



Science in the Crown

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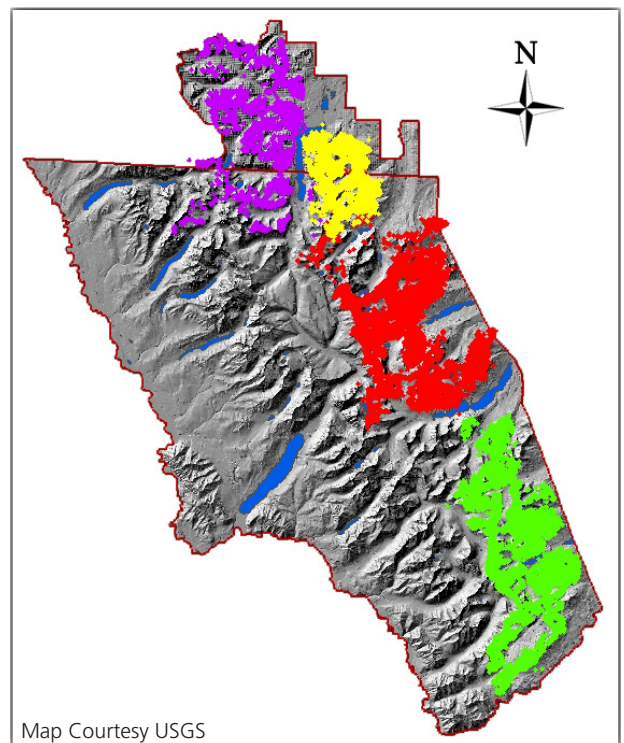
Rediscovering the Bighorn

USGS Scientists Discover Evidence of Waterton-Glacier International Peace Park's Geologic Past in the Movement of Bighorn Sheep

By Kim Keating, Ph.D.

Following ancestral pathways, bighorn sheep in Waterton-Glacier International Peace Park range between the wind-scoured slopes of winter and alpine greens of summer, seldom straying far from the rocks that provide refuge from predators. Their pathways are learned, with knowledge of favored bedding and feeding sites, and the trails that connect them, being passed from one generation to the next. It is knowledge acquired in the wake of glacial retreat and even the stones tell of the seasonal rhythm it prescribes. Stacked atop a limestone outcrop in the Many Glacier Valley, rows of argillite cairns form the ruins of a primitive drive system, used to hunt sheep as they crossed the valley between winter and summer ranges. Built some 4,000 years ago, these modest piles of green rock offer mute testimony to the long presence and enduring traditions of wild sheep, for even today the descendents of those animals follow this same path.

These stones remind us, too, that man once shared in the knowledge of sheep, clocking his own habits according to their timeless migrations. But that was long ago. To rediscover that knowledge, Waterton Lakes and Glacier National Parks, The Glacier National Park Fund, and the U.S. Geological Survey have joined in sponsoring a state-of-the-art study of bighorn sheep movements. Since 2002, scientists have used radio collars equipped with Global Positioning Systems to track nearly 100 individuals. Periodically recording each animal's location, these collars give researchers unprecedented insights into ancient migration patterns and the spatial structure of



Map Courtesy USGS

Bighorn sheep have established well-defined neighborhood groups, observable in their migration patterns, which appear to be based upon geologic and glacial movement barriers from Glacier National Park's past.

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USGS Photo

USGS researcher Jenny Shrum secures the head of a bighorn sheep ewe as others take blood samples and fit the animal with a radio collar.

“Sheep” continued from pg. 1

bighorn society, revealed in part by the boundaries that partition territory among individual clans.

Nowhere is this partitioning more evident than on Apikuni Mtn. Walk its ridgeline and only the soulless could be unmoved by what you see there: a towering phalanx of ice-sculpted peaks, what the Blackfeet call The Backbone of the World. But directly underfoot the ridge itself is relatively unremarkable. Lacking the sheer crags that dominate the distant view, few would recognize this rounded rubble-strewn crest as a near-impenetrable boundary, particularly for animals with the legendary agility of mountain sheep. Yet ewes from the Iceberg-Ptarmigan clan rarely cross south of its summit as they move between neighboring drainages, and those from the adjacent Sheep Curve band seldom cross northward. It is an invisible but not uncommon kind of border line, for research has shown that, throughout Waterton-Glacier, ewes are similarly

partitioned into at least ten unique bands, and scientists believe there may be fifteen or more.

