Crown of the Continent

THE UNIVERSITY OF MONTANA

MAGAZINE

Autumn 2012 Issue 9

THE UNIVERSITY OF MONTANA CROWN OF THE CONTINENT INITIATIVE

TABLE OF CONTENTS

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EDITORS NOTE

We welcome our readers to this Fall 2012 Issue (#9) of The University of Montana Crown of the Continent E Magazine. We have collected in this issue a wonderful array of informative, fascinating, and even inspiring articles, information pieces, and photographs about and from the Crown. We hope that you will agree.

As we announced in the Editors' Note of the Summer 2012 issue of this E-Magazine, we will soon be combining our Crown of the Continent Initiative, of which the nine issues to date have been a significant and perhaps the most public component, with our new Greater Yellowstone Initiative, and merging them into what will from here on be called the "UM Crown of the Continent and Greater Yellowstone Initiative." Consequently, this will most likely be the last issue that will focus exclusively on the Crown. Rest assured, however, that even while we incorporate a second focus on the Greater Yellowstone ecosystem and all that goes with it when one takes the broad view, we have every intention of continuing to grow our coverage of and activities in the Crown. In a variety of ways, we will expand our publications both by adding additional ones and increasing their frequency and size in order to do justice to our enlarged and very exciting opportunity and mandate.

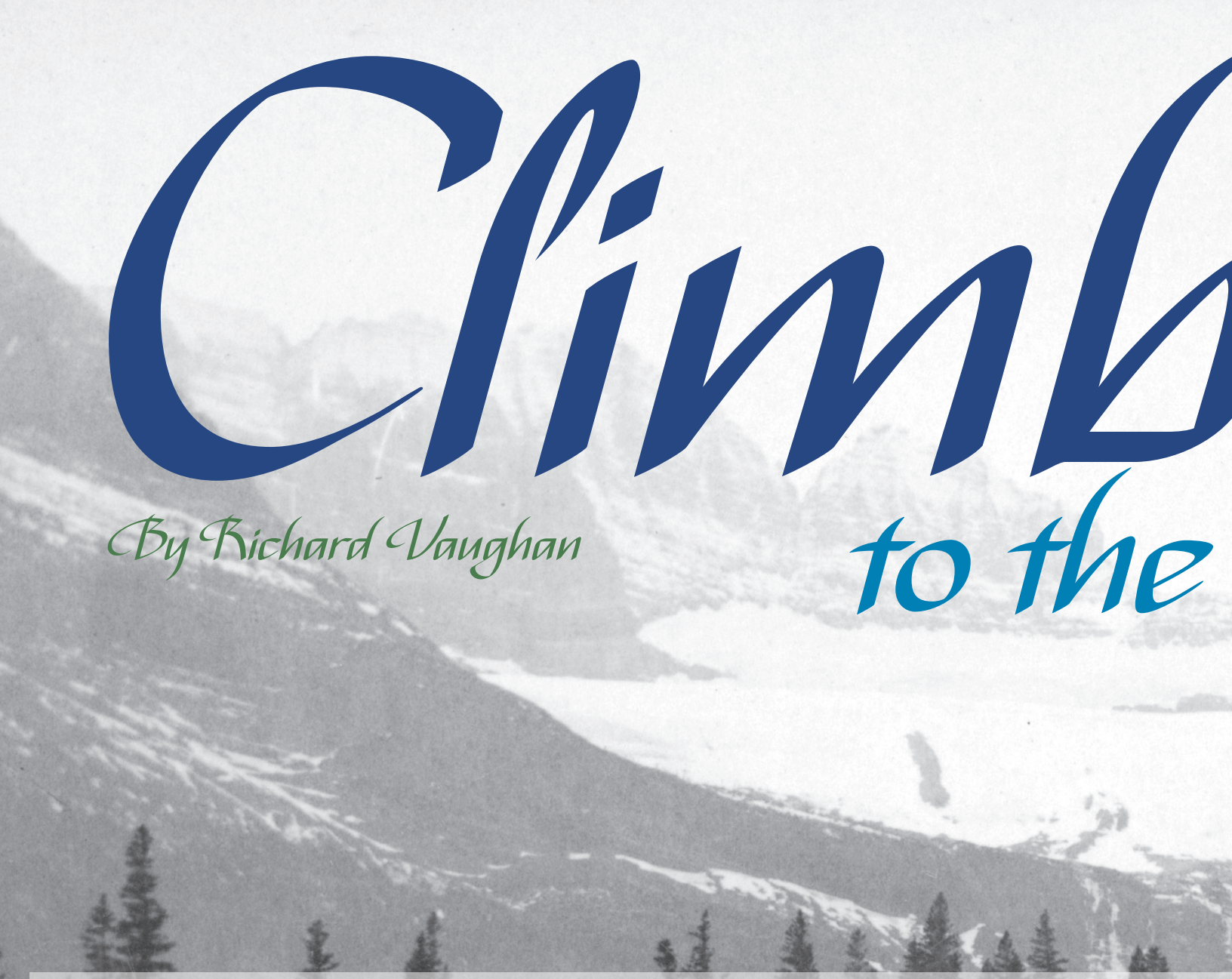
As part of this transition and in order to take advantage of the number of marvelous science articles, photographs and other images, historical pieces, and informational contributions that we have received and now have in hand that focus on Greater Yellowstone, within the next few weeks you will receive the link to the only E-Magazine issue we plan that will focus exclusively on Greater Yellowstone. Thereafter, starting with the Winter/ Spring issue, we will send your way the combined "UM Crown of the Continent and Greater Yellowstone E-Magazine." Please be on the lookout in the early New Year for the UM Greater Yellowstone Initiative E-Magazine. It will be a cooperative effort with several of our new partners who are long-time explorers and supporters of that unique and inspirational ecosystem.

