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Research Learning Center

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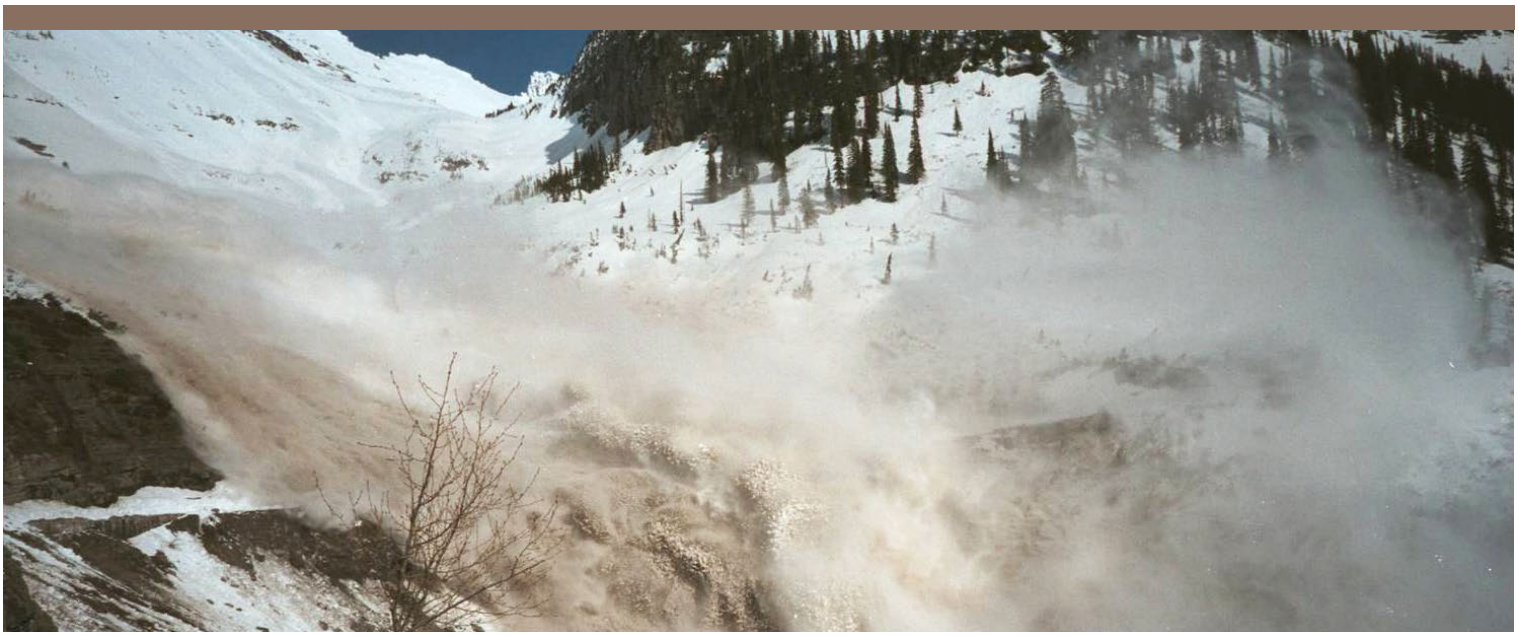

Glacier's Avalanche Cycles: Past, Present, and Future

By Peri Sasnett

I shove another massive shrub out of my way, hoping to find a clear path before me. No such luck. Instead, I see a never-ending swath of head-high alder bushes. I devise a strategy. Carefully balancing on top of a downed log, I begin to follow it. To my relief, several others lie ahead, creating a clearing through the thick vegetation. But eventually those run out, and I'm stuck swimming through the dense brush once again. According to the GPS unit, we're only half a mile from the Going-to-the-Sun Road, but from what I can see, we could be anywhere.

Leading the way is Erich Peitzsch, a U.S. Geological Survey (USGS) physical scientist who's chosen this fall day to collect data, hopeful he won't disturb too many visitors with the roar of his chainsaw. Ironically, we're out in the warmth of the September sun to study avalanches, without a snowflake in sight.

