Crown of the Continent
Research Learning Center
Glacier National Park

National Park Service
U.S. Department of the Interior

Science in the Crown

Citizen Science ~ Volunteers in Service to Loons

by Jami Belt, Coordinator, Citizen Science for the Common Loon, GNP

Glacier National Park harbors approximately 20 percent of Montana's breeding Common Loons, a Montana Species of Special Concern, with an average of about 36 adults and 5 chicks each year. Before 2005, surveys of Glacier's loon population had been conducted annually since 1989, but limited resources restricted organized, data collection to the one-day, statewide event known as Loon Day. Held in mid-July, Loon Day has and continues to provide valuable information on population numbers and nesting activity; however, it is only a limited survey upon which to build management direction.

In 2005, Glacier's Wildlife Biologist Steve Gniadek and Resource Education Specialist Sallie Hejl piloted the Citizen Science Project for Common Loons, with funding from the Rocky Mountains Cooperative Ecosystem Studies Unit. Their goals were to gain a more accurate estimate of Common Loon population status and to identify factors affecting loon nesting success in Glacier National Park. This project trains volunteer observers and Glacier NP staff to increase accuracy and coverage of Glacier's loon lakes throughout the nesting season. The project expanded in 2006 and 2007 with funding from the Glacier National Park Fund and Glacier National Park Associates.

"Citizen Science" refers to research or resource management projects that use trained volunteers to gather scientific information that would otherwise be unavailable, due to lack of personnel or funding. One of the oldest Citizen Science efforts is the more-than-a-century-old Audubon Christmas Bird Count. These annual surveys record trends in bird populations, which may identify threats or environmental changes.

Citizen Science is being used by an increasing number of scientific, data-seeking efforts, both in conservation organization and agency settings. These citizen contributions foster stewardship and increase awareness about resource issues while involving the public in the process of science by providing useful data.

Common Loon family taken with a telephoto lens by Bob Chinn, veteran Glacier NP Volunteer Loon Observer.

From 2005 to 2007, project coordinators Therese Hartman (2005) and Jami Belt (2006 and 2007) recruited and trained nearly 300 volunteers to monitor potential loon lakes repeatedly throughout the nesting season. These volunteers conducted more than 1,000 surveys on 88 of Glacier's lakes recording data about the occurrence or absence of loon adults and chicks. Observations of loon behavior were also recorded to help identify the relationship between incidences of disturbance and nesting success. In 2006 and 2007, each of the 45 priority loon lakes was monitored at least three times: once prior to Loon Day, once on Loon Day, and once after Loon Day. Data were entered into the newly-created, Glacier loon database and are being exported into a statewide database.

In 2007, with many returning volunteers, our sampling methodology improved by adding Glacier's first annual Spring Loon Day, a survey conducted in most other areas of northwest Montana for the last decade that aims to determine which loon territories are occupied and which lakes are most likely to have nesting attempts. Further, assistance was extended to Waterton Lakes National Park staff in order to build a loon monitoring program in Waterton. With the help of their staff and a few Canadian volunteers, surveys were conducted on all eight potential loon lakes in Waterton.

Three years of valuable data on Glacier's loons gathered by our dedicated volunteers shows that season-long monitoring provides a more reliable estimate of Glacier's Common Loon population and nesting success than Loon Day counts alone. Most importantly, we have a more accurate count of chicks by detecting chicks that hatched but did not survive to be counted on Loon Day as well as detecting chicks after Loon Day. Based on 2007 season-long data, the number of residential Common Loons in Glacier was 46 adult loons (20 pairs and 6 singles) and 10 chicks. This is notably different from the 2007 Loon Day estimate of 43 adult loons (10 pairs and 23 singles) and 6 chicks. The 2006 season-long population estimate of 45 adults (16 pairs and 13 singles) and 5 chicks also differed from the 2006 Loon Day estimate of 36 adults (9 pairs and 18 singles) and 4 chicks.