In this Fall 2012 "Crown of the Continent" issue which this Editors Note leads off, you will find articles, shorter pieces, information, and images that reflect the range of our interests (and, we hope, yours): scientific pieces about research that explain things most of us only wonder about but don't fully understand (the piece on the Confederated Salish and Kootenai Tribe's Bull Trout research project and Ray Callaway's article on Invasive Plant Species); historical articles that tell fascinating stories about individuals who explored and then wrote fundamental pieces about the area now encompassed by Glacier National Park and the rest of the Crown (Richard Vaughan's article on George Bird Grinnel's climb to the glacier now bearing his name, and Kim Briggeman's recent piece from The Missoulian called "An Investor's Visit to the Mission Valley September 1883, for example); short information pieces on specific conservation projects being conducted in the Crown (the Infographic and related text by the Miistakis Institute, our partner in Calgary, on the highway animal crossing projects in the region); excerpts from existing publications on aspects of the Crown that we hope will lead you to seek them out and read further; and the Book Review and Recommendation that might just provide you with an idea for a seasonal gift for someone you know who is already captivated by the Crown or should be.

As always, we are pleased to point out that this issue, like the others before it, would not be possible without the generous contributions from many partner organizations and individuals whose work (and much of their play) is focused on the Crown. The Missoulian, the Miistakis Institute in Calgary, and the several talented individuals whose articles and photos appear here deserve our special thanks. Without them there would never have been a UM Crown of the Continent E-Magazine!

We want to wish all of our readers a wonderful holiday season and the exciting start of winter in our spectacular outdoor landscapes! Our gift wish for you is that you get to be out in it often—on skis, snowshoes, in hiking boots, perhaps—, and, if that isn't possible, to spend lots of time with good books, films, and lively conversations with like-minded friends that remind you of your attachments to and abiding interest in the Crown of the Continent and the other awe-inspiring and mysterious parts of our Northern Rockies wonderland.

Jerry Fetz and Rick Graetz, Editors



Climb to the

By Richard Vaughan

One hundred and twenty-seven years ago

this fall, in September 1885, George Bird Grinnell got his first glimpse of the glacier that is today one of the jewels of Glacier National Park …Grinnell Glacier. Dwindling supplies and bad weather kept Grinnell from reaching the glacier in 1885, but his appetite had been whetted and in his trip diary he vowed he would return "to the ice."

Although new to this pocket of Montana, Grinnell was no stranger to the American West. His western travel experiences had begun fifteen years earlier when he served as a member of O.C. Marsh's first Yale Paleontology Expeditions. A few years later he was spending summers hunting buffalo and elk on the plains of Nebraska and Kansas with the leaders of the famed Pawnee Scouts, Frank and Luther North. In 1874 he served as a scientist on Custer's Black Hills Expedition, and a year later found himself doing the same on the Ludlow Yellowstone Reconnaissance.

Grinnell was born in Brooklyn, New York, in 1849 and raised in Manhattan on the former estate of American natura
As the son of a merchant, and later stock
Audubon's widow, then at a private boarc
traveling to the American West, Grinnel
unsuccessful attempt to run the family st
first articles in a young sportsman's news
working as an assistant to Professor Mar
he took on the additional responsibilities
History Editor. Over the next few years,
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majority stock holders. Soon after, Georg
company president and editor of the new

As editor, Grinnell worked closely wi
who were spread across the country. One
Schultz, captured his interest through his
known area in northwest Montana refer
eled by Schultz's accounts, Grinnell asked

