climate temperatures if Prothonotaries or other birds that currently winter in habitats closer to the equator would begin to winter in places like LA and Florida.

- Their favorite part was when a PROW flew right above us and sang. They also seemed to enjoy learning about how the nextboxes are constructed. One commented how JELA protects so many more species than they realized (referring to more than just PROWs, but learning the bird helped illustrate one of the species).

One person didn’t realize researchers actually work on national parks, mostly because “it just wasn’t a thing I thought about.” They thought parks were more touristy and like the nearby airboat swamp tours. Most didn’t know about the PROW, so pretty much all aspects of research were new to them

- What didn’t work as well: the map of LA with the different nestbox sites. Most visitors were out of state folks so they weren’t familiar with the Atchafalaya or the other more-central sites. It did help to show how prothonotary range is spread across the state.

- What worked less well at times: Picture of the geolocator "backpack." We talked about how it doesn't hurt the bird, but the school-age children were still pretty concerned about it and also us having to capture the bird. My read on it was that one kid got loudly concerned and the others followed joined in.

- What might’ve helped: a mic probably would have given us a clearer picture

- Why the iPad/iPhone app worked**:** gave visitors ability to explore swamp sounds, let them connect what they heard to what they saw, that everything is different but all lives in the same swamp community. Made an immersive experience even more so

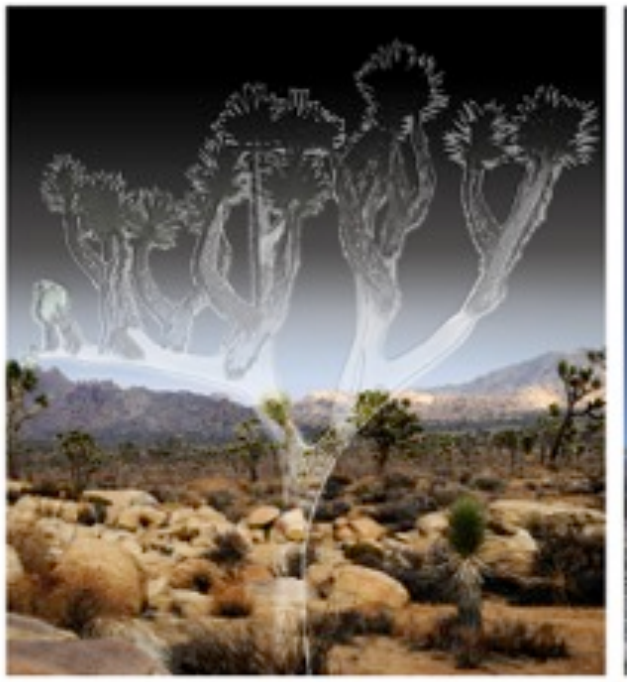


Photo Credit: Geoffrey Thomas

CYNTHIA ANDERSON

Joshua Tree National Park

I Speak for the Trees

Program type: Walk

Duration: 60 mins.

Theme: By speaking for the Joshua Trees, we can help ensure their continued survival.

Cynthia Anderson worked for more than 25 years as a marine biologist before becoming an interpreter. In addition to working for the National Oceanic and Atmospheric Association for a time, Cynthia has taught community college courses and coordinated afterschool programs in collaboration with the Lawrence Hall of Science. She worked at Joshua Tree National Park.

Program Strengths

Questions that invite participation, observation, prediction
Insight into how we know what we know
An invitation to speculate or find personal meaning

Cynthia Anderson's Take on iSWOOP
iSWOOP supports rangers. Being able to have the newest information and being able to help the public understand it is so important. So often the rangers the public sees aren't the researchers. Yet research is a huge component of parks and so crucial to our management.

Cynthia's Experience with Visitors—Her Favorite Part of iSWOOP
iSWOOP helps create a bridge between the information we have to offer and the emotional connection we want to make with visitors. For example, I led a walk called *I Speak for the Trees* and visitors said that our walk and program made them see the park in a different way. Hearing about the Joshua trees, they worried about what will happen to the park and the natural resources in the future. One man cried because he is so frustrated by the lack of funding for the parks, but he was grateful that we were still able to do ranger programs. I told the group about Juniper Harrower, the fact that she is a woman, a mother, a researcher, and an artist (to name a few things) and they were very intrigued by what she will study in the future. They were also glad to know that our park is researching the effects of climate change on the trees because they would be very unhappy if there were no trees in the future.

