Crown of the Continent
Research Learning Center

National Park Service
U.S. Department of the Interior

Glacier National Park

Science in the Crown

Fall/Winter 2014 • Journal for the Crown of the Continent Research Learning Center • Vol. 10

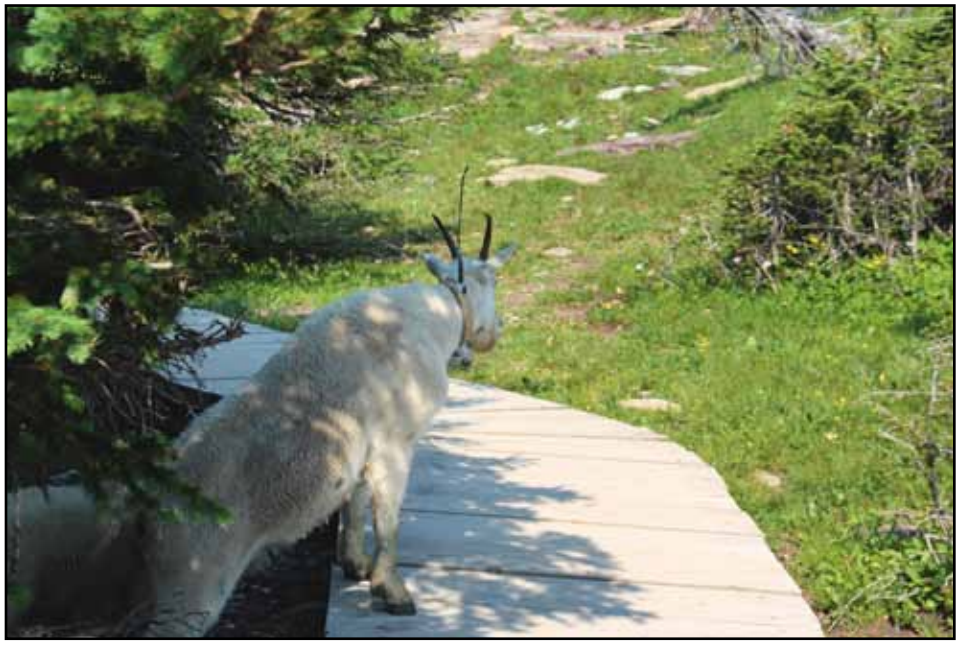
Unsure Footing: Glacier's Habituated Mountain Goats

By Colin May

Snow mutes the mountain goat's hooves as she moves through the small trees along the trail. Distracted by the view at Hidden Lake Overlook, I don't notice her until she's standing right in front of me. Her off-white wool still has patches of winter coat. Her sharp black horns curve off the top of her head. After observing me for a few moments, the goat turns and continues on her way.

I had been warned that the goats at Logan Pass possess little fear of humans and that close encounters are likely, but it still surprises me to find myself so near a wild animal. Until now, my experience viewing goats consisted of a pair of binoculars and small, white figures dotting the steep cliffs above Avalanche Lake. Here at Logan Pass, you don't need binoculars.

Even compared to sweeping views of backbone ridges and monument peaks, a close interaction with a wild animal can be a visitor's most powerful experience at Glacier National Park. Wesley Sarmento, a mountain goat researcher from the University of Montana and my guide at Logan Pass, echoes these sentiments.



NPS Photo

A collared female goat using a break in the "traffic" to cross the boardwalk on the Hidden Lake Trail at Logan Pass.

"There are probably 50 people here," Sarmento points out. "All crowded around watching one goat. I suspect it's the highlight of a lot of people's trips, getting to see these animals close up."

But close access to mountain goats raises some issues. Visitor safety is a high priority, and many get far closer

Continued on pg. 4

SCIENCE IN THE CROWN

EDITOR
Melissa Sladek

DIRECTOR
Tara Carolin

CONTRIBUTORS
Jami Belt
Tara Carolin
Colin May
Terry Peterson
Melissa Sladek

COMMENTS? CONTACT
Melissa Sladek
Crown of the Continent
Research Learning Center
P.O. Box 128
West Glacier, MT 59936
406-888-7894

"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.crownscience.org

Director's Corner

By Tara Carolin

The Crown of the Continent Research Learning Center is one of 19 National Park Service (NPS) sponsored research learning centers (RLCs) distributed across the United States. Born out of the NPS 2001 Natural Resource Challenge, a broad initiative to revitalize and expand NPS natural resource programs, RLCs are intended to fulfill a vision of using "parks for science and science for parks."