Ice

George B. Grinnell circa 1885, Notman Portrait, Library of Congress

list and painter John James Audubon.
broker, Grinnell was educated first by
ding school, and finally at Yale. Besides
l's post-college years were filled with an
ock brokerage, the publication of his
paper known as Forest & Stream, and
sh at Yale. While working for Marsh,
of serving as Forest & Stream's Natural
Grinnell and his father began purchas-
shing Company and were, by 1880, the
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vspaper.
th the paper's freelance correspondents
writer in particular, James Willard
s writing and his knowledge of a little
red to as "the Saint Mary's region." Fu-
d Schultz to serve as his first Montana guide. Schultz agreed and the two met in Fort Benton in late August 1885 and began a month long excursion by wagon, horse, and foot into the mountains that were then part of the Blackfeet Reservation. Recalling his first impression of Grinnell many years later, Schultz wrote "…the moment he got down from the stage and we shook hands, I knew. 'Here,' said I to myself, 'is no tenderfoot'." Over the next few weeks Grinnell proved him right. Together they explored the Saint Mary's Lakes; traversed mountains, valleys, and streams; met and hunted with the region's indigenous peoples; named several geographic features; and saw evidence of glacial activity, particularly as they travelled up the Swift Current Valley. Besides glimpsing the future Grinnell Glacier they spotted another glacier, to the north, which would become known as Swiftcurrent Glacier. As he would for the rest of his life, Grinnell recorded each day's events in a small trip diary that he would later use as the basis for his articles.

Disappointed at not reaching the glacier in 1885, Grinnell returned to New York and quickly slipped back into the busy world of publishing and the causes important to him. In addition to turning his diary into a 15-part Forest & Stream serial, Grinnell immersed himself in the creation of a new society dedi-

Photograph: Grinnell Glacier, Nov. 1, 1887, Beacom Photograph, Glacier National Park Archives

cated to preserving the wild birds of America, an organization he appropriately named, the Audubon Society. It soon became clear that finding the time to return to Montana in 1886 was just not going to happen.

"You cannot conceive, what a disappointment it is for me," Grinnell wrote Schultz, "to give up all hope of seeing you this autumn, and in making another trip with you. It is something I had thought about for almost a year, and I had always hoped that something would turn up to make it possible for me to go with you deep into the mountains whose outskirts we explored last year. I shall never be satisfied until I find out what lies behind the frowning peaks that surround St. Mary's, and get close to some of the glaciers that furrow those mountains. Let us think of the trip as only postponed a year."

Over the next year, Grinnell planned the trip in the little free time he had. He hoped that two close friends, Luther North and George Huntington Gould, could join him on the 1887 trip. As it turned out, only Gould made the trip. After months of planning and correspondence, the two agreed to meet in Lethbridge, Alberta on October 1st, 1887; Grinnell coming from the east coast, Gould from the west.

From Lethbridge, Grinnell and Gould headed to a camp on the Belly River where they met Schultz. They then traveled southwest by wagon and horseback, arriving at the northern end of Lower Saint Mary's Lake several days later. The plan, upon arriving, was to locate a boat Schultz had hidden nearby and then to transport all the gear to the isthmus between the two lakes. There they would make a base camp to fan out on short hunting excursions. Upon reaching the lake, however, Schultz determined that they needed more manpower to get the gear and horses up the lake. Schultz knew that his friend Jack Monroe was hunting in the Pike Lake area, a few miles to the north, so he sent Grinnell off to find him. The two returned the next day, and the four travelers began their trek. The diary Grinnell kept of the 1887 trip allows us to follow the group on their wilderness excursion.