Peitzsch is part of the USGS Climate Change in Mountain Ecosystems program, based in Glacier National Park. Small but widely known, the group studies the park's melting glaciers and other ice features, and monitors climate change impacts in the alpine. Peitzsch's research specifically focuses on understanding how climate change will affect avalanche cycles in Glacier and the surrounding area—and in turn, how those effects will ripple through the landscape beneath the snow.

While many of us may think of avalanches as a hazard for backcountry skiers or snowmobilers, they're actually an important ecological phenomena. Much like wildfire, landslides, or beetle infestations, avalanches are a periodic landscape disturbance essential for wildlife habitat. Avalanches stimulate new growth, are a haven for nutrient-rich plants and berries, and create a patchwork of much-needed open

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In This Issue

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"Science in the Crown" is a periodically published journal of the Crown of the Continent Research Learning Center (CCRLC).

The CCRLC serves Waterton-Glacier International Peace Park, Grant-Kohrs Ranch National Historic Site, and Little Bighorn Battlefield National Monument.

Crown of the Continent
Research Learning Center

CCRLC is part of a network of research learning centers that the National Park Service established to promote research and scientific understanding.

www.nps.gov/rlc/crown/index.htm

Director's Corner

By Tara Carolin

The summer of 2017 won't soon be forgotten by staff or visitors of Glacier National Park. A late, wet spring led directly into a hot, dry summer, ushering in more visitors than the park has ever seen before. More than a million visitors in July alone broke not only our own monthly record, but that of any large, western national park. The Sprague Fire, Glacier's largest wildfire of the summer, impacted visitors, staff, and community members with evacuations, closures, and hazardous smoke conditions that we hadn't experienced since 2003. Staff reacted with shock and disbelief when we got word that Sperry Chalet had burned, and truly grieve the loss of such an iconic piece of the park's history. And yet, the Crown of the Continent Research Learning Center (CCRLC) continues each day with our mission to promote research and science education, an exciting task as 2017 provided an array of fascinating and fun opportunities.

Two of our most exciting events in 2017 included hands-on learning. The CCRLC held the first ever Waterton-Glacier Mushroom BioBlitz and Waterton-Glacier Butterfly BioBlitz, which you can read about on page 3 of this newsletter. I must give kudos to Evan Portier, who took on all of the logistics planning for these events, while also working for Glacier's Native Plant Nursery and Glacier's Education Program. We also thank the many subject-matter-experts who made the event possible, as well as the Glacier National Park Conservancy for funding citizen science opportunities in the park. In addition, our annual Noxious Weed Blitz and Waterton-Glacier Science & History Day were both well attended and successful events.

Our Citizen Science Program was busy from beginning to end this year. Our High Country Coordinator, Wendy Cole, independently organized Spring Loon Day due to some hiccups in hiring other citizen science staff. She also led this summer's Goat Days as well as day-to-day pika and goat surveys. Our Loon Coordinator, Erik Nelson, who by the way created the design on this year's Glacier employee t-shirts, took the lead organizing our Summer Loon Day and coordinating our loon citizen scientists.

We were fortunate to have Terry Peterson back once again as Citizen Science Coordinator. Her hard work has boosted the energy of our program the past few years. This year, we expanded our educational outreach to more groups than ever before, including Glacier Youth, Blackfeet, and Montana Conservation Corps participants, as well as the Woods Project, Sierra Club, and various university and high school groups from both near and far. Despite getting shut out of the backcountry due to fire danger later in the season, we had a very successful season in both increasing our educational outreach and meeting data collection goals. I can't list all of our citizen scientists by name, but it is thanks to them and their dedication that these goals were met. Good job, citizen scientists!