Rams also are clustered in patchwork fashion, but with less distinct boundaries among the half dozen or more social groups whose home ranges each encompass multiple female bands. The result is a suite of neighborhoods, each a collage of male and female social groups that

regularly splinter and re-congregate within their own home ranges. Within each neighborhood, movements of ewes and rams intertwine, but truly coincide only during the November–December breeding season. More often, especially during summer, males and females cloister themselves on ranges as gender-specific as a high school locker room—albeit, one where streakers are seldom seen.

Bighorn neighborhoods are linked primarily by young exploratory males seeking home ranges (and breeding opportunities) outside their natal areas. Such connections can be tenuous; a

lingering effect of the vast ice that once inhibited cross-valley movements. Still, even at low levels, interchange between neighborhoods has important ecological consequences, as evidenced by distributions of disease-causing organisms and by genetic differences among the sheep themselves. For example, the tick-borne blood pathogen *Anaplasma ovis* is found in about one-half of the sheep north of Glacier Park’s St. Mary River, yet is apparently absent from animals to the south. And mountain sheep occupying the international boundary area northward into Waterton Lakes National Park harbor a strain of the bacterium *Pasteurella trehalosi* that is genetically distinct from strains recovered from animals to the south. Indeed, even the animals themselves show evidence of long separation between some neighborhoods, with bighorns in the Many Glacier and Two Medicine Valleys being as genetically distinct from one another as Asians are from Europeans.

Together, these findings tell a story of ecological complexity born of the interplay between unrelenting ice and a species’ faithfulness to place. They reveal much of what we see today as an ongoing response to the ghosts of glaciers past, an ecological echo in time whose ripples can be traced in the subtle arrangement of stone on stone, or an animal’s quiet avoidance of a nondescript ridge crest. They remind us to listen carefully; for in these echoes one can rediscover the ancient, once-familiar traditions of wild sheep in a land sculpted by ice.

Featured “Scientist in the Crown”

Each issue of “Science in the Crown” includes an article that highlights a different scientist or research project affiliate with the Crown of the Continent Ecosystem or Glacier National Park. These articles are intended to help make current park science more visible and accessible to park staff, managers and the general public.

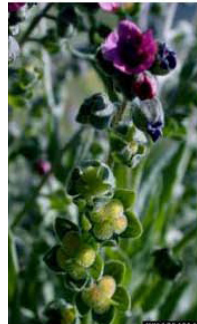
If you have a study you would like us to highlight, or know a scientist currently working in the park you think should be featured, please send an email to Paul_Ollig@nps.gov

Glacier National Park Citizen Science project: Mapping non-native invasive plants in the backcountry

By Dawn LaFleur and Susan Sindt

“Glacier National Park has weeds!” That’s a headline that some visitors to the area might be surprised to hear. In fact, Glacier National Park (GNP) initiated a weed management program in 1991. The program was based on NPS policy, which states that exotic species should be controlled if they displace native flora, interrupt ecological processes, or interfere with interpretation of the natural scene. The current vegetation management program targets weeds listed as “noxious” by Montana law. GNP recognizes that these species threaten biological diversity of native plant and animal communities, thereby altering ecosystem processes.

Monitoring is necessary to establish baseline data that would indicate the extent of encroachment of non-native invasive plants into native ecosystems. Evaluation of the compiled monitoring data helps to make effective management decisions. After implementing weed management practices, monitoring surveys provide data used to evaluate effectiveness of education, training, and management programs, and prevent reinvasion of weeds into treated areas. This Citizen Science program, initiated with funding from a grant from the Parks as Classrooms program, is designed to facilitate the goals of this weed monitoring effort. Volunteer observers supply information they obtain during