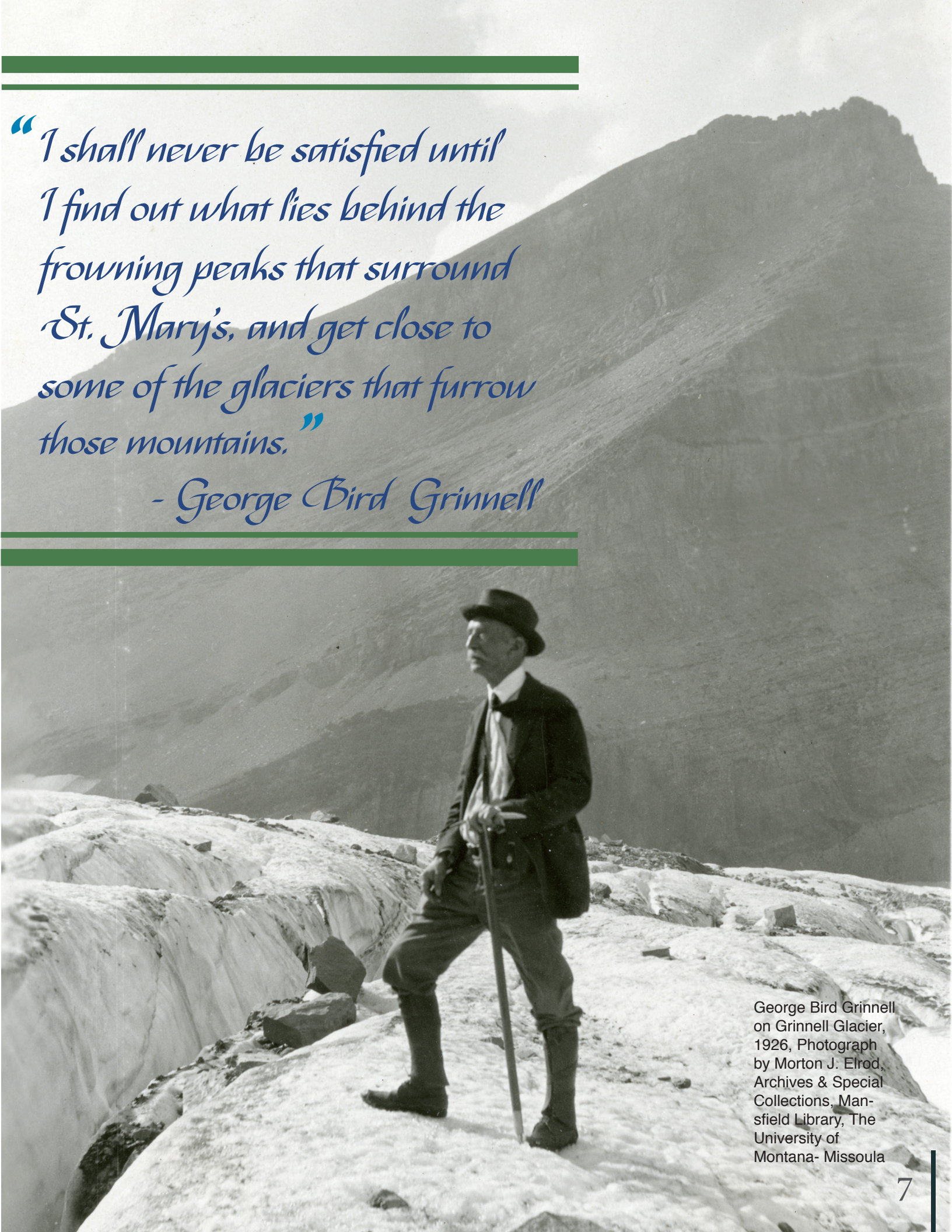
Over the next few weeks Grinnell, Gould, Schultz and Monroe hunted and fished in the general area of the Saint Mary's Lakes. As it turned out, they had much better success hunting than in 1885, largely due to arriving later in the fall when game had moved down the mountain sides foraging for food. Given Grinnell's desire to get back to the glaciers he had seen two years before, it seems odd that he did not immediately head up the Swift Current Valley. Gould, however, had informed him that he had to return to his Santa Barbara law practice by the end of the month. So, serving as host, perhaps Grinnell felt his friend's time would be most enjoyed if they stayed in the Lakes area hunting and fishing. On October 25th Gould, led by Monroe, headed back to Lethbridge and returned California.

A few days later, while waiting for Monroe's return, Grinnell was relaxing in camp when he saw a man and some horses "coming up the trail on the opposite side of the lake." Grinnell thought that it was Joseph Kipp, the legendary trader who often employed Schultz, but a quick view through his eyeglass revealed it was "a military outfit." The next morning the leader of the group rode into camp and introduced himself as Lieutenant John Beacom of the United States Army. Beacom was stationed at Fort Shaw but spent much of his time patrolling the border region for horse thieves and whisky traders. Beacom and Grinnell hit it off right away, and soon the young officer was invited on the next leg of the trip. Beacom agreed to meet them the next morning, where Swift Current Creek enters Lower Saint Mary's Lake. Grinnell, Schultz and Monroe (back from escorting Gould) packed up their camp and left for the Swift Current that evening by moonlight.

The next day, joined by Beacom, the foursome started up the Swift Current Valley, camping about one-and-a-half miles below the fifth lake. (In both his 1885 and 1887 trip diaries, Grinnell refers to the Swift Current lakes by the numbers one through six, and always spelled "Swift Current" as two words. The first four of these lakes, moving up the valley, no longer exists, having been submerged into the manmade Lake Sherburne in the 1920s.)

On October 31 the group was up before dawn and headed toward the southern most of the two glaciers Grinnell had seen two years before. The path they chose was around the northern end of the fifth lake, today's Swiftcurrent Lake, and then down its western shore. Continuing on horseback they crossed the land mass that separated the fifth and sixth lakes. Hugging a steep mountain along the western shore, they continued on until reaching a small stream at the end of the lake where, Grinnell's diary notes, "Beacom took a picture." The foursome explored a snow slide above the lake, but realized it was too late to go farther. At about 2:00 P.M. they started back toward camp, Grinnell and Beacom retracing their steps along the western shore of the lake, while Schultz and Monroe swung around on the eastern side.

The next day Grinnell, Schultz and Monroe packed extra gear on the mules and started for "Grinnell's lake"



"I shall never be satisfied until I find out what lies behind the frowning peaks that surround St. Mary's, and get close to some of the glaciers that furrow those mountains."