Our Librarian, Anya Helsel, was especially helpful with providing service to our researchers this past year and helping me issue research permits in a timely fashion. She also helped staff and visitors alike with researching a wide variety of topics in the George Ruhle Library. Our Science Communication Specialist,

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Waterton-Glacier BioBlitz! A Fun-filled Day of Hands-on-Science

By Melissa Sladek

"I see one! Quick, get the net!" Boy Scouts and butterflies abound as the first-ever Waterton-Glacier Butterfly BioBlitz begins. I angle my camera closer to capture the savvy stalkers making their way through a field of wildflowers, wielding their nets in anticipation of the next flittering butterfly. With an excited leap, a scout captures an unsuspecting fritillary and gently places it into the expert hands of Waterton Lakes National Park biologist Jen Carpenter.

A Boy Scout checks his net for captured butterflies. Citizen scientist volunteer and butterfly enthusiast Bob Chinn looks on. *NPS photo by Peri Sasnett.*

Carpenter is part of a larger contingent of staff and experts from both Waterton Lakes and Glacier National Parks who have come together to host two BioBlitz events this summer. The excitement began in early June with a fungus foray, in which citizen scientists worked with experts to identify and collect the parks' mushroom species during the inaugural Waterton-Glacier Mushroom BioBlitz. The fun continued with the Waterton-Glacier Butterfly BioBlitz, held in early July. Excited butterfly enthusiasts joined Lepidoptera specialists to identify the parks' colorful assortment of butterflies.

At Glacier, the Crown of the Continent Research Learning Center's (CCRLC) Citizen Science Program coordinated both events. The program has engaged the public in citizen science since 2005, and currently manages the Common Loon and High Country Citizen Science projects. Through these projects, thousands of citizen scientists have been trained and introduced to data collection, providing a cadre of folks interested in identifying mushrooms and butterflies during this summer's BioBlitzes. Even so, participants ranged from well-seasoned citizen scientists to young novices interested in discovering the unique, delicate, and perplexing species found throughout the fungus and butterfly worlds.

Expert mycologists from both the United States and Canada worked alongside sixty public participants at the Mushroom BioBlitz, searching high and low for the diverse array of fungus species found in the park. From the tiny bird's nest fungus to the red belt conk, citizen scientists collected a variety of specimens throughout Glacier. In fact, experts verified that 140 species were collected in all!

Among the most interesting to mushroom experts was Phaeomarasmius erinaceus, a small mushroom found on wood. It is relatively rare, and this may be Montana's first record of it. The bird's nest fungus took home the "cutest" award. According to University of Montana mycologist Cathy Cripps, this fungus looks like a tiny bird's nest with eggs inside (the eggs are actually filled with spores). When a raindrop hits the "nest," the "eggs" splash out and spores are dispersed. Although these fungi represent some of the highlights, participants found many fascinating specimens—at least 28 new species were added to Glacier's mushroom list.

Not to be outdone, volunteers at the Butterfly BioBlitz ran, jumped, and leaped to catch and identify as many butterfly species as they could find. Once again, experts from both sides of the border joined with citizen scientists to identify the wide-variety of collected species. Captured butterflies ranged from large, colorful swallowtails, like the western tiger swallowtail, to checkered-winged fritillaries, such as the arctic ridge fritillary. Participants even collected two butterflies new to park records: the variegated fritillary (Euptoieta claudia) and the western checkerspot (Euphydryas chalcedona). Perhaps of greatest interest though, is the identi-