NPS Photos

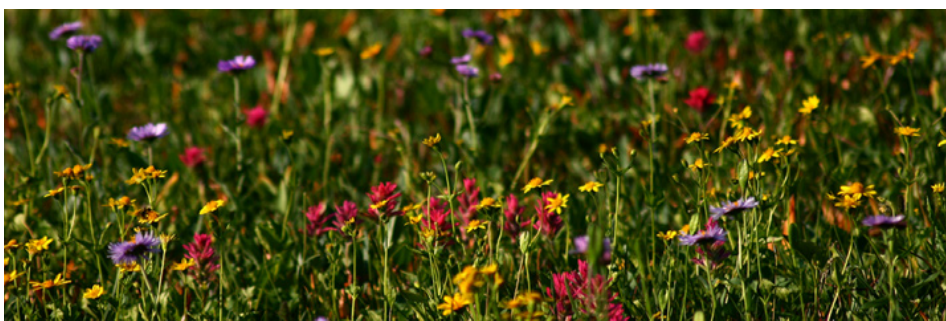
The invasive plant citizen science project focused on the identification and mapping of five problem species in the park: (clockwise from upper left) figwort, spotted knapweed, oxeye daisy, St. John’s wort, and houndstongue.

their own backcountry hiking activities in Glacier National Park.

Six training sessions, coordinated by Susan Sindt (Citizen Science Weed Mapping Project Coordinator), were offered in 2008 for 28 local volunteer citizen scientists. These trainings were led by Dawn LaFleur, Glacier National Park’s Integrated Pest Management Supervisory Biologist. The volunteer observers help by reporting sightings of the five targeted noxious weed species throughout the park.

Training sessions typically lasted 4-5 hours. The first part utilized a PowerPoint presentation to introduce and differentiate the 5 noxious weed species. A weed identification booklet (*Montana’s Noxious Weeds*, Montana State University Extension office) was provided for each volunteer observer to assist them with field identification.

These training sessions included background on the Crown of the Continent Research Learning Center, the NPS mission, safety, the park’s weed management program, and the organization of the Citizen Science program. Field instruction included training on how to ID plants in the field, how to fill out survey forms, and how to use GPS units to mark locations. This summer 81 survey forms were turned in, representing 56 different locations, from 78% of the trainees. Weeds watch out! The Citizen Science “weed mappers” are on your trail!



Native wildflowers thrive in the park’s alpine meadows.

Paul Ollig

Developing a Fisheries Database for Glacier National Park

By Richard Menicke

Crown of the Continent waters provide habitat for a rich fishery resource, due in large part to outstanding habitat quality. Bull trout, a federally-protected species, and genetically-pure westslope cutthroat trout (a species of special concern in Montana) are reliant on these pristine waters. Migration and habitat use patterns documented for these native species link large geographic areas within the larger Flathead watershed. Bull trout resident to Flathead Lake have been observed spawning near the headwaters of the Flathead River in British Columbia. Past research has documented the presence and relative abundance of other native and non-native fish species in Crown waters.

Information describing the fishery resource within Glacier National Park is spread across a variety of reports. No electronic repository exists locally to store information from decades of valuable research investigations. A fisheries database for Glacier that addresses this deficiency and provides a centralized and electronically-

accessible home for fish distribution data is currently in development.

The Glacier fisheries database will provide park managers summary information on fish distribution and other pertinent data by stream reach.

The fisheries database will ultimately allow for more effective management and conservation of the park's aquatic resources.

Glacier National Park has partnered with Montana Fish, Wildlife and Parks (FWP) to adopt the structure of the Montana Fisheries Information System (MFISH) database. MFISH is publicly-accessible via the internet and provides managers and recreational anglers a tremendous resource for identifying fish presence by stream name. MFISH has both a tabular and map interface to create an enjoyable browsing experience.



NPS Photo

Bull trout, a protected species, are reliant on the pristine fishery resources in Glacier National Park.

The U.S. Geological Survey and the Rocky Mountain Cooperative Ecosystem Unit (CESU) are additional partners in developing Glacier's fisheries database. A \$5000 grant from the CESU in 2008 will allow us to include in the database information from previous fish research projects. Results from extensive USGS fish survey work in the North Fork Flathead area scheduled for 2008 field season will add valuable fishery information to the database.

The interactive MFISH database can be explored at:

<http://fwp.mt.gov/fishing/mfish/>

An Update on the Crown of the Continent Invasive Plant Field Guide

Imagine how useful a user-friendly, ecosystem-specific field guide on invasive plants with potential for ecological impact in protected areas would be. The Crown of the Continent Research Learning Center and Glacier National Park's Invasive Plant Species Biologist are designing and developing just such a field guide in concert with members of the Crown Invasive Plant Network (CIPN), a committee of the Crown of the Continent Managers Partnership. The guide will serve as a tool for educating staff, volunteers, and the general public. It will also

provide the CIPN a foundation from which to build a common strategy for communication, education, and technical assistance.