- George Bird Grinnell

George Bird Grinnell on Grinnell Glacier, 1926, Photograph by Morton J. Elrod, Archives & Special Collections, Mansfield Library, The University of Montana- Missoula

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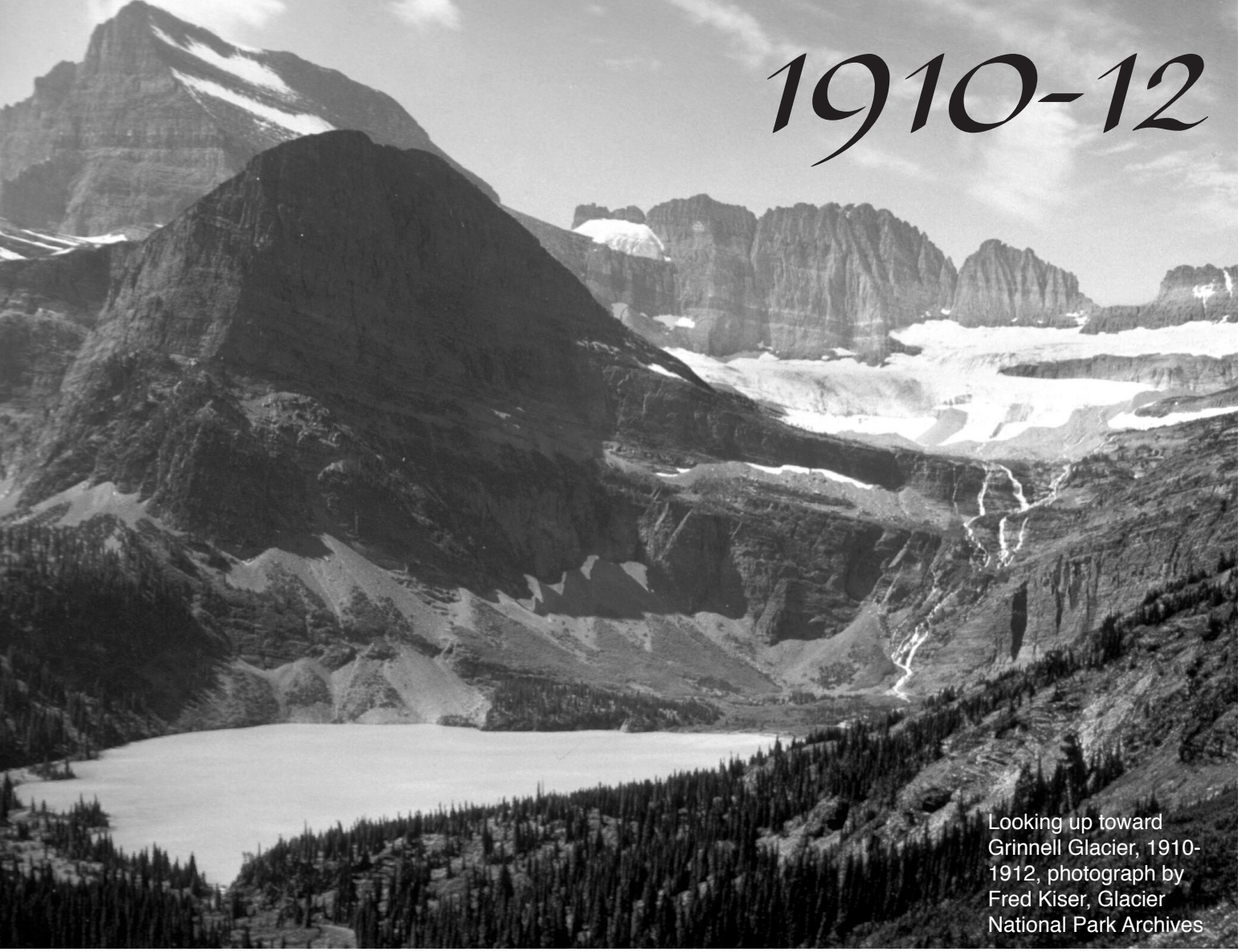
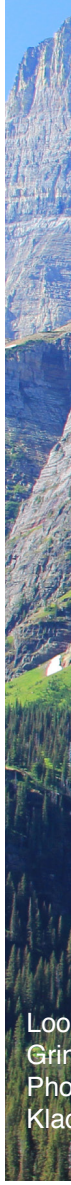


Looking up toward Grinnell Glacier, 1910-1912, photograph by Fred Kiser, Glacier National Park Archives



as they were now calling the sixth lake (today's Lake Josephine). Beacom, unable to climb because of an old injury, headed back to meet the rest of his outfit on the Lower Saint Mary's Lake, but not before proposing that the glacier they were attempting to reach be called "Grinnell's Glacier." In the years to come, Schultz would often take credit for naming the glacier, but the diary clearly indicates it was Beacom. Years later, after his death, Beacom's brother sent Grinnell a quote from Beacom's own 1887 diary in which he describes the trip and confirms it was the Army Lieutenant who gave the glacier its name.