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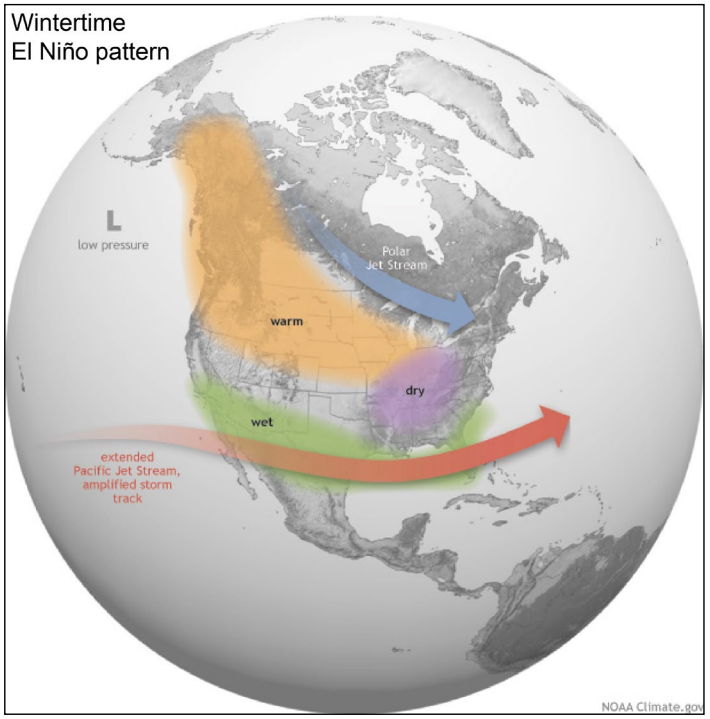
"Avalanches" continued from pg. 1

space. Peitzsch and his collaborators are asking a fundamental question about these habitats and the avalanches that create them: *will a changing climate affect avalanche behavior, and if so, how?* His first step in answering these questions is to establish a timeline, or chronology, of past avalanche activity, providing a baseline from which to monitor future changes. This is where the chainsaw comes in.

While avalanches can easily snap mature trees, many trees survive a slide with only scarring on their trunks. These scars are recorded in the tree's rings in the same way a drought year results in a narrow growth ring, or a fire leaves a charred area. "Reaction wood" is another pattern that can form within a tree's rings in response to an avalanche. If a slide bends a tree downhill, it will grow asymmetrically to right itself, leaving a lopsided pattern in its otherwise-circular rings. An approved research permit allows Peitzsch to use a chainsaw to take slices, known as "cookies", of dead and downed trees found in avalanche paths throughout Glacier and the surrounding area. He uses these cookies to date the trees and the years the scarring took place, allowing him to construct a record of major avalanche cycles over the past 100–200 years.



This image shows a simplified version of a wintertime El Niño pattern as it moves across the North American continent. (NOAA)

Peitzsch uses this record to tease out correlations between avalanche years and long-term climate patterns, called teleconnections. One well-known example is the El Niño/La Niña cycle (the El Niño/Southern Oscillation, or ENSO); others include the Pacific Decadal Oscillation (PDO) and the Arctic Oscillation (AO). These teleconnections have an effect—albeit not a simple one—on the variables of a winter here in northwest Montana, including temperature, precipitation, and storminess.

Many of Glacier's large-magnitude avalanche cycles are brought on by a specific weather pattern. First, an extended cold snap with clear nights causes feathery snow crystals, known as surface hoar, to form on the snow's surface. Once buried, these crystals serve as a lurking weak layer, with the potential to cause future avalanches. Next, a storm system arriving from the Pacific Ocean drops feet of snow on top of this existing weak layer, triggering major avalanches. Scientists are still studying exactly how climate change will affect these broader climate patterns (teleconnections), but any variations are likely to affect local weather patterns and thus avalanche behavior. For example, a shifting Arctic Oscillation that results in fewer cold snaps would mean a lower chance of surface-hoar formation (and associated weak layers), perhaps decreasing the number of slides we see. Conversely, changes in the PDO might make the Pacific storms stronger or more numerous, increasing the potential for major avalanches. These connections are incredibly complicated, and their effects on snowpack are not straightforward. As Peitzsch explains, "That's where it gets complex. . .the interaction of fewer cold spells and warmer storms. Will we see more avalanches or will we actually see less avalanche activity? That's what we're trying to figure out now." The multifaceted nature of these questions underscores the

Many trees survive an avalanche with only scarring on their trunks. These scars are recorded in the tree's rings just as a fire leaves a charred area. *NPS photo by Peri Sasnett*

USGS researchers Adam Clark and Erich Peitzsch collect tree slices from dead and downed trees found in avalanche paths throughout Glacier. The slices, or "cookies," allow Peitzsch to construct a record of major avalanche cycles over the past 100–200 years. *NPS photo by Peri Sasnett*

importance of Peitzsch's work to understand them.