The guide will contain detailed descriptions for 42 species and brief descriptions of 21 species, including the highest priority species occurring in the Crown of the Continent Ecosystem (CCE) and those with potential to invade the CCE. Graphic design and layout for the guide is underway and printing is targeted for the spring of 2009.



NPS Photo

Spotted Knapweed
(*Centaurea maculosa*)

New Curriculum Introduces Flathead Valley Students to Noxious Weeds

By Melissa Sladek



NPS Photo

Over 500 local 3rd, 4th and 5th grade students were introduced to noxious weeds of Glacier National Park during September field trips.

Amidst the cluttered desks, buzzing computers and stacks of research materials found at the Crown of the Continent Research Learning Center (CCRLC) rests eight large, brightly-colored hula hoops. Inquiring minds might wonder at these office oddities. And although never vocalized, visualizations of CCRLC staff dancing to the rhythm of spinning hula hoops may pop into their heads. Rest assured, although all of us at the CCRLC enjoy our work, the hula hoops were bought for another, much greater purpose. These and other educational supplies helped local third and fourth grade students conduct scientific experiments during the fall of 2008.

With the help of a Parks as Classroom grant, CCRLC was able to create and implement an education program on non-native invasive plants in Glacier National Park. The program consists of a pre-activity, a field trip, and suggestions for follow-up activities.

Pre- and post-activities are designed for classroom use whereas the field trip is structured to get children outdoors and practicing hands-on science.

Hence the hula hoops. In one component of the field trip, students conducted plant plot surveys using hula hoops to designate the sampling area. They surveyed two different plot sites, one in a heavily, human disturbed site and one in a relatively undisturbed site. Plant diversity and noxious weed density were recorded.

Prior to the plot surveys, each of the 20 participating classes were taught activities from the pre-activity lesson plan in the classroom. Highlights include a noxious weed plant invasion demonstration and a PowerPoint presentation. The field trip included other activities beyond the plot surveys such as plant investigation stations, games, and a hike, which allowed students to gain a greater understanding of this issue.

Over 500 students, teachers, and parent chaperones from five surrounding

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Big Changes for the Staff of the CCRLC

By Paul Ollig

After nearly six years working at the Crown of the Continent Research Learning Center, Dr. Sallie Hejl is stepping down as Director to pursue an exciting new job with the U.S. Fish and Wildlife Service in California. Before she left, I sat down with Sallie to capture a few thoughts from her tenure at the CCRLC:

Looking back on your tenure as both Resource Education Specialist and Director of the CCRLC, what accomplishment are you most proud of?

These are the two big things, I guess. The creation of the education

program, and that includes things like the resource bulletins, notebooks for interpreters, the fire ecology workshop and brown bag seminars. I helped create the Waterton-Glacier Science and History Day and the noxious weed curriculum. These things represent a new direction for the CCRLC, They try to help transfer the latest knowledge of resource issues to various groups of people. I also did the research needs catalog to help promote research in the park and helped create the citizen science projects, working with Jami Belt. I am really excited about these, because they educate people, and they let people contribute to the park.



NPS Photo

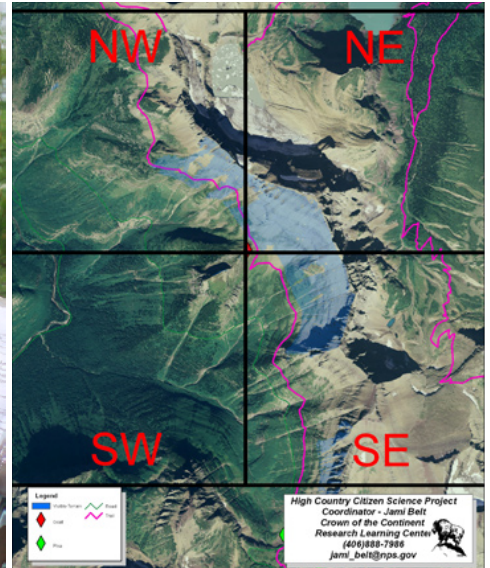
Sallie Hejl says goodbye to the CCRLC after nearly six years.