It is the mission of RLCs to increase the effectiveness and communication of research in national parks by facilitating the use of parks for scientific inquiry, supporting science-informed decision making, communicating the relevance of and providing access to knowledge gained through scientific research, integrating current scientific research into educational and outreach programs, and promoting science literacy and resource stewardship. In essence, national parks are excellent natural resource laboratories, often serving as a less manipulated control group compared to lands managed for multiple uses. As such, RLCs encourage research in our parks. At the same time, we strive to enhance the value of research by bringing it to a variety of audiences, ranging from interested students and visitors to land management decision-makers.

As the National Park Service approaches its second century of service in 2016, RLCs aim to advance the National Park Service vision by connecting people to their parks in new and relevant ways and by using the best available science and scholarship to manage park resources in the face of complex challenges and an uncertain future. RLCs across the country are engaging visitors and youth in citizen science opportunities, participating in bio-blitzes to inventory understudied taxa, providing workshop training opportunities for educators on topics such as climate change, promoting opportunities to involve students in science, technology, engineering and mathematics (STEM) with hands-on experiences, and expanding and improving our science communication outreach.

In this newsletter, you will find several examples of how the CCRLC is supporting this mission, from supporting research on mountain goats to exploring the results of a recent harlequin duck study to inspiring a passion for wilderness and conservation in youth while they collect and analyze data. Additionally, we produced our first science movie, "Lords & Ladies: the Harlequin Ducks of Glacier National Park," created a new climate change brochure, and have added multimedia features to this newsletter. We hope you enjoy it.

Research by the numbers: 2014

- Student researchers: 27
- Reports published: 38
- Permits issued: 50
- Residence user nights: 444
- Presentation attendees: 803

Citizen Science Snapshot: 2014

- Students involved: 191
- Participants trained: 278
- Surveys completed: 536
- Volunteer hours: 8,000+

Harlequin Duck Research Summary

By Terry Peterson

In our 2012 newsletter, we shared information about an ongoing harlequin duck research project taking place in Glacier National Park. This year, we're able to tell you the findings from this investigation, ending a three-year thesis project conducted by University of Montana master's student Warren Hansen and park staff. The study focused on whether human presence, stress physiology, and stream flow variation affected the nesting success and stream use of harlequin ducks.

Harlequin ducks are amazing migratory birds that winter in the rough waters off the Pacific Coast and migrate eastward in the spring, nesting near the female's natal stream. The birds mate for life and can live up to 21 years. Glacier has the highest density of breeding harlequin ducks in Montana and in the lower 48 states. Most of the birds breed within the McDonald Creek drainage.

Climate change is altering the earth's environmental patterns. These changing patterns could cause a mistiming of arrival for many migrating birds, including harlequins. An earlier or later arrival can lead to decreased nesting success and, ultimately, to population declines. In addition, climate change increases unpredictable high-water events, which are often the cause of flooded nests.

Hansen used 24 years of data from Upper McDonald Creek to assess how brood sizes relate to stream flow. His analysis found that higher and less-predictable stream flows are good predictors of reduced numbers of chicks. He states, "Based on the results of this study, and climate change forecasts and its effects on stream flow, harlequin ducks are going to face major challenges in the next 50–75 years." To meet these challenges, he adds, ". . . we need to ensure that the ecosystems used during each life history stage are fully intact and functional."

Another component of the research included looking at human presence on Upper McDonald Creek (in heavily used sections along the Going-to-the-Sun Road) in relation to areas used by harlequins. Researchers wanted to determine if heavy human use in these locations affected the birds' use of stream habitat.

Hansen found there was actually a greater probability of duck pairs occupying stream pools near the road versus other stream habitat. At times, the areas near the pools do have high human use, but the fact that the birds were found

Above: A male and female harlequin pair stop for a brief rest. Photo by Warren Hansen.