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The chainsaw whirs through the last tree of the day, and I breathe a sigh of relief. After helping lug forty samples out of the woods—some over three feet in diameter and weighing up to twenty pounds—I'm ready for a reprieve. Peitzsch needs this large sample size to get a clear picture of the past, because a single tree may not record each major avalanche that occurred in a given path. With the addition of samples from a dozen other local slide paths, his dataset now totals over 600 cross-sections and cores. Identifying and dating the avalanche scars within each one will be painstaking work, but it will illuminate the avalanche history of northwest Montana.

As we clamber up the last few feet to the road, and I pull the remaining alder twigs from my hair, I realize I'd never previously thought about avalanches in relation to climate change. Here in Glacier, we often highlight melting glaciers and wildlife impacts—the plight of the pika comes to mind. But I hadn't recognized that something as seemingly unrelated to climate as avalanches could be affected as well. Nor did I know how important they are as wildlife habitat. The open canopy of an avalanche path provides abundant light and water—supporting huckleberries, cow parsnip, and glacier lilies, which are key food sources for grizzly and black bears. In the upper reaches of these meadows, bighorn sheep graze on young plants, while the open landscape allows them to watch for predators. In some cases, these treeless areas can also act as a firebreak, interrupting otherwise continuous acres of forest.

Given the diverse functions these habitats serve, it's critical that we piece together how they may change going forward. This research is just one part of a holistic understanding of how climate change will impact Glacier National Park, beyond simply warmer temperatures or receding glaciers. Peitzsch, and his 600 cookies and cores, will provide a glimpse into the past, helping us understand the present and giving insight into what the future may look like.

To get a closer look at this research and forecasting avalanches on the Going-to-the-Sun Road, see our new ***storymap****.*

Cover photo: An avalanche rips down the mountainside near the Haystack area on the Going-to-the-Sun Road. *NPS photo*

Fire-Fueled Finds

By Stephanie Metzler

Driving Going-to-the-Sun Road (GTSR) has become a must-do summer activity for those touring Glacier National Park, and—though it is freshly repaved and the vehicles are far more comfortable—that driving experience is much the same now as it was for early motorists. Squeezing past oncoming traffic, hugging the wall on turns, and gazing awestruck from the incredible perspective of Logan Pass are things all GTSR travelers have done since its completion in 1933. But the scenery itself is not unchanging.

The Reynolds Creek Fire started on July 21, 2015. It grew and consumed the forest on both sides of the Going-to-the-Sun Road, leaving behind a new landscape and new archeological finds.
NPS photo by Tim Rains

On July 21, 2015, a fire was spotted in the St. Mary Valley. It grew and spread and became the Reynolds Creek Fire, which burned for several weeks on both sides of Going-to-the-Sun Road. Now the views of the park are spectacular in a different light. Winding through the eastern half of GTSR, drivers pass through charred snags surrounded by low, often sparse vegetation. Never-before-seen glimpses of St. Mary Lake appear. It's a whole new perspective. And just as those forests once hid these views, they hid other, more personal finds.

Fire is one of the most useful natural disturbances for uncovering historic sites and artifacts, especially in a highly vegetated area like Glacier. The Reynolds Fire did not disappoint. Once burned, the forest allowed researchers to see many hidden sites. And yet, if you were to stumble upon one of these locations, it would look more like an old trash pile than a place for archeological study. Brent Rowley and Kyle Langley do not agree. As the saying goes, "one man's trash is another man's treasure." Rowley and Langley are seasonal archeologists at Glacier National Park. Following the Reynolds Creek Fire, they explored the newly burned swath. The Baring Creek Cabin, a historic backcountry patrol cabin still used by park staff, was known to have been in the fire's wake. But previously unknown were a historic trapper cabin and construction camp sites used by road crews during the building of GTSR. These recently discovered locations provide a new glimpse into Glacier's colorful past.