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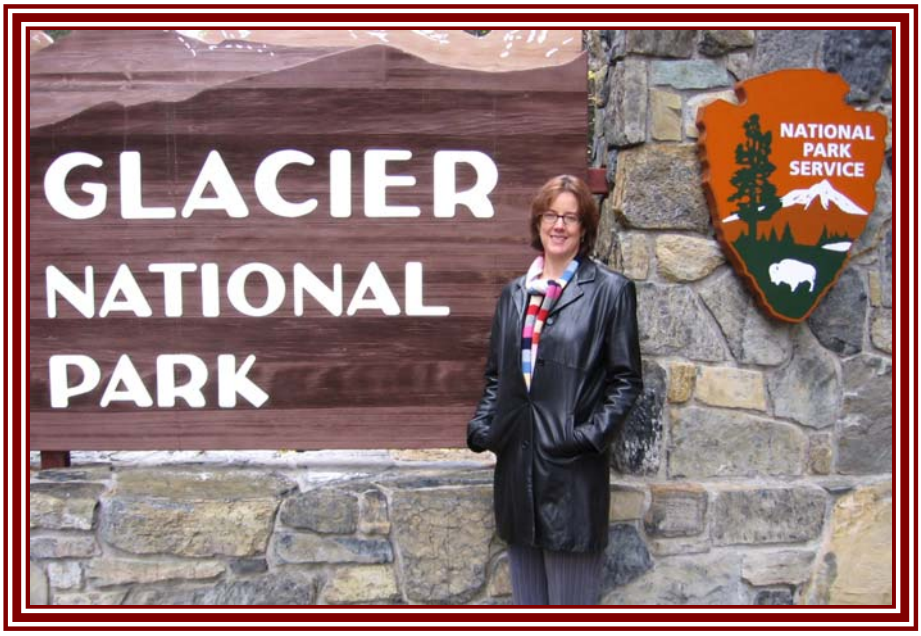
Leigh Leaves to Head NPS Climate Change Program



☼ ***Leigh Welling became the first Director of the Crown of the Continent Research Learning Center in 2002. It was a move in step with her career path paved with her philosophy that applying an integrated and multidisciplinary approach to science and science education is critical to understanding earth's systems and developing sound resource management practices.*** ☼

Leigh hails from the West. Growing up on ranches in northwestern Nebraska and eastern Montana, she moved to Colorado for high school and college. She earned Masters (1991) and PhD (1996) degrees in Oceanography at Oregon State University. Her research focused on using marine microfossils to reconstruct past oceanic and climatic conditions.

Following graduate school, she taught geosciences at the University of Nevada-LasVegas while pursuing an interest in science communication. Leigh moved to the University of North Dakota (UND) to focus on enhancing science literacy and remote sensing applications for land management. While at UND, she served as co-chair of the Northern Great Plains sector for the National Assessment on the Impacts of Climate Variability and Change (a major part of the US Global Change Research Program) and held a key administrative position in the Upper Midwest Aerospace Consortium.

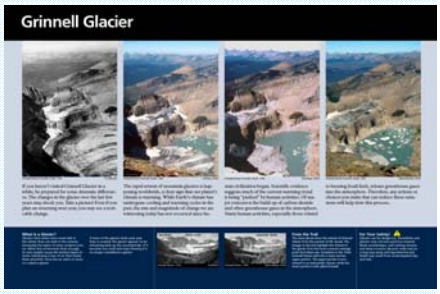
As the first Director of the Crown of the Continent Research Learning Center (CCRLC), Leigh's major contributions include the Jerry O'Neal NPS Student Fellowship (see next page), the annual Waterton-Glacier Science and History Day, participation in the Crown of the Continent Managers Partnership (CMP), and communicating climate change (see below). Leigh helped create the Crown Invasive Plant Network (CIPN), a subcommittee of the CMP. Currently, members of CIPN from over 20 agencies and organizations, led by the CCRLC and Glacier's Plant Biologist, are designing and developing a field guide to serve as a tool for educating staff, volunteers, and the public.

Leigh's major responsibilities at CCRLC included strategic planning, partnership building, budgeting, and promoting opportunities for park research with university and agency scientists. While at the Research Learning Center, she continued to work on national teams to promote climate change communication and technology transfer with groups such as the National Research Council, the Heinz Center, the Nature Conservancy, and NASA's EROS Data Center. During 2005-2007, she also served as National Coordinator for the 17 other NPS Research Learning Centers. And, critical to beneficial park interaction was her frequent contact with Science and Resources Management and Interpretation and Education Divisions to identify and meet park-based research and educational needs.