The group camped at the head of the lake, with a plan to "make the glacier" the next day. Grinnell's first sentence in the diary entry for November 2nd leaves no doubt as to their success – "A most important day, for we reached the glacier, discovered a new lake, a most beautiful falls, true moraines at the foot of glacier and killed a superb ram." He follows that brief summary with more details:

"We breakfasted by moonlight and started in the gray dawn, on foot, for the glacier. Crossed the snowslide, about ¼ mile from camp, and kept up the valley on the East side, keeping well away from the creek. Less than a mile from camp we crossed another little creek, which runs down from a cañon in the southeast, and soon found ourselves at the edge of the timber. Beyond was a grass opening, dotted here and there with low spruces. Passing through this, we

> *"We breakfasted by moonlight and started in the gray dawn, on foot, for the glacier."*
>
> *George Bird Grinnell*

king up toward
nnell Glacier, 2011,
otograph by Will
czynski

stood on the border of a beautiful lake. It is perhaps a mile long and not quite as wide. Its water is of a clear green, not quite clear, but much less muddy than I supposed would be the case. To the left of it, or South, stands the solid wall of a peak which we named Monroe's Peak. At the head of the lake there is a narrow fringe of willow and lodge pines. Then rises a thousand feet of precipice over which plunges the water fall from the glacier. On the north, Grinnell's Mountain rises abruptly in a series of rocky ledges to a great height. Over all, is the tremendous amount of ice of the glacier, and about that, the snow patched vertical walls of the knife edged mountains. Here we stopped for a while and gazed in wonder and admiration."

After taking some pictures, the explorers proceeded along the lake, eventually reaching the foot of the falls where they began their ascent. The spray from the falls kept the rocks slippery, and the need to constantly renegotiate finger and toe placements made the going hard and slow. About two thirds of the way up, they reached a shelf that held debris that had been pushed down from the glacier. "Here," the diary continues, "were enormous peaks of drift—from boulders the size of a small house to pebbles the size of a pin head. Some as sharply angular as where they fell from the cliff above onto the ice, others worn and wounded by attrition against the subjacent rock. Most of this drift was larger; the finer gravel having been carried on and over the falls into the valley below where it was spread out in a great mass covering many acres."

As they ascended, they kept an eye on the falls that served as their map upward. Great masses of ice jetted outward from the falls, while in other places the water dropped down a sharp incline for a hundred feet or more. Keeping to the right of a great mass of "morainal drift," they continued working their way up until they reached a point just below the lowest edge of the glacier. From this vantage, Grinnell could begin to get a sense of the Glacier's size. "The glacier," the diary records, "lies in a basin two miles wide by one and one-half deep, and consists of two principal masses; one