Program Strengths
This outline reflects a program developed to share the natural history of the Joshua tree. The park-based science is woven in through the use of props that the featured scientist (and artist-in-residence), Juniper Harrower, created for rangers to use.

What to look for	**Where to look**	**Notes**
Questions that invite participation, observation, prediction	**117, 161, 183**	Visitors explore characteristics: What exactly is a Joshua tree? Cynthia uses props made by the iSWOOP featured scientist to demonstrate the special relationship Joshua trees have with the Yucca moth. Visitors predict advantages and disadvantages to deep and shallow root systems
A story about a scientific researcher	**163**	Tell the group about how Juniper collected data both while pregnant and taking care of her young child. At times all three generations, Juniper, her mom, and her son, were working on measuring trees or collecting moths.
About how we know what we know	**256**	Juniper's props – root and fungus (batting). Also diagrams of roots and the fungal network underground.
Invitation to speculate or personal relevance	**225, 286**	Visitors are asked how they are inspired by Joshua trees. Ask visitors what they think the threats might be to the Joshua trees

Joshua Tree National Park
Interpretive Program Outline Form 2016

Name Cynthia Anderson **Supervisor** Lorna Shuman

First Program Date (tentative) 3/15/2017

Program Type:
____Interpretive Talk (Ex. Patio Talks) __x__Conducted Activity (Ex. Guided Walk)
____Illustrated Program (Ex. PowerPoint Program)

Location(s): Cap Rock **Length of Program:** 1 – 1.5 hours

Target Audience: Visitors to Joshua Tree National Park

Topic: Joshua Trees

Title: I Speak for the Trees!

Goal: Visitors will gain an understanding of how past and present climate change has affected the Joshua trees, and what actions each of us can take to help ensure their continued survival.

Objectives:
1. During the program, 50% of visitors will be able to identify two characteristics or adaptations of Joshua trees that allow them to survive in the desert.

2. By the end of the program, visitors will be able to name the desert that Joshua trees live in and two environmental conditions they require to survive.

3. By the end of the program, visitors will be able to explain two ways the Joshua tree is currently threatened.

4. After they leave the park, 75% of visitors will be able to discuss 2 actions they can take to help Joshua trees survive.

Theme Statement (Must be a complete sentence.): By speaking for the Joshua Trees, we can help ensure their continued survival.

Introductory Statement: Who has visited JOTR? How many of you came here to see Joshua trees (brief discussion)? Do you know why they are called Joshua trees (story)? People come here from all over the world to witness these compelling trees, which inspire curiosity, intrigue, and sometimes even disgust (Fremont quote). Today we will

learn about the characteristics of this desert environment, some of the adaptations we see in Joshua trees that help them survive in this harsh environment, to learn about why we are concerned for Joshua Trees in the future.

In the book The Lorax, Dr. Seuss wrote, "I am the Lorax. I speak for the trees, I speak for the trees for the trees have no tongues." During today's hike, I am going to channel my inner Lorax and speak for the Joshua trees! Along the way, we will look at some of the aspects of this diverse and beautiful ecosystem and think about how we can help ensure the survival of the iconic Joshua Tree.

Identify your Selected Points to Include in your Program (Identify 4-8 points that support your theme.):

Point 1: What is a desert?
Questioning:
Ask visitors what environmental characteristics are shared by all deserts.

- Low rainfall (10" in the definition of a desert; 5-6" here)
- Temperature extremes (very hot in summer and freezing in winter)
- Sporadic rainfall (winter and monsoon seasons)

Have you ever heard someone say that there is "nothing out there" in the desert? Do you think that is true?
Story share:
When I first moved to Joshua Tree, I had lived by the ocean my whole life and worked for more than 25 years as a marine biologist. When I told my friends and family I was moving to the desert, they were horrified! There is no ocean, river, or water there…there are no fish or marine mammals there…there is no life out there! That is a very common misconception, and we will see today that there are different types of deserts, and there is great diversity in desert habitats.