Since October 2007, Leigh has been the Climate Change Coordinator for NPS Natural Resource Stewardship and Science. Her responsibilities include working with national, regional, and park programs and staff to develop and implement strategies for effectively responding to the challenges that climate change presents to resources management and park operations. With an overarching goal of promoting sustainable relations between humans and the environment, Leigh is looking forward to working with others across the NPS and outside partners on this important issue.

Communicating Climate Change

As climate change threatens national parks, the CCRLC has made communicating the impacts one of its highest priorities. In 2007, Leigh directed efforts, in collaboration with GNP's Division of Interpretation and Education, to have three wayside exhibits created and installed, a site bulletin prepared, and provided seasonal interpretive training for the third year, all based largely on the research of Dr. Dan Fagre. Dr. Fagre is a research ecologist with US Geological Survey at the Northern Rocky Mountain Science Center, specializing in Climate Change in Mountain Ecosystems. While at CCRLC, Leigh supported several regional and national efforts to communicate climate change impacts by spearheading talking points for 10 bioregions in the US; organizing speakers for the George Wright Society forum; writing articles; coordinating workshops; and presenting overviews to a variety of audiences including the NPS Advisory Group and the National Leadership Council.



Grinnell Glacier wayside exhibit, at the Grinnell Glacier trailhead in the Many Glacier area, GNP.

Citizen Science

(continued from page 1)

This large dataset, plus data collected prior to 2005, has also given us better information about Glacier's loons, such as chick hatch dates, migration dates, chick mortality, and chick detectability that would have been missed by monitoring only on Loon Day. Volunteers also helped us locate and map nest sites, areas of potential disturbance, and probable nursery areas on each of the lakes with known nesting activity for use in future monitoring and management.

With a grant from Glacier National Park Associates in 2007, an intern was hired to create a training manual and help structure a project coordinator internship as a viable, low-cost solution for making the project sustainable in future years. The program is now well-developed, with a large network of volunteers who are eager to continue monitoring loons and are willing to work on other citizen science projects in the Waterton-Glacier International Peace Park area in future years.

Challenges to using Citizen Science include investing a substantial amount of effort to find, train, and manage volunteers and to maintain data quality. The rewards of educating volunteers in-depth about a resource issue, fostering stewardship, and increasing the quantity and quality of the data have far outweighed the challenges.

Jami Belt (with clipboard), Citizen Science Loon Project Coordinator, led advanced training sessions for volunteers who had helped in previous field seasons.

Jerry O'Neal NPS Student Fellowship

The Crown of the Continent Research Learning Center, in collaboration with the Rocky Mountains Cooperative Ecosystem Studies Unit (RM-CESU) and in association with the University of Montana (UM), created the Jerry O'Neal National Park Service Student Fellowship to support research in Glacier National Park (GNP), Grant-Kohrs Ranch National Historic Site, and Little Bighorn Battlefield National Monument. Jerry O'Neal, a former Deputy Superintendent of Glacier NP, was actively engaged in a range of environmental management projects.

The Jerry O'Neal Fellowship granted its first awards in 2007 to three students. Competition is open to graduate students or superior, upper division under-graduate students at RM-CESU universities and colleges. The recipients for 2007 each designed research projects in Glacier NP.

Photo: David McKenzie

David McKenzie (U. of Wyoming) and field assistant, Marci Trana, conducted research on the dynamic interaction between fire and climate in GNP**: "Early Post-fire Successional Trajectories in Glacier NP, MT."** This research will provide land managers and park interpreters new knowledge about how climate change has affected forest types and species distributions in the park. Field work was completed in 2007, and results will be presented to park managers in 2008.

Sarah Wilson (U. of Montana) conducted an **"Underwater Archaeological Survey of Former Townsite of Altyn, Lake Sherburne."** With a field crew of six, Sarah surveyed, inventoried, and photographed the submerged portion of the town of Altyn, a turn of the 20th century mining town located in the area which is now inundated by Lake Sherburne near Many Glacier in Glacier NP. Due to a low water level, the crew was able to study the majority of the Altyn townsite in a more traditional, terrestrial archaeological manner but incorporated scuba for a unique comparative study. The research site contained a prehistoric campsite including a hearth

Photo: Sarah Wilson

feature, stone tools, and butchered bison remains. This project will provide educational opportunities for the public to learn about the archaeology and history of Glacier NP. A report will be distributed to GNP, the MT Historical Society, UM's Mansfield Library, and various public libraries.