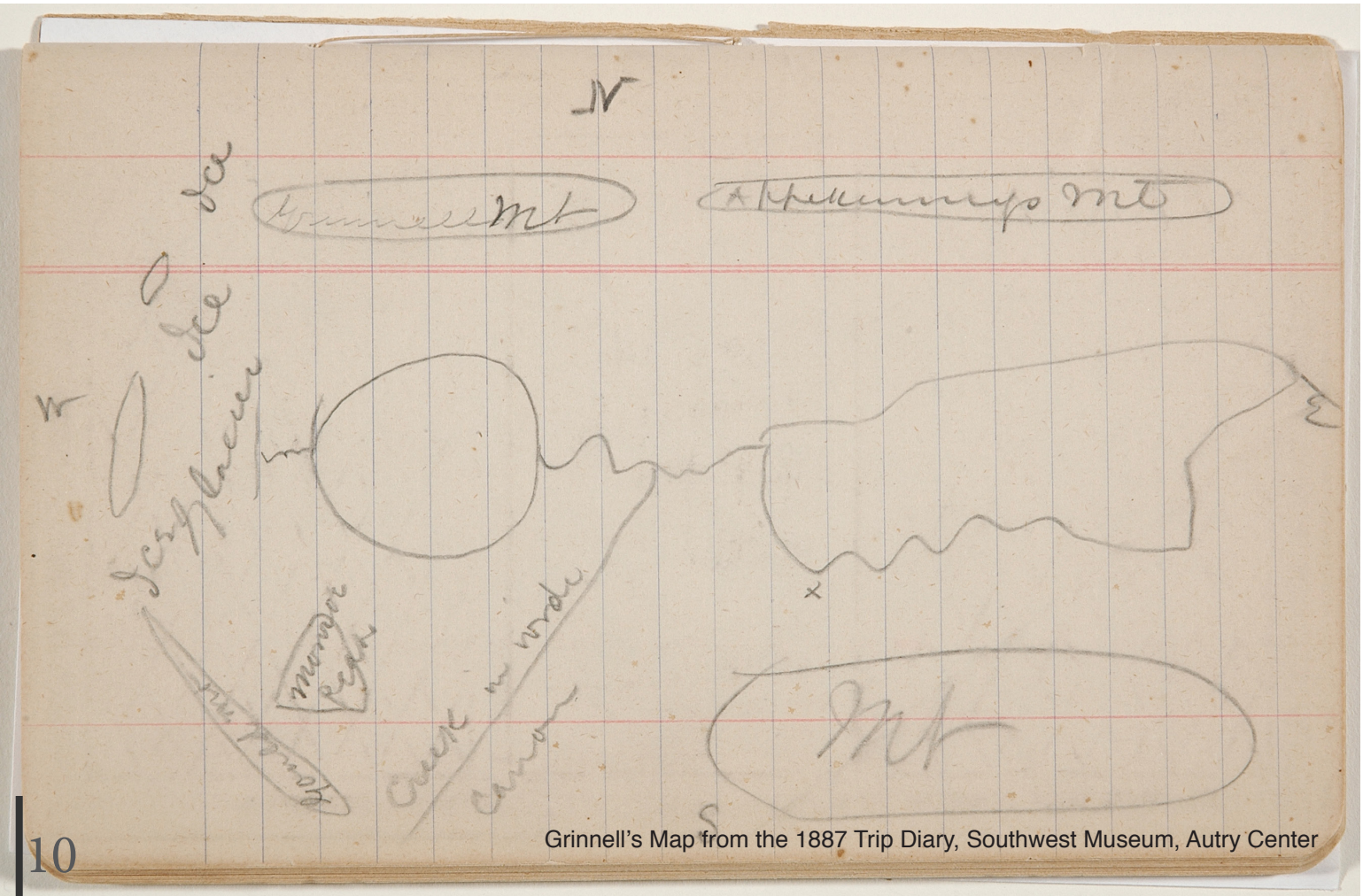
below which covers far more ground than the one above, and another on a ledge above which is very thick and is constantly falling over onto the mass below. It is difficult to estimate the thickness of the ice, but from the lower edge of the lower mass where, by melting, it thins off to the comb of the glacier, I should judge the vertical distance to be 600 feet. The thickness of the upper mass cannot be much less than 300, although from immediately below it seems less than that."

Although he had called the ice mass a glacier when he had first seen it in 1885, Grinnell was now compiling observational evidence to help solidify that declaration. In addition to noting the thickness of the ice and the debris found on the surface, he also noted the milky water he had seen in the sixth lake in 1885 was not present in 1887. He explained this as being due to the colder temperatures found in November. As a result, the ice was no longer moving down the mountain pushing glacial dust into the stream and then into the lakes – or as he described it in the diary, "the glacier is frozen up and will not move again until spring."

Unable to reach the upper section of the glacier, the trio ate lunch on the lower section and took in the sights. Soon the temperature began to drop and they decided they had better keep moving or begin their descent. Just then they spotted a bighorn sheep. Grinnell loaded his rifle, dropped to his knee, and fired. Sure that he had hit the ram but unwilling to give up his quickly dwindling time on the ice to find out, Grinnell sent Jack Monroe off to retrieve the ram while he and Schultz continued exploring. Finally, realizing that they needed to head back to camp, the trio headed down the mountain.

> "The roof seemed
> that eight inches
> and admitted the
> It was beautiful s

The diary reveals no detail about their route down. Grinnell's published account suggests they hung to



Grinnell's Map from the 1887 Trip Diary, Southwest Museum, Autry Center

l not to be more
or a foot thick
light quite freely.
ky blue ice."

- George Bird Grinnell

the side of the newly named Grinnell's Mountain, rather than climbing over the precipice at the foot of the glacier. Regardless of the route, they were in store for one more amazing sight. "We had gone but a short distance," the diary records, "when we passed on the lower side of a great snow drift in a gully. The snow had melted from above and the water had tunneled under it, so that a heavy roof stretched across the ravine. Jack went into it, and then called to me to come and see. I entered and was astonished at its beauty. It was eight to ten feet from floor to roof and perhaps thirty feet wide and sixty to seventy feet long. The roof seemed not to be more than eight inches or a foot thick and admitted the light quite freely. It was beautiful sky blue ice and had melted from the bottom so as to form a curious pattern of squares. It was lovely." Continuing on down to the camp, the day's diary entry concludes with a satisfied, "Feasted on sheep meat."

After the excitement and exertion of the climb, the next few days were spent relaxing in camp, writing up notes, and packing for the trip back down the valley. By November 5th they were back on Lower Saint Mary's Lake. Carrying a quarter of the sheep on his horse, Grinnell rode over to see Beacom and present the meat to the soldiers. Additionally, he told Beacom about the ice "in G's Basin," and presented him with a sketch of the valley and "his ideas as to the glacier."