Joshua trees are an indicator species of the Mojave Desert (show picture of two desert ecosystems in the park). Their preferred elevation is between 3000' and 6000' feet. The Colorado desert is too low and too hot for the Joshua trees to survive. Park scientists think that Joshua trees need a hard freeze and rainfall during both the winter and monsoon seasons in order to produce blooms in the spring.

Point 2: The range of the Joshua tree has changed dramatically since the last ice age, about 13,000 years ago.

Technique(s) (optional):
Questioning:
Ask visitors where in the park or country they think the Joshua trees are found?

- Show laminated pictures of current and historic distribution.
    - What do they think happened to cause the distribution to shrink?

Imagination:
Have visitors look around and imagine what the landscape may have looked like 13,000 years ago during the last ice age. Were the same plants and animals living here?

Explanation:
During the time of the last ice age, the Shasta ground sloth (show picture) lived in the area that we now call Joshua Tree National Park. Dung balls from the sloths were discovered in the 1930s, and these dung balls were composed of leaf fibers, fruits, and seeds of the Joshua tree. It appears the Joshua trees were a favorite food of the sloth! The location of the sloth dung, as well as seeds found in pack rat middens suggest that Joshua trees had a much larger distribution than they do today. With the extinction of the sloth about 13,000 years ago the range of the Joshua trees has shrunk. Today, Joshua tree seeds are dispersed by birds and seed-caching rodents, such as squirrels and packrats, which cannot disperse seeds as far as large mammals.

Transition: Although the range of the Joshua tree has been reduced over time, its remaining distribution is extremely important to the Mojave Desert ecosystem. Joshua trees are important enough that the park is named after them. So what exactly is a Joshua tree and why do we call them Joshua? As walk to our next stop think about how the Joshua tree may have gotten its name.

Point 3: The Joshua tree is an important part of the desert ecosystem.
Technique(s) (optional):
What exactly is a Joshua tree anyway? Joshua trees are members of the agave family. The Latin name for Joshua tree is *Yucca brevifolia*, which means short leaves. Like the California fan palm, *Washingtonia filifera,* the Joshua tree is a monocot, in the subgroup of flowering plants that also includes grasses and orchids. Joshua trees and fan palms also share a similar adaptation to survive in the extreme temperatures in the desert: they retain their dead leaves, which form an insulating layer to protect them in times of extreme heat and extreme cold.

Roots: Are the roots of Joshua trees deep or shallow? What is the advantage of having a shallow root system?

- The roots are close to the surface so they can quickly absorb water after it rains. What are the disadvantages?
- Because the roots don't go down very deep and Joshua trees tend to be top heavy, strong winds can topple the trees fairly easily. Most Joshua trees die this way.

Flowering: Joshua trees are the most recognizable plants of the Mojave Desert. They depend on just the perfect conditions: well-timed rains, and a crisp winter freeze.

- Researchers believe that freezing temperatures may damage the growing end of a branch and cause it to flower.
- A flower can't grow unless the growth stem is damaged. Plant flowers eventually produce fruits which have seeds inside them. But in order to produce seeds, a flower must be pollinated.
- One amazing thing about Joshua trees is the unusual way they are pollinated. What kinds of animals pollinate flowers? Bees, butterflies, humming birds, bats. Joshua trees are pollinated only by yucca moths, *Tegeticula yuccasella*.
- The Joshua tree has a special relationship with the yucca moth, the only know intentional pollinator in the world.

Pollination: Each spring, yucca moths emerge from the ground to mate and lay eggs in the flowers of Joshua trees. Unlike bees and birds that accidentally spread pollen from flower to flower as they gather nectar, these moths intentionally pollinate Joshua trees.

- Yucca moths have modified antenna to collect pollen, which they roll into a ball, carry it under their chins to a different flower, and push it down into the center of another Joshua tree flower that does not already contain a pollen ball.
- By pollinating the flowers the moths ensure that they will produce seeds, which are lined up inside fruits that are clustered on the stem that held the flowers. Eventually, the seeds will feed their caterpillars when they hatch.
- New trees can grow from seeds that fall onto the ground, or seeds that are dispersed by small mammals and birds.
- In other words, there would be no Joshua trees without the Yucca moths, and no Yucca moths without the Joshua trees. Show seeds, seed pods, photo of Yucca moth.