Erich Peitzsch (MT State University) is focusing his research on **"Forecasting Wet Slab Avalanches."** Erich began his field experiments in avalanche forecasting in 2007 and will continue in 2008 during the annual spring opening of the Going-to-the-Sun Road

Photo: Mark Dundas

(GTSR), GNP. Peitzsch's research will help improve the understanding of how production and movement of water through a stratified snowpack affects wet slab avalanches. Safe snow conditions turn dangerous in a wet snowpack. Peitzsch will present a final report of his findings to GNP land managers in 2008 which hopefully will aid in avalanche forecasting for the GTSR.

Eastside Grassland Ecological Assessment

by Tara Carolin, Ecologist, GNP ***(summarized from reports by Jen Asebrook, Dave Shea, Sue Olin, Dean Pearson, Lisa Bate, and Gordon Dicus)***

Glacier NP staff assessed the status of eastside grasslands in 1999-2001. NPS Fee Demonstration Funds provided funding for this project that was undertaken to describe the ecological baseline condition of eastside grassland communities as a basis for determining where management intervention may be needed to protect grassland integrity and as a baseline for future monitoring by the NPS Inventory and Monitoring Program.

The study area consisted of fescue grasslands, dominated by bluebunch wheatgrass, Idaho fescue, and rough fescue that were located east of the Continental Divide between 4,500-6,500 feet in elevation where precipitation ranges from 26 to 46 inches annually. Percent ground cover was estimated in 155 vegetation plots in 99 meadows. A total of 342 plant species including 33 non-natives were identified. The plots were classified into 11 different vegetation associations, with rough fescue/Idaho fescue/geranium being the most common (34%), while the kinnikinnick/fescue type was common on drier sites (20%), and 25% of the plots were classified in a weedy timothy/bluegrass/smooth brome type.

Additionally, small mammals, birds, and ungulate use were surveyed in selected meadows. Small mammals were surveyed at 6 weedy and 6 undisturbed areas. Deer mice dominated in most meadows with western jumping mice and voles as uncommon to rare components. Yellow-pine chipmunks and meadow voles were also rare. Vole populations were more diverse here than in similar habitats elsewhere in the state, although Glacier's overall densities were lower.

Above: Eastside grasslands of Glacier National Park, above St. Mary Lake.

Below: Bighorn sheep on winter range in the Many Glacier area.

Bird point counts were conducted at 35 stations in 7 areas. Diversity ranged from 68 species at Belly River to 36 at Rising Sun, from a total of 96 species across the 7 areas. The most common species included Savannah, Clay-colored, and Vesper Sparrows. Other common species included Pine Siskins, White-crowned and Chipping Sparrows, American Robins, Tree Swallows, Warbling Vireos, and Brown-headed Cowbirds. Grasslands near riparian areas had the highest diversity, but sites with lower diversity had unique species that were absent or rare at other stations.

Ungulate use of grasslands was monitored by direct observation and pellet counts. Ungulate use of the low elevation grasslands is low during summer, but elk use is extensive in spring and fall. Average group size for bighorn sheep was 7.3 (range 1-25). A minimum estimate for the park bighorn population is 445, including 85 sheep on the Many Glacier winter range and 185 sheep on the Two Medicine winter range. Most of the critical winter range for bighorn is at higher elevations. Kinnikinnick-dominated communities provided more important winter range for bighorns than fescue grasslands, demonstrating the importance of diverse vegetation communities in the park.

Evaluating Alternative Futures for Flathead County

by Dr. Tony Prato, Prof., Univ. MO-Columbia

For the past five years, a group of scientists has assessed how future development in Flathead County may influence land use, within an area that includes part of the Crown of the Continent Ecosystem. A computer model simulated nine alternative futures for the county for two time periods: 2004-2014 (10 years) and 2004-2024 (20 years). These "futures" consist of combinations of three economic growth scenarios (low, moderate, and high) and three land use policies (baseline, moderately restrictive, and highly restrictive).