Continued on pg. 7

"Goats" continued from pg. 1

to goats than the park's rule of 25 yards. Sarmento interrupts our interview several times to remind people to stay on the trail, and that goats, though cute, can be dangerous.

We're learning that human proximity causes problems for the goats, too; these goats at Logan Pass aren't totally wild anymore. To investigate this issue, Sarmento is in the second year of a three-year study into how the mountain goats' relationship to humans alters their behavior, a process known as habituation.

NPS Photo

Mountain goats traverse a snowfield at Logan Pass. The goats are easily spotted all along the Logan Pass area. Visitors must stay at least 25 yards away from them.

Figuring this out means asking the right questions. How and when are goats using areas with heavy visitor use? How and why might goats be aggressive to humans? To what extent are goats demonstrating "unnatural" behavior because of human influence? And how can we deter problem goats from problem behaviors?

Sarmento is the passionate workhorse of a project with many players and moving parts, including two full-time technicians who help gather data. The project is overseen by Glacier's Natural Resources Program Manager, Mark Biel, and University of Montana Professor Joel Berger. Understanding these human–wildlife interactions is a fundamental objective of the park's Going-to-the-Sun Road Corridor Management Plan. The plan outlines a comprehensive assessment of the human impact and use of the park's most highly trafficked artery, the Going-to-the-Sun Road, and its surrounding areas.

Another goat steps onto the boardwalk at Hidden Lake Overlook. This one stands out—it's wearing a collar of leather and plastic, with a conspicuous antenna. Having this piece of humanity attached to it may make the goat seem even less wild, but the collar is a crucial tool.

Biel, who heads up the complex operation of safely capturing and collaring the goats, hoped to equip a total of 25 goats with tracking devices. He and his crew came close to reaching that goal; 24 goats now have radio or GPS collars. The effort is worth it. Collars allow researchers to track the goats' locations and maintain continuous data on individual goats. The GPS collars take the goats' locations every two hours, generating thousands of data points for the study. In studying how the goats make use of Logan Pass, Sarmento has formulated two hypotheses.

"The habituated goats time their movement into the overlook pretty well with people," he explains. "It's either because they know the people are going to be giving them salt, and that's when they show up. Or they know that people are scaring away predators and it's safe to come in."

Salt is an important resource for mountain goats, and they are desperate to get it. Because goats don't get salt from the vegetation they eat, their natural behavior is to venture to mineral deposits, or licks. To do this, they often leave the safety of the cliffs they cling to. These cliffs serve as their escape route from predators like bears, wolves, and mountain lions. Getting salt from a natural lick can be risky. At Logan Pass, a different salt source exists—human urine.

"Wild goats go in, get the salt, and get out of there" Sarmento explains. "They don't want to spend an extra minute in those dangerous locations. The habituated goats come here, lick salt, sleep, feed, lick more salt … they'll hang out all day. It seems they feel safer."

Indeed, the goats at Logan Pass seem relaxed despite their distance from cliffs. They mosey around people at the Hidden Lake Overlook, stopping at trees to lick what was probably a visitor's makeshift restroom. It's a complex situation. Are they here because we provide salt, or safety, or both?

"With enough data," Sarmento says, "we should be able to know for sure."

As we start back down the trail, more visitors flood past us toward the goats, in awe of the iconic species. My awe, however, is muddied with uncertainty.

**

A few weeks before our trip to Logan Pass, Sarmento takes me into the backcountry to see a natural mineral lick. The goats that frequent this lick don't see many humans, and so Sarmento refers to them as "wild" goats. He concedes that the goats at Logan pass are also wild, but because of habituation, they're further from their natural lifestyle.

To get to the lick, we hike a few miles up a trail, then bushwhack toward the base of a mountain. When we arrive at a meadow a quarter mile from the lick, Sarmento pulls out his binoculars. He points to white dots on the mountainside—three groups of goats next to a wet patch leaking from beneath the cliffs.