Use Juniper's props – yucca moth glasses, pollen, laminated photos. Explain Juniper's research on how the Joshua trees and the moths are doing at different elevations. Tell the group about Juniper, the fact that she is a woman, a mother, a researcher, and an artist (to name a few things). Listen to visitors' impressions.

Branching and Aging: When a Joshua tree flowers, the flower splits the existing branch into two (or more) new branches. Most Joshua trees here in the park don't branch until they are at least 6 feet tall.

- Have visitors look around and ask them which Joshua tree they think is the oldest, and why.
    - How can you tell how old they are? Can you count the rings? It's extremely difficult to tell how old a Joshua tree is because they don't grow a new ring each year; all three parts just grow bigger.
- Biologists conducted a study to try to figure out how old Joshua trees are. They used old photographs of trees that they could identify. They also knew when the photos were taken. They compared the height of the tree in the photo with the height of the tree today so they knew how many inches it had grown in a certain number of years. From this study, they figured out that Joshua trees grow approximately 1 ½ inches per year on average. They also estimated that most Joshua trees can live to be approximately 200 – 300 years old.

Nurse Plants: What do you see growing in this bush? A little Joshua tree. When Joshua tree seeds fall on the ground, some of them germinate, take root and grow into new trees.

- Do you think the tender, juicy little seedlings have a better chance of survival if they grow out in the open, or inside a thorny bush? Why?
- Regardless of the type of bush, we call them nurse plants because they take care of the little Joshua trees. Many animals like to eat the tender seedlings, but they can't get to them as easily if they are growing inside a thorny nurse plant.
- Usually, when the Joshua tree grows larger, it outcompetes the nurse plant for water and nutrients, and the nurse plant dies.

Pups: New Joshua trees are also capable of sprouting from the roots and branches of older trees. We call these small trees "pups".

- When they sprout out of branches or roots it is called vegetative reproduction, or rhizomal growth.
- Being able to reproduce vegetatively allows a much quicker recovery after damaging floods or fires, which may kill the main tree.
- Park scientists consider plants that are within 10' of a parent plant to be pups.
- Although an old Joshua tree can sprout new plants from its roots and branches, only the seeds produced in pollinated flowers can scatter far enough to establish a new stand of trees.

Transition: Joshua trees have a special relationship with the yucca moth that is vital to both of their survival. Just like that relationship, other forms of life in the desert depend on the Joshua tree and we often refer to it as a "keystone species". As we walk to our next stop, think about how the Joshua tree could be important to other forms of life.

Point 4: The Joshua tree is a keystone species that many forms of life depend on.

Technique(s) (optional):

Questioning:

How do you think the Joshua tree is important to other forms of life? (discussion)

What do you think it means to be a "keystone species"? (discussion)

Explanation:

A keystone species is a plant or animal that plays a unique and crucial role in the way an ecosystem functions. Without keystone species the ecosystem would be dramatically different or cease to exist altogether.

Live Joshua tree:

- 25 different species of birds are known to nest in the trees: Scott's oriole's, woodpeckers, etc.
- Loggerhead shrikes use the leaves to impale prey (show picture).
- Insects and lizards can be found in the layer of dead leaves on trunks and branches.

Dead Joshua Tree:

- They provide food for insects like termites, and shelter for many insects, lizards, snakes, rodents, rabbits, etc.
- I have seen desert tortoises build burrows under dead Joshua trees for added protection and stability.
- When the trees decompose, the organic material adds nutrients to the soil.
- Even in death the Joshua tree is a source of life, and is an important part of the ecosystem.

Transition: The Joshua tree is a keystone species that is extremely valuable to the desert and all the life that lives here, but it isn't the only plant that calls the desert its home. As we walk to our next stop, look for other plants that may live here.

Point 5: The Joshua trees aren't the only plants that call the desert their home

Technique(s) (optional):
Questioning:
Ask visitors what other plants they saw while we were walking.

Explanation:
Depending on where you are in the park, you'll find different communities of plants that are largely based on elevation. Pinyon pine trees are here in our park at higher elevations (> 4,000 feet).