Simulation results indicated land shortages (area available for development is less than the area required for development) of 26,929 acres for the high growth scenario in the period 2004-2014 and 16,671 acres and 92,989 acres for the moderate and high growth scenarios, respectively, in the period 2004-2024 with the current land use policy. A land shortage of 45,219 acres occurred for the high growth scenario in the period 2004-2024 only with the moderately restrictive land use policy. No land shortages occurred for any of the three growth scenarios with the highly restrictive land use policy. All of the land shortages occurred in the agricultural housing density as it had the lowest order of priority for development.

Simulation results indicate that both economic growth scenarios and the land use policy scenarios influence whether land surpluses or land shortages occur and that controlling economic growth is probably not a viable way to reduce land shortages. However, land shortages can be alleviated by implementing a more restrictive land use policy. Researchers are now evaluating the impacts of alternative futures on wildlife habitat.

The ultimate goal is to develop an ecosystem landscape modeling system for Flathead Co. that allows regional planners and resource managers to evaluate the potential economic and ecological consequences of future economic growth and land use policies.

Senior investigators for the project were Tony Prato, Univ. MO-Columbia; Ramanathan Sugumaran, Univ. N. IA; Ric Hauer of the Flathead Lake Biological Station, Univ. MT; and Dan Fagre, USGS N. Rocky Mt. Science Center. The project was funded by the ISDA Coop. State Research, Education, and Extension Service. For more information: http://www.cares.missouri.edu/montana.

Plant Communities Mapped for Peace Park

by Richard Menicke, GIS Coordinator, GNP

In 1998, Glacier National Park (GNP) became one of the first NPS units to begin its vegetation classification and mapping project under the joint USGS-NPS Vegetation Mapping Program. This program will include about 270 NPS units within the next twenty years.

While Glacier's project began in earnest in 1999, Waterton Lakes National Park (WLNP), in Alberta, joined the project in 2000, with the goal of creating a seamless vegetation map for Waterton-Glacier International Peace Park (IPP). Field data were collected from 682 vegetation plots within the IPP project area; 628 were from the GNP area and 54 were from the WLNP area. Vegetation data from other existing data sets provided an additional 1,100 plots for the vegetation analysis needed to describe National Vegetation Classification (NVC) System plant associations (communities). Ecologists with NatureServe and the Montana Natural Heritage Program analyzed these data and published the *Vegetation Classification of Waterton-Glacier International Peace Park* in 2004.

A second component of the project, accuracy assessment (AA), was conducted throughout the Peace Park from 2002 through 2006. Data were collected from 1,160 AA sites (918 from GNP and 242 from WLNP). The AA sample points were used to ensure that the mappers (USGS Upper Midwest Environmental Sciences Center in LaCrosse, WI) met program accuracy requirements. The combined data sets led to the identification of 226 NVC plant communities at Waterton-Glacier IPP.

Forty-eight map classes were developed to map the vegetation and general land cover of Waterton-Glacier IPP, with 42 of them representing NVC vegetation types. The other six map classes depict general land cover: three representing non-vegetated land cover and three representing developed areas. Two spatial databases were produced to show locations of vegetation and general land cover; one of GNP and environs and one of WLNP and adjoining Blood Indian Timber Limit. Summary reports generated from the spatial database layers indicate forest and woodland types dominating the landscape, populating 55% of the polygons and covering 66.5% of the entire IPP area.

Plot 232 was sampled in 2000 and classified as Dwarf-shrub Herbaceous Vegetation (*Drya*s and *Polygonu*m).

The Waterton-Glacier IPP Vegetation Mapping Project delivers many geospatial and vegetation data products in hardcopy and digital formats. These products consist of an in-depth project summary report discussing methods and results, which include plant community descriptions and dichotomous keys, map classification and descriptions, and AA contingency tables. They also include representative ground photos of plant communities, database sets of vegetation plots and AA sites, field data sheets, aerial photograph prints and images, hardcopy maps, and spatial databases of vegetation communities, fieldwork locations, aerial photo indexes, and project boundaries. Final products are available at: <http://biology.usgs.gov/npsveg>.