In order to understand habituated goats, Sarmento needs to know how their behavior differs from goats with less exposure to humans. Perhaps the biggest differences are the ways they protect themselves. The "wild" goats visit licks in a group. They don't bed down far from a cliff. They're skittish around humans. At this point, Sarmento goes into researcher mode. He gets out his clipboard, GPS, rangefinder, and stopwatch. We'll be in this meadow for an hour while he performs a behavioral scan. Every three minutes, Sarmento marks what each goat is doing—is it bedded, feeding, licking, moving, or vigilant? He records other variables: distance to escape, grouping, and habitat type.

Data collection seems monotonous, but it's the lifeblood of a project like this. Sarmento has plenty of patience for it, and goes into the field almost every day to get more samples. He'll spend all winter crunching the data.

After we finish the scan, Sarmento asks me to keep as quiet as possible as we continue our approach.

"The plan is to get in on these goats without scaring them," Sarmento whispers. "We're trying to control for a lot of things, and a human influence is one of them. These are wild goats here. They'll run from people at 500 yards."

As I creep through the trees to our next scan site, with a dozen mountain goats perched nearby, I can't help but feel privileged to be in the presence of truly wild animals.

**

The sun beats down and a group of mountain goats move into the shade of a crooked mountain peak at Logan Pass. A beautiful scene for sure, but there's something wrong. I hear a young girl ask her mom if she can pet a goat. I watch a grown man try to feed a goat a flower. This isn't the wild place it's supposed to be. It's not supposed to feel like a zoo. As we hike back down the trail, weaving in and out of incoming visitor traffic, we encounter another mountain goat licking at the ground in a small copse of trees. Among the huddled spectators, a young girl frowns in disgust when Sarmento explains that the goat is likely licking up human urine. I know how she feels.

It's like we've diminished the mountain goat, in some way, to mere spectacle. In having their behavior so altered, they've lost some of their majesty. And it's undeniable that we did this to the goats, though of course we didn't mean to.

The question looms: how do we fix it? How do we find the balance between allowing visitors to enjoy these beautiful creatures and preserving the health and safety of both humans and animals?

"We have to understand habituation fully," Sarmento says. "A lot of folks think it's just salt. But what if we take away the salt and the goats are still here? And something else is going on? To make good management actions, you have to understand the problem."

Despite their iconic status, mountain goats are relatively unstudied, so it will be a long road to complete understanding. Sarmento urges patience. We shouldn't jump to conclusions, even if a hypothesis makes sense. "Let's make sure that what makes sense is actually what's going on," he says. "Ecology has a funny way of proving us wrong."

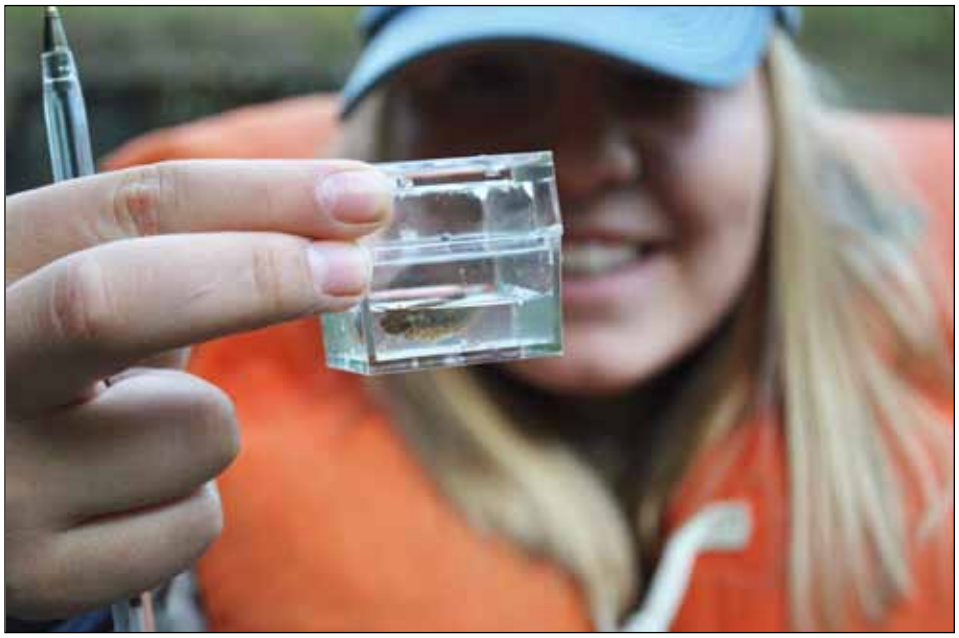
I continue down the trail, leaving the goats to themselves, and hope that others will follow. As our vision of the problem becomes clearer, we should feel inspired to act toward an enduring mission—to respect the wildness of wild animals.