High Country Citizen Science Project 2008 Season a Success

By Jami Belt

Glacier National Park resource managers need baseline information about the status of mountain goats, pikas and Clark's Nutcrackers to detect future population changes. The High Country Citizen Science project, sponsored by the Glacier National Park Fund, engages trained volunteers to collect data on these high country species whose habitat may be adversely impacted by climate change.

Pikas have already been extirpated in portions of the Great Basin due to climate change impacts, and their numbers have declined in other portions of their range. Little is known about how mountain goats will adapt to warmer average temperatures and other habitat level changes. Concerns about the stability of Glacier's mountain goat population have arisen due to a decline in recent years in the number of mountain goats using a large mineral lick. Clark's Nutcrackers have lost a substantial amount of on their primary food sources, whitebark pine seeds, due to the combined impacts of white



NPS Images

Detailed maps were produced to help standardize data collection methods for citizen science volunteers conducting goat surveys.

pine blister rust and mountain pine beetle infestations; impacts which are exacerbated by climate change.

The primary objective of the High Country Citizen Science project is to develop protocols for long-term volunteer monitoring of mountain goats, pikas and Clark's Nutcrackers

to detect impacts of climate change. Secondary objectives include developing an abundance estimate and mapping park-wide distribution of mountain goats, documenting new locations of pikas for future monitoring, and documenting locations of Clark's Nutcracker sightings for future monitoring. The project is also expanding upon ongoing research by Lucas Moyer-Horner (University of Wisconsin Ph.D. candidate) on climate change response in Glacier's pika populations and contributing to upcoming 2009 research by Ph.D. candidate Theresa Lorenz on habitat-types occupied by Nutcrackers Glacier National Park.

During the 2008 season 86 High Country Citizen Science volunteers were recruited and trained to complete systematic 1- hour long mountain goat and/or pika surveys at 36 mountain goat and 20 pika survey sites, and to document opportunistic sightings of Clark's Nutcrackers. During 8 classroom and field-based training sessions, citizen scientists learned about

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Crown of the Continent Research Learning Center

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Research Learning Center Goals:

- Facilitate use of parks for scientific inquiry;
- Support science-informed decision-making;
- Communicate relevance and provide access to research knowledge; and,
- Promote resource stewardship through partnerships

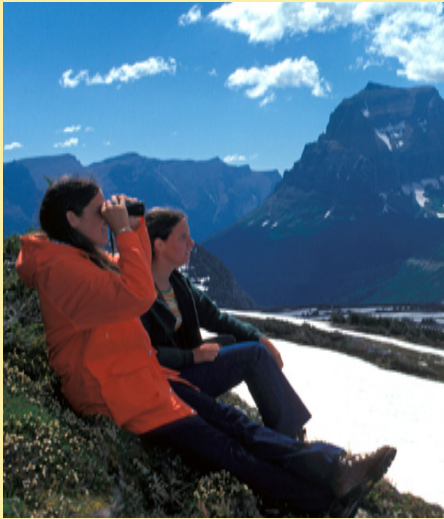
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Acting Director Clerk

Paul Ollig
Research Education Coordinator

Seasonal and Temporary Staff:

Jami Belt
Melissa Peterson
Susan Sindt
Melissa Sladek

Want to Become a Citizen Scientist?



NPS Photo

The Crown of the Continent Research Learning Center is looking for dedicated individuals who wish to assist with our research efforts as wildlife observers and citizen scientists. Participation in the program requires attending a 3-8 hour training session (depending on the project). Current citizen science projects include:

Common Loon Monitoring:

Involves extensive surveys of Glacier National Park's hundreds of lakes to document presence of Common Loons and observations of breeding and nesting behaviors.

High Country: Involves extensive back-country surveys to collect data on the number and distribution of three species of concern for Glacier National Park: mountain goats, pikas, and Clark's Nutcrackers.

Noxious Weed Mapping: Involves mapping surveys of Glacier National Park's 700+ miles of hiking trails to determine the distribution and extent of noxious weeds invading the park.