Piles of debris lie scattered around these sites (broken plates, rusty metal, glass). Time has taken its toll, but also given these discarded objects new value. Langley holds a small glass container that looks to be a medicine bottle. "So this logo here is only from 1915 to 1929... the Illinois Glass Company." Rowley responds with an "oh, wow" and they discuss how this time frame matches the road construction period. These little pieces of trash are no longer trash at all, but clues to lives lived decades ago.

At the remains of the Baring Creek Cabin, Rowley picks up an oddly shaped object that looks like crystallized rock. "So this is what happens in a really hot fire. This is what the windows to the Baring Creek Cabin now look like... It depends on what type of glass it is as to what temperature it melts. This was burned at... maybe even as high as 1800 degrees." The fact fuel was cached in the cabin

This crystalized-looking rock is actually the remains of the Baring Creek Cabin windows.
NPS photo by Melissa Sladek

may have something to do with that extraordinarily high number. Fire destroys most things—80-year-old wood walls were no match for the blaze—but it leaves non-combustibles like stone, metal, and some glass. Another little object found near the

cabin is a glass vial that may have been left by a long-ago visitor. During Glacier's early days when visitors toured the park on horseback, horse wrangler/tour guides issued the day's coffee ration in these little tubes.

Shape, size, materials—every piece of information about a site or artifact is important. And nothing is more important than context. Where was this found? Around this cabin structure children's toys were discovered, telling us families probably lived here. Conversely, the lack of toys or household items at the construction camps points to the fact it was probably only men living there in makeshift barracks.

Trash from a historic trapper cabin was exposed after the Reynolds Fire burned the surrounding vegetation. *NPS photo by Melissa Sladek*

Think about your home. You probably have tools or toys or other things scattered around your house. How about your trashcan? Scraps there would tell interested investigators a great deal about your diet and habits. If viewed 100 years from now, your trash would tell tales of your daily life. Archeologists are essentially investigators of life. They strive to find all the evidence they can to create as complete a picture as possible. Within the burnt remains of the Reynolds Fire, before new vegetation grows in the nutrient-rich soil and obscures these sites, archeologists get to study and piece together lives from a not too distant Glacier past.

There are no plans to remove the artifacts found in the burn area. They help tell the story of this place. If you happen upon one of these sites, remember the objects aren't litter that needs to be cleaned up. Nor are they souvenirs to put in your pocket. They are protected park resources, just like the rocks, bears, or buildings. Each artifact, and its location on the ground, provide information about the people that used this space. If you choose to handle them, please replace them as closely as possible to the way you found them. These resources show human connection to the land. A story that is still unfolding today.

Some archeological sites may be unknown to park archeologists. If you do discover any artifacts, note the location and notify park staff.

"BioBlitz" continued from pg. 3

fication of the Gillette's checkerspot, a Montana Species of Concern.

Participants at the Butterfly BioBlitz ranged from a small, but exuberant little girl of 3½ to a butterfly veteran nearing 70. Overall, over 80 citizen scientists, staff, and experts helped to collect and identify 46 different butterfly species in various locations throughout the park! A variety of innovative techniques were employed in capturing the winged beauties—from leaping, to stalking, to near dance, our participants showed their true creativity. Although our volunteers differed on capture techniques, one thing remained consistent among them all. . .smiles, plenty of smiles. Indeed—smiles, curiosity, and excitement were overarching themes at both BioBlitzes, providing a great start to a summer filled with hands-on science and discovery.

This event was made possible by the support of Waterton Lakes National Park, the Glacier National Park Conservancy, Montana Geographic Alliance, Western Montana Mycological Association, Alberta Mycological Society, and our many volunteer experts. To find out more, contact Tara Carolin at tara_carolin@nps.gov.