This article, along with audio podcasts and an interactive map of the study area, is also found on our website's "featured article" page.

In Search of the "Canary in the Coal Mine"

By Jami Belt

Fascinating creatures lurk beneath the surface of Glacier National Park's waters, rivaling the grizzly bears and bighorn sheep found in the mountains above. On a crisp September day, high school students, armed with dip nets, wade into these waters to rouse these creatures out of their predatory haunts. We are in search of dragonfly larvae, a voracious predator that also serves as a "canary in a coal mine," alerting us to threats affecting its aquatic home.



NPS Photo

A Flathead High School student examines a dragonfly larva. Dragonfly larvae are great indicators of mercury pollution because they are at the top of the aquatic-insect food chain, giving them ample time to bio–accumulate, or store, mercury.

Distinguishable by their bulging eyes and toothy lower lips, dragonfly larvae are quickly identified by the students and carefully plucked from nets using gloved fingers. The gloves prevent possible contamination of our precious samples from little bits of human skin or hair and the trace amounts of chemicals they harbor.

The study, a collaborative effort between the National Park Service, United States Geological Survey (USGS), and several universities, engages citizen scientists to collect dragonfly larvae in over 40 national parks. The samples will be sent to labs at the University of Maine, USGS, and Dartmouth College to help shed light on how much mercury these dragonfly bodies contain, and how much risk that poses for food webs throughout our national parks.

Dragonfly larvae spend their first several years at the top of the aquatic-insect food chain, giving them ample time to bio–accumulate mercury, which has found its way into smaller insects that dragonfly larvae prey upon. Mercury, a toxic pollutant that floats on global air currents, is sourced largely from coal-burning power plants and fossil-fuel emissions, and can be found in relatively high concentrations in dragonfly larvae. Fish eat lots of these larvae, meaning mercury concentrations don't just end with dragonflies. Instead, they magnify in intensity the higher up the food chain you look.

Prior to the field trip, students from Flathead High School's International Baccalaureate program explored the complex, global topic of mercury deposition. As part of Glacier's Youth Exploring Science (Y.E.S.!) citizen science initiative, the students will take the knowledge they have gained during the classroom sessions and the data collected on their field trip, and develop their own hypothesis. This hypothesis can then be tested using both the data they collected and the data gathered at other parks.

Engaging Flathead High School students in this program is a natural fit since the project idea was born out of research conducted by high school students in Maine. Students exploring mercury biogeochemistry with the Acadia Learning Project noticed that all orders of insects found below a wetland complex had higher mercury than those found higher up the watershed. The students wanted to explore their findings more, so they selected the insect order that was found in all of the water bodies they sampled—dragonflies—and began targeting them specifically for further testing.

Typically, fish are tested to gauge mercury risk to humans. This information is used to advise people on how much fish is safe to consume in tested water bodies. But fish are harder and more costly to catch than dragonfly larvae, and not all water bodies at risk for mercury have fish. The work the Maine students pioneered presented scientists with

potentially a more simple and cost-efficient way to test for mercury levels in food webs. Scientists ran with it, creating a protocol that is now being tested in national parks across the country.

Students from Flathead High School are furthering this legacy of student-generated research as they develop their own hypotheses about how Glacier's mercury levels will compare to those in more urban-based national parks.