- Other trees in the park include: California junipers, scrub oak, desert willow, ironwood, California fan palms, palo verde, smoketrees, cottonwood, and mesquite.
- Other plants along this trail include blackbrush, rock goldenbush, galleta grass, skunk bush, silver and pencil cholla, and many wildflowers in the spring.

Mycorrhizal fungal communities living in the root systems of Joshua trees.

- Communication network across species.
- Potential for all of trees and plants in these large valleys to be communicating about environmental conditions and diseases.
- Juniper's props – root and fungus (batting). Also diagrams of roots and network underground. No one had proven that Joshua trees, like trees in northwest or northeastern forests, have fungal networks. Offer description of taking soil samples at different elevations and analyzing them in the lab. Visual of root cell exchanging sugar for moisture, an example of mutualism. Juniper wondered if fungi at high elevations would be noticeably better at drawing water to the Joshua tree roots than the fungal networks at low elevations. If the stronger fungi were added to the soil and Joshua tree roots at different elevations, could they help a struggling Joshua tree survive? Ask participants for their predictions about the future survival of Joshua trees and their moth and fungal helpers.

The park is protecting many different types of plants and entire communities: we are more than just the Joshua trees!

Transition: The Joshua tree and other plants that are protected here provide immense value to the desert ecosystem and wildlife that live here, but what other types of value can we attribute to this place? As we walk to the next stop, think about what inspired you to come to this place.

Point 6: Many people find inspiration in the Joshua trees.
Technique(s) (optional):
Questioning:
Ask visitors how they are inspired by Joshua trees. (discussion)

Explanation:

- Artists: e.g. Artist's Tea
- Photographers
- Musicians: U2
- Movies:
- Others?

Transition: Many people find inspiration and beauty in the Joshua trees. In spite of its protection, there are threats to its survival. As we walk to our next stop think about what threats there might be.

Point 7: The future of the Joshua trees.

Technique(s) (optional):

Questioning:

Ask visitors what they think the threats might be to the Joshua trees. (discussion)

Explanation:

- We are currently seeing the effects of climate change on the landscape:
    - Nighttime temperatures have increased.
    - Precipitation has decreased: in the early 1900s, average rainfall in this area was double what it is today (10”-12” then, 5”-6” now).
    - Pinyon pine, juniper, and Joshua trees have started to die out.
    - Different plant communities in the park are based on elevation and the climate associated with that elevation. As the climate shifts, the plants will start to shift up in elevation.
    - Mathematical modeling of an increasing temperatures shows little suitable habitat for Joshua trees, with reduced recruitment and survivorship at lower elevations.
    - But mathematical modeling has limited applicability when we look at conditions in microhabitats throughout the park. For example, near rock piles or boulder formations, the air stays cooler and has higher humidity than in areas close by in open valley habitats.
- What are we doing? Counting baby Joshua trees, studying microhabitats, keeping plant and wildlife corridors open, climate-friendly park.
- What can you do?
    - Just like the Lorax we can all speak for the trees! Make changes at home, share what you’ve learned with others, and volunteer.
    - When you post on social media, please include a resource message with your beautiful picture.
    - It took a million little actions to get us where we are today and it will take a million little actions to get us out.

Conclusion Statement: People come from all over the world to witness the amazing Joshua trees. Visitation has gone from approximately 1.25 million visitors in 2014 to more than 3 million in 2017 (graph). We can work together to uphold the mission of the NPS, which is twofold: 1) to protect and preserve, 2) for the enjoyment of the visitor today and into the future. We as a staff of approximately 100 park rangers can’t do it alone with 3 million visitors. We need your help! And the first step you can take is to get educated. Thank you for coming on a ranger-led program. The more time spent learning about this amazing tree, the more apparent it is why our park was named after them and why they are protected. With climate change, the future of the Joshua trees is changing. In order to ensure this iconic species’ continued survival, we all need to speak for the trees.

Self Evaluation (Include at least 5 self-evaluation questions. These questions should directly relate to the program you are giving.)**:**

1. Was the group engaged? Did they ask questions and seem interested?
2. Did my presentation flow well? Did my transitions make sense?
3. Did they react to and relate well to my techniques (props and stories)?
4. Did I answer their questions effectively, or if I didn't know the answer, did I say "I don't know, but I can find out for you"?
5. Did I help them understand the connection between the presentation topic and the Park's mission?

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