Mysteries of the Northern Hawk Owls

Adult Northern Hawk Owl perched in a burned area in Glacier National Park.

At the southern edge of their very northern range, Northern Hawk Owls have shown a rather mysterious presence within Glacier National Park. First discovered nesting in a recently burned area of the park in 1994, this species of the wet, boreal forests of the North appeared to be only barely present in this marginal area. However, after the fires of 2003, numbers of this diurnal, long-tailed owl dramatically increased, probably associated with increased numbers of voles that were supported by rampant post-fire herbaceous growth. This irruption of owls drove the desire of wildlife biologists to find out more about their movements and reproductive activity and success, especially after young owls were observed during the spring and summer of 2005. With funding from Glacier NP and The Glacier National Park Fund, Denver Holt and his field technicians from the Owl Research Institute set out to find new biological information about this intriguing species. During two field seasons, 10 nests were found and 33 birds were banded, including 24 young. Nest site and prey characteristics were also recorded. A small mammal trap-line run in 2007 had no captures, corresponding to the reduced nesting success in 2007. This information and future field work and analysis will be helpful to resource managers and educators working in the range of this little-known cavity-nester.

Stream Monitoring in Glacier

by Billy Schweiger, Ecologist, ROMN

In 2007, Rocky Mountain Inventory and Monitoring Network (ROMN) began long-term, stream monitoring in Glacier NP. The ROMN is part of the National Park Service Inventory and Monitoring (I&M) Program, which was established in the early 1990s to better understand the health of the parks. This program organized parks with significant natural resources into 32 networks based on proximity and ecological similarity. There are two major components to the program: (1) to gather baseline information about parks and the surrounding ecosystems through natural resource inventories and (2) to conduct long-term monitoring for key indicators of ecological health, or "vital signs." The purpose of the Vital Signs Program is to provide scientifically credible, long-term ecological information for natural resource protection and management. Having this information will be useful for park managers and scientists to assess the efficacy of management practices and restoration efforts and receive early warning of impending threats to the resources and systems that the NPS was created to protect.

In August 2007, the Rocky Mountain Network published its Vital Signs Monitoring Plan. It is the general foundation of the network's long-term ecological inventory and monitoring program and has been administratively and scientifically approved. It is available online at: http://science.nature.nps.gov/im/monitor/

ROMN VITAL SIGNS

Monitoring Category	Vital Sign
Air & climate	Wet & dry deposition
	Weather & climate
Biological Integrity	Invasive aquatic biota
	Invasive/exotic plants
	Freshwater communities*
	Vegetation composition, structure, & soils*
	Focal species: beaver, elk, grizzly bear & Great Sand Dunes endemic insects
	Wetland communities
Ecosystem Patterns & Processes	Landscape dynamics
Geology &Soils	Surface water dynamics*
	Vegetation composition, structure, & soils*
Water	Water chemistry
	Groundwater dynamics
	Surface water dynamics*
	Freshwater communities*

* Vital sign is listed under two monitoring categories.

Scientists in the Rocky Mt. Network monitor vital signs to determine the health and condition of a park.

Phil Matson (FLBS) measures discharge and Billy Schweiger (ROMN) measures stream chemistry on a small tributary to Bowman Lake. (Photo: Lindsey Johnson, FLBS)

The Network, with help from many partners including staffs from Glacier NP (GNP), Univ. of MT Flathead Lake Biological Station (FLBS), and US Geological Survey (USGS), completed a draft protocol for wadeable stream monitoring methods in August. Using the protocol, field crews conducted pilot stream sampling in the N. Fork of the Flathead River drainage and select other locations within the park, from August through mid-October, completing 26 sample events. Crews were primarily from FLBS and ROMN, with contributions from GNP staff and volunteers. The GNP rangers in the North Fork were very helpful in logistics, and all sample events were completed successfully and without incident (though at one site we did have a semi-close encounter with a big mountain lion!).

We collected multiple measures at each site including macroinvertebrates (bottom dwelling stream insects and other invertebrates), periphyton (unicellular organisms like diatoms and algae), and water quality (analyzed for 36 parameters). Crews also collected *in situ* physiochemistry data (e.g., temperature) and instantaneous discharge (using an acoustic Doppler flow meter). Finally, they measured stream physical habitat: including substrate, channel geomorphology, large woody debris, bank morphology, human disturbance, stream canopy cover, riparian vegetation structure and cover, and presence of key invasive plant species like Canada thistle and knapweed.