Flathead students wondered whether air currents and precipitation captured by western Montana's mountain ranges make Glacier National Park a beacon for mercury deposition. The students are also investigating questions such as the effect of flow rate on contaminants at our distinct sampling sites. For instance, will dragonflies from Johns Lake, a stagnant, swampy area surrounded by cedar forest, accumulate more mercury than the clear, fast-flowing waters of Lower McDonald Creek? Several in the group were curious about how the other aquatic species we found, among them the fist-sized giant water bug and a mother leech with her hundreds of babies attached to her underside, would affect the diversity of dragonfly families. The hypotheses that show the most promise for further exploration will be used as a jumping point for students in next year's classes.

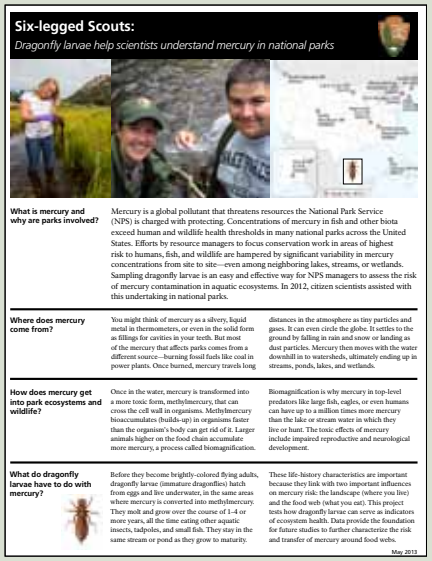
The students' new insights are a leap forward from their previous knowledge of mercury pollution. During the first classroom session, I asked the students to answer some basic questions about mercury contamination. Many of them thought mercury was an essential mineral in our diet that came from plants or fish, and not something to be concerned about. By the end of the field trip, the students understood the consequences of mercury pollution and rallied to identify and bag the best samples they could find to ensure they were making their finest contributions to the research. After all, few would argue that humans are at the top of the food chain and ripe for bioaccumulation.

Thanks to dragonflies and the students collecting them, our knowledge of mercury pollution will likely increase and help inform us of what we are eating. As they say, you are what you eat.

Six-Legged Scouts

Dragonfly larvae are currently being sampled for mercury levels in national parks across the country. Mercury is a toxic pollutant that can harm human and wildlife health, threatening the natural resources the National Park Service (NPS) is charged with protecting.

Citizen scientists collect the dragonfly larvae from distinct collection sites and ship them to laboratories for analyses. To see which national parks are involved in this citizen science effort and to learn more, visit the NPS's Air Resources website.



Six-legged Scouts:
Dragonfly larvae help scientists understand mercury in national parks

What is mercury and why are parks involved?

Mercury is a global pollutant that threatens resources the National Park Service (NPS) is charged with protecting. Concentrations of mercury in fish and other biota exceed human and wildlife health thresholds in many national parks across the United States. Efforts by resource managers to focus conservation work in areas of highest risk to humans, fish, and wildlife are hampered by significant variability in mercury concentrations from site to site—even among neighboring lakes, streams, or wetlands. Sampling dragonfly larvae is an easy and effective way for NPS managers to assess the risk of mercury contamination in aquatic ecosystems. In 2012, citizen scientists assisted with this undertaking in national parks.

Where does mercury come from?

You might think of mercury as a silvery, liquid metal in thermometers, or even in the solid form as fillings for cavities in your teeth. But most of the mercury that affects parks comes from a different source—burning fossil fuels like coal in power plants. Once burned, mercury travels long distances in the atmosphere as tiny particles and gases. It can even circle the globe. It settles to the ground by falling in rain and snow or landing as dust particles. Mercury then moves with the water downhill in to watersheds, ultimately ending up in streams, ponds, lakes, and wetlands.

How does mercury get into park ecosystems and wildlife?

Once in the water, mercury is transformed into a more toxic form, methylmercury, that can cross the cell wall in organisms. Methylmercury bioaccumulates (builds-up) in organisms faster than the organism's body can get rid of it. Larger animals higher on the food chain accumulate more mercury, a process called biomagnification.

Biomagnification is why mercury in top-level predators like large fish, eagles, or even humans can have up to a million times more mercury than the lake or stream water in which they live or hunt. The toxic effects of mercury include impaired reproductive and neurological development.

What do dragonfly larvae have to do with mercury?