For more information, please contact Citizen Science Coordinator Jami Belt (jami_belt@nps.gov).

"High Country Citizen Science" continued from pg. 6

species identification, management concerns, and how to observe and document observations of each species. They also learned how to use field equipment such as spotting scopes, compasses and GPS units. Most volunteer observers come from the ranks of frequent visitors to the park, are primarily from the local area,

range in age from 20 to 74 years old, and have a wide range of occupations. Experience with wildlife observation ranges from wildlife photographers to those who have never used a spotting scope.

To date, High Country Citizen Scientists have completed 186 mountain goat

surveys at locations throughout the park, with a goal of surveying each site at least three times. 46 High Country Citizen Scientists took part in the first annual Mountain Goat Days population count on August 15 – 17, during which surveys were completed at all mountain goat sites to develop a snapshot of the population in these representative areas. Mountain Goat Days volunteers were also stationed at strategic locations to help to ground-truth aerial surveys conducted by park biologists during that same weekend. High Country Citizen Scientists have also completed 59 pika surveys at the 20 official survey sites and 20 new pika sites have been discovered and documented. Over 44 Clark's Nutcrackers observations have also been documented.

Glacier National Park's citizen science program was established in 2005 to help resource managers address the need for baseline information and monitoring. Citizen science projects generally are low in cost, engage large numbers of people to gather large datasets, use non-invasive monitoring methods, educate participants about resource issues and foster stewardship amongst participants.



NPS Photo

Citizen scientists spent hours peering through scopes in search of mountain goats, like the two seen perched on the cliff above.

“Big Changes” continued from pg. 5

What is your fondest memory of your time working at the CCRLC?

Working with all the different people. So it’s not just one memory, but all the memories of working with all the different people, both at Waterton and Glacier. But most importantly the people working at the CCRLC. The people at the CCRLC are so dedicated. They work hard and are just simply fun to be with.

Is there anything you wish you had been able to accomplish that you didn’t? Is there something you would have liked to do while here that you didn’t get a chance to?

I really wish I could have created a superintendent’s notebook. And what that is, is a very short one-page summary of key resource issues for the superintendent. This would provide a valuable source of information for

them as they make their management decisions. Also, creating an exciting website. This is something I wasn’t able to, but am excited that is now getting done.

What is your hope for the future of the CCRLC?

That’s a hard one to answer. Well, I hope that it is able to continue to contribute to the CCRLC’s four goals. To me, one of the things I’d really like to see is a strong citizen science program with a full-time coordinator. That person could then continue the three programs we’ve already begun and potentially create others. I think that fosters our relationship with the community. The neatest thing to me about the it isn’t just educating people about the resource or data collection, but their development as stewards of the park. It makes them feel good and makes us feel great that we’re able to

work together on these critical issues.

You recently accepted a position as a regional refuge biologist for the US Fish and Wildlife Service in California. What will this job entail? What part of this new career are you most looking forward to?

The job entails, I think, working with helping and advising refuge biologists in California and Nevada. It’s a new career path for me, getting to focus on being a wildlife biologist and getting to be in the field more are what I am most looking forward to. But I’ll most definitely miss working with everybody at the CCRLC and Waterton-Glacier International Peace Park.

Sallie may be contacted at her new office in Stone Lakes National Wildlife Refuge.

<http://www.fws.gov/stonelakes/>



“Science in the Crown” is a bi-annually published journal of the Crown of the Continent Research Learning Center serving Waterton-Glacier International Peace Park, Grant-Kohrs Ranch National Historic Site and Little Bighorn Battlefield National Monument.

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“Weed Curriculum” continued from pg. 5

schools participated in the noxious weed education program. Results from teacher and parent comments and teacher evaluations indicate a high rate of approval for the program, especially its hands-on science component. In the words of Connie Warner, a participating fourth grade teacher at Ruder Elementary, “The noxious weed program was a wonderful experience for our students. It directly connected to the 4th grade science standards while providing rich, hands-on learning experiences for our kids.”

All contents of the program are now packaged and available as an educational trunk that educators can check out.

If you are interested in using the “Plant Invaders” trunk, please contact Laura Law, Glacier National Park’s Education Specialist, at 888-5837.



NPS Photo

Students arriving for a noxious weed field trip wait along the shores of Lake McDonald.