The ROMN and FLBS are currently analyzing the 2007 samples. They will assess water quality data relative to state and EPA standards. Biological data will be developed into Glacier and ecoregion specific Index of Biotic Integrity and multivariate bioassessment models that will help interpret and integrate the results. Physical habitat data will be used to classify each site within the bioassessment models and will be worked up into hydrologic models of stream condition. Long-term goals of the project include developing reference conditions for Glacier's streams as a means to assess long-term monitoring data. The survey design permits this because it is an unbiased sample of the park's streams. The end result of these analyses will be the first ever, statistically valid, park-wide assessment of the ecological condition of GNP streams.

ROMN will continue stream monitoring in Glacier NP in 2008 and 2009. They will collect up to 70 additional sample events at randomly selected survey sites across the entire park. They will also begin data collection at "sentinel sites." These are stream locations where data will be collected multiple times per year and are often co-located with stream gauges.

Keep an eye out for the crews this year – we will be the ones picking bugs out of streams, collecting more data, and helping learn more about the wonderful and important streams of Glacier NP.

Northern Leopard Frogs Return to Waterton Lakes National Park

by Cyndi Smith, Conservation Biologist, WLNP

Juvenile northern leopard frog (*Rana pipiens*) that hatched from introduced eggs, Waterton Lakes National Park. (Photo: Parks Canada)

Last year was a year of many celebrations in Waterton Lakes NP (WLNP), highlighted by the 75th anniversary of the Waterton-Glacier International Peace Park. It also marked the year that northern leopard frogs (NLFR) returned to the park … with a little help from their friends!

Once the most widespread frog species in North America, the northern leopard frog has been mysteriously disappearing since the 1960s. This 3½-inch amphibian, which varies in shades of green and brown, had been widely collected for use as lab specimens, food industry delicacies, and even as fish bait. Massive declines of this species have occurred, particularly in Canada and the Western U.S. Causes for this loss are not totally known but are probably the result of a combination of ecological factors.

Despite annual surveys of over a dozen wetlands since 1995, and intensive surveys of 120 sites in 2003, no NLFRs had been seen or heard in Waterton since 1980. After it had been determined that the species had been extirpated, a species management plan was approved in the spring of 2007. This plan and subsequent activities were guided by the Northern Leopard Frog Recovery Plan and subsequent Reintroduction Strategy for the province of Alberta.

With the assistance of Alberta Conservation Association (ACA) staff, the WLNP staff surveyed known breeding sites in provincial areas within the Oldman River watershed, as close to the park as possible. Then, on April 26th, parts of two egg masses were removed from a private pond belonging to a conservation-minded landowner about 120 km (74.5 mi) northeast of the park. Half of three additional egg masses were collected from another site over the next month. At the reintroduction site in the park (a known historical breeding area), each egg mass was placed into a floating enclosure that allowed free flow of water but excluded predators.

Following the provincial recovery protocol, no more than half of the egg masses could be removed from any one breeding site. Because female NLFRs produce only one egg mass (of 3,000-5,000 eggs each) per year we concluded that our eggs came from five different females, increasing the genetic variation at the recipient site, which should increase our chance of successful reintroduction. The relocation of egg masses was chosen over transfer of tadpoles or juvenile/adult frogs because eggs are not known to carry diseases such as chytrid fungus or *Rana* viruses.

We monitored the egg masses until they hatched and released the tadpoles from their enclosures once they had reached a stage at which they were capable of avoiding predators. We released 13,625 live tadpoles and counted 253 dead ones and 534 unhatched eggs – a hatching success rate of 94%, well above the normal range of 1-6% if they had been unprotected. Then, on July 20th, we observed the first juvenile frogs, and within two weeks they were dispersing to adjacent ponds.

Our population viability analyses had suggested that we should reintroduce eggs over multiple years and at multiple sites within easy dispersal distance. Providing there is nearby breeding success outside WLNP, we will transfer more egg masses in 2008 and 2009. We will also continue monitoring the first cohort to determine over-winter survival. Hopefully in a few years, we shall see our first locally-born northern leopard frogs.