Before they become brightly-colored flying adults, dragonfly larvae (immature dragonflies) hatch from eggs and live underwater, in the same areas where mercury is converted into methylmercury. They molt and grow over the course of 1–4 or more years, all the time eating other aquatic insects, tadpoles, and small fish. They stay in the same stream or pond as they grow to maturity.

These life-history characteristics are important because they link with two important influences on mercury risk: the landscape (where you live) and the food web (what you eat). This project tests how dragonfly larvae can serve as indicators of ecosystem health. Data provide the foundation for future studies to further characterize the risk and transfer of mercury around food webs.

May 2013

"Harlequins" continued from pg. 3

frequently at these pools may be because most of the desired deep-pool habitat is disproportionately closer to the road. In addition, the surveys took place in the spring, when the Going-to-the-Sun Road is typically still closed to vehicles. Further research or monitoring is needed, especially as the road receives more use, to document the ducks' behavioral response to close human activity.

Hansen also studied the stress physiology of female harlequins in order to understand how their winter grounds affected their ability to reproduce. By taking feather samples from the birds upon their arrival to the park, Hansen was able to examine stress hormones that were secreted during the growth of the feather. Hansen found that females who exhibited high stress hormone levels were less likely to nest, and concluded that events occurring during the non-breeding season do influence whether or not females harlequins will produce chicks.

For now, Glacier National Park's harlequin population is stable. But in the years to come, this vulnerable, charismatic species will need continued monitoring. With increased visitation and traffic along the Going-to-the-Sun Road and a warming climate, park managers want to make sure harlequin numbers remain stable and that these beautiful little sea ducks remain a part of Glacier's landscape.

Intern Spotlight

By Colin May

Shadowing a mountain goat researcher wasn't explicitly in the job description, but it turned out to be the highlight of my time here. As the science communication intern at the Crown of the Continent Research Learning Center, one of my tasks was to write the feature article for the fall newsletter. So I found myself at Logan Pass, zigzagging between visitors to get photos of mountain goats. Sometimes I'd be so distracted by the charismatic creatures that I'd lose track of the researcher. Hungry to learn as much as I could, I'd hurry to catch him so I could record everything he said on an audio recorder. When visitors asked us what we were up to, I'd say, "he's the scientist, I'm the science journalist."

If there's one thing I've learned in my three months here, it's the importance of good science communication. Scientists do valuable work, but they don't automatically reach a wide audience. As a writer, my goal is to make their work accessible and to get people to care about it. I spent hours talking with the goat researcher, learning the ins and outs of mountain goat ecology, the research methods, and most importantly, the *so what* of it all. In the grand scheme of things, I see my role as that of translator. I get to the guts of the issue and tell the scientist's story for anyone who is interested, whether they're part of the scientific community or not.

In addition to newsletter articles, I worked on developing resource briefs and web content for the Research Learning Center. Educating means more than just conveying information; our goal is to get people to care.

NPS Photo

Colin May, on the right, interviews Wesley Sarmento, a University of Montana graduate student, for "Unsure Footing." See page 1.

Getting to know Glacier myself was a crucial part of being able to tell its story. Luckily, this mission justified plenty of days getting out of the office and into the field. Not only did I explore the different regions of the park, I also practiced with cameras and audio equipment to capture the sights and sounds of the park. Surrounded by other visitors and volunteers, it quickly became apparent that Glacier is a park that is dear to many people, myself included.

As I begin my career as an environmental communicator, I've become more and more resolute in my mission to help make the work of scientists better known. An informed public is more likely to engage with and act for the well-being of the natural world. In our internet age, the huge variety of media consumed by viewers provides an opportunity for communicators to take advantage of different tools. In some cases, it's an informational resource brief that a teacher can adapt for the classroom. In the case of our newsletter feature, we produced both audio and video pieces to accompany the written story, creating an interactive, multimedia experience.

My time here has let me expand my professional skillset while contributing to the mission of the park system, which I've been personally enjoying for years. Scientist or not, we really are all part of the scientific community.

To see more of Colin's work, visit his online featured article at http://www.crownscience.org/article/unsurefooting.