Want a closer look at this event? View this article online along with our new ***Waterton-Glacier BioBlitz video****.*

Staff Spotlight

By Erik Nelson

A typical field day conducting citizen science in Glacier National Park starts early. As the sun begins to rise above the horizon, my supervisor and I find ourselves in a little-visited corner of the park where we've come to check on a group of reclusive animals. The long grass in the meadow we tramp through is wet with dew and the mosquitoes are particularly fierce and thick. In the trees, the dawn chorus of birds permeates the air; they are no doubt more excited about the mosquitoes than I am.

As we make our way deeper into the woods, we see signs of bear, wolf, and moose all around us. There's a good chance no one has visited this part of the park since the last survey was conducted here a month before. We clamber over deadfall as silently as possible, trying to avoid making any loud noises. Our quarry is highly sensitive to disturbance. We are conducting a survey for common loons—a bird, which ironically, has become uncommon throughout its range.

We reach the edge of a small lake speckled with water lilies and surrounded by dark hills. We pause and listen. From the center of the lake comes a sound without equal, it wavers and echoes amongst the low hills. A loon is calling. Standing hidden in the trees, a motion on the lake soon catches our eye. There they are… loons…gliding on the black water.

There are five adults and two chicks on the lake today, and it takes us the better part of an hour to figure out who belongs to whom. Three of the adult birds are actually interlopers, who use every known display and call to assert their claim to the lake. My supervisor furiously scribbles down the behaviors we are seeing while I stand watching in awe, thrilled to see these magnificent birds and hear their eerie wailing. These loons are vocalizing and posturing, not for us, but for each other—rearing back, diving, and treading water are all ways to signal their displeasure to competitors.

Nelson stops to take a selfie while leading a citizen science student group. *NPS Photo by Erik Nelson*

The birds at this particular lake are extremely sensitive to disturbance, which is why we have chosen to survey them without volunteer citizen scientists today. But typically, our goal at the Crown of the Continent Research Learning Center is to train volunteers to conduct loon surveys on their own. Citizen scientists receive the skills they need through an all-day training session and are provided access to our field equipment (spotting scopes, GPS, maps, and radios). They select from lakes that need to be surveyed and schedule site visits with us, so we can assure that all priority lakes are visited. Our goal is to monitor nesting attempts and record how many loon chicks survive each year. This year, four chicks fledged within the park, a number consistent with the annual average of 4–6 chicks.

Prior to this summer, I've had extensive experience in environmental education and spent a significant amount of time working as a biologist, but in some ways, citizen science feels unique. Citizen science provides opportunities for people to make connections with the ecosystem while giving back to the park. Citizen scientists also become ambassadors for the species they study, sharing their passion with others.

Conservation has always been a prime motivator in my life. Being at the synergistic midpoint between science and education is something I'm quite used to, but helping facilitate that interplay, via citizen science, feels like an extraordinary privilege. Helping loons is important, but providing the public with the opportunity to connect, learn, and assist in needed data collection is incalculably beneficial. I feel humbled to have played even a small role in making that happen.

"Director's" continued from pg. 2

Melissa Sladek, has been working hard with help from Stephanie Metzlar to update our website and ensure that our communication products meet section 508 compliance for accessibility. Science Communication Technician Peri Sasnett created our first storymap, which highlights avalanche research (see cover article). I also appreciate Brian Dao for coordinating our brown bag presentation series, taking care of our researcher residence, and countless other tasks to keep our operation running smoothly. In September, we bid farewell to Alanna Wulf, who as Glacier's first Sustainability Educator laid the groundwork for improving sustainable operations via community partnerships. We welcome our new Sustainability Educator Laice Dedrick, who will follow up on this effort in 2018. Yes, we will remember 2017 as an extremely busy, but also highly productive year at the CCRLC, thanks to the work of all of our dedicated staff and volunteers.