Kathryn Romanchuk (ACA) and Cyndi Smith (WLNP) releasing an egg mass into the predator exclosure. (Photo: Parks Canada)

The Value of Monitoring: a case in point(s)!

by Steve Gniadek, Wildlife Biologist, GNP

Seeing a porcupine for the first time is usually a memorable experience! After all, they are the second largest rodent in North America, weighing from 12 to 25 pounds (6-12 kg) and armed with an arsenal of quills protruding from nearly every part of the body. They are the only NA mammal with body hairs that have modified into quills. Even the single young are born fully quilled with eyes wide open. Mainly solitary and usually nocturnal, porcupines are strict herbivores. They feed on the inner bark of trees and coniferous foliage during winters, adding leaves and stems of woody and herbaceous plants in the summer.

Early naturalists considered the porcupine a common animal when Glacier NP was established in 1910. Sighting reports suggested they were at least widespread if not abundant (especially at higher elevations) until the late 1970s. Only a few sightings have been reported in recent years in the park, and most have been at lower elevations near the eastern park boundary. This decline parallels a drop in porcupine numbers over more than 20 years in the Rocky Mountain West, despite individuals living to 20 years.

Since porcupines have become scarce and are probably functionally extirpated from Glacier NP, opportunities to study them in the park and determine the causes for their decline have been lost. However, Katie Mally, a University of Montana graduate student working with Professor Kerry Foresman, is studying porcupines in the Bitterroot Valley (south of Missoula, MT). Starting in 2007, Katie captured a few and fitted them with small transmitters to learn more about their behavior and causes of mortality. All of her study subjects have been found in the lower elevations of the valley, not in the higher forests of the mountains where they once seemed common. Perhaps her study will shed some light on the decline of porcupines in Glacier and elsewhere.

Speculation on the factors leading to the decline of this species has focused on predation. The most efficient predators of porcupines are fishers and mountain lions. Fishers are poorly documented in the park and are probably rare at best, but mountain lions are widespread and may have been an important factor in the demise of porcupines. Mt. lions were implicated in the recent near-extirpation of porcupines in the Great Basin.

Porcupines have been persecuted throughout the West because of their feeding habits that sometimes result in girdled trees of commercial value and an unfortunate desire to gnaw on ax handles, canoe paddles, or other objects to obtain salt residue from human perspiration. Though a "protected" species in Glacier NP, the porcupine was once considered a nuisance animal, and many were likely destroyed in developed areas, while others became roadkill. How all these factors were instrumental in this species' disappearance is unknown.

How do porcupines fit into the ecological scheme of things? Could they be an important ingredient in helping to structure natural communities, and how will Glacier's relatively intact natural environment adjust to the loss of this species? Change is a constant in nature, but loss of a species can have a cascading effect with consequences that may not become apparent for years to come.

If a system of regular surveys had been in place during the last several decades, the decline may have been detected in time to conduct studies targeting specific questions about the decline. Maybe we could have intervened to slow or modify the decline – maybe not.

Perhaps the most important lesson from the decline of the porcupine is appreciating the importance of monitoring as the basis for wildlife management in national parks. Part of Glacier's mandates is to protect wildlife for future generations.

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Sallie Hejl, Director
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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.***

Upcoming Projects & Events

Citizen Science in Glacier's High Country

Changes are occurring in Glacier's alpine and subalpine areas, causing growing concern about many high country plants and animals. This project focuses on mountain goats, Clark's Nutcrackers, and pikas and will begin in summer 2008. The CCRLC is looking for volunteers to help us on this project.

More Citizen Science possibilities for volunteers: Weed Mapping

Help identify problem areas in Glacier National Park's backcountry where non-native plants are gaining a root-hold. Training (including GPS) will instruct how to track down five exotic plant species that threaten the survival of sensitive native plants. Call CCRLC to sign up.

Waterton-Glacier Science and History Day

Waterton Lakes National Park will host the 5th Annual Science and History Day on Tuesday, July 22, 2008, at the Bayshore Inn Conference Centre, Waterton townsite, 8:30 am to 4:30 pm.

All photos NPS unless otherwise indicated.