The last two weeks of the trip were spent working their way back to Lethbridge, with occasional side trips to see the sights, hunt, and visit with friends of Schultz and Monroe. Monroe departed at an undisclosed date, but Schultz stayed with Grinnell all the way to Lethbridge. Grinnell's diary entry for November 20th simply notes, "Parted rather tearfully from Schultz, who returns to Agency

Looking East Over Grinnell Lake, Photograph by Rick and Susie Graetz

George B. Grinnell in Glacier National Park, 1916, Pearson Photograph, Collection of the Author

at once." A day later Grinnell was eastbound on the Canadian Pacific Railroad.

Arriving back in New York City, Grinnell immediately began converting his diary into a massive 18-part serial account for Forest & Stream. Gould contributed three parts to the series, including a 1500 word poem. Part one of the serial, entitled "The Rock Climbers," appeared on December 29, 1887. As winter settled in, Grinnell managed what were to be the final days of the Audubon Society (although other organizations of similar name and purpose would soon continue its work), while taking on a new cause as a co-founder (with his friend Theodore Roosevelt) of the Boone and Crockett Club. He also began work on the first of what became more than twenty books he would write over the next forty years. Grinnell continued to travel back to the Saint Mary's region, whenever time permitted, well into the 1920s. His relationship with Forest & Stream lasted until 1921, ten years after he sold the publication. When not writing books or Forest & Stream articles and editorials, Grinnell published dozens of articles in scholarly journals, as well as more general pieces in the day's most widely read periodicals—often offering his paternalistic views on the conditions and treatment of the Native Americans of the day.

Although always wary of getting officially involved in the relationship between the government and Native Americans, Grinnell did accept an appointment to serve as a Commissioner to negotiate the sale of much of the Saint Mary's region from the Blackfeet in 1895. The "ceded strip" sale, as it became known, ultimately opened the region to becoming a National Park, but contemporary historians have questioned not only Grinnell's reasons for serving as a Commissioner but also his fairness toward the Blackfeet.

One of the popular-press pieces Grinnell wrote, entitled "Crown of the Continent," appeared in The Century Magazine in 1901. The article took Grinnell's descriptions of the region's beauty to a new and larger audience. The call for turning the region into a national park quickly followed and for the next ten years Grinnell worked the halls of Congress while his pen urged the public to let their voices be heard as well. Finally, in 1910, the Saint Mary's region, and the larger area surrounding it, officially became Glacier National Park.

The Toe of Grinnell Glacier, Photograph by

Grinnell remained a New Yorker all his life, ultimately dying there in 1938. His last trip to the glacier that he first climbed in 1887 was in 1926 at the age of 76. His diary for the trip is brief and his tone seems a little more possessive about the region, referring to the features named after him as "my mountain" and "my lake." Even at an advanced age though, Grinnell observed the world with a scientific eye, noting in his 1926 diary that "the glacier is melting very fast and the amount of water coming from it is great. All these glaciers," he noted, "are receding rapidly and after a time will disappear." Grinnell managed one more trip back to the Park a year later but did not return to the glacier.

Besides the firsthand account of Grinnell's ascent of the glacier, the 1887 diary contains one other treasure—a

drawing of the valley—probably created at the same time as the one he gave Beacom on November 5th. The drawing is a bird's eye view of the basin looking down upon the valley. In the center of the page are two unidentified lakes, one small round one to the left (the newly discovered lake, or today's Grinnell Lake), and a longer one to the right (the sixth lake, or today's Lake Josephine). Above the lakes sit two mountains labeled "Grinnell Mountain" and Appekunnys Mountain" (Appekunny being Schultz's Blackfoot name – today the two mountains are considered the single Mount Grinnell). To the left of the round lake are the words "Ice Glacier," "Ice," "Ice," with two thin ovals to the left of the words. The ovals might represent ice masses or the rock peaks of today's Garden Wall. Below the glacier is "Gould Mountain," with the triangular "Monroe Peak" sitting between it and the round lake. While Gould Mountain, a tribute to his 1887 traveling companion remains on today's maps as Mount Gould, "Monroe Peak," named in honor of the man who became Grinnell's favorite guide, is today known as "Angel Wing." To the right of these two mountains is a line coming in from the bottom left, labeled "Creek in woods - canon" – today's Cataract Creek. Further to the right is an unnamed mountain (today's Mount Allen). Two other marks, a squiggly line running down from the glacier into the round lake and a small "x" on the southwestern shore of the longer lake, represent Grinnell Falls and the campsite the trio used on those cold November nights.

y Rick Graetz

In a letter to Gould, written some months after the trip, Grinnell explained that Beacom indicated he would use his copy of the sketch to produce an official army map. If Beacom ever did that, the map has not been identified. Grinnell produced at least three more formal maps of the region over the next few years. The nomenclature of the valley evolved as each map was produced; named features appeared, changed or disappeared altogether as each map became more detailed than the one before—but all can be traced back to this 1887 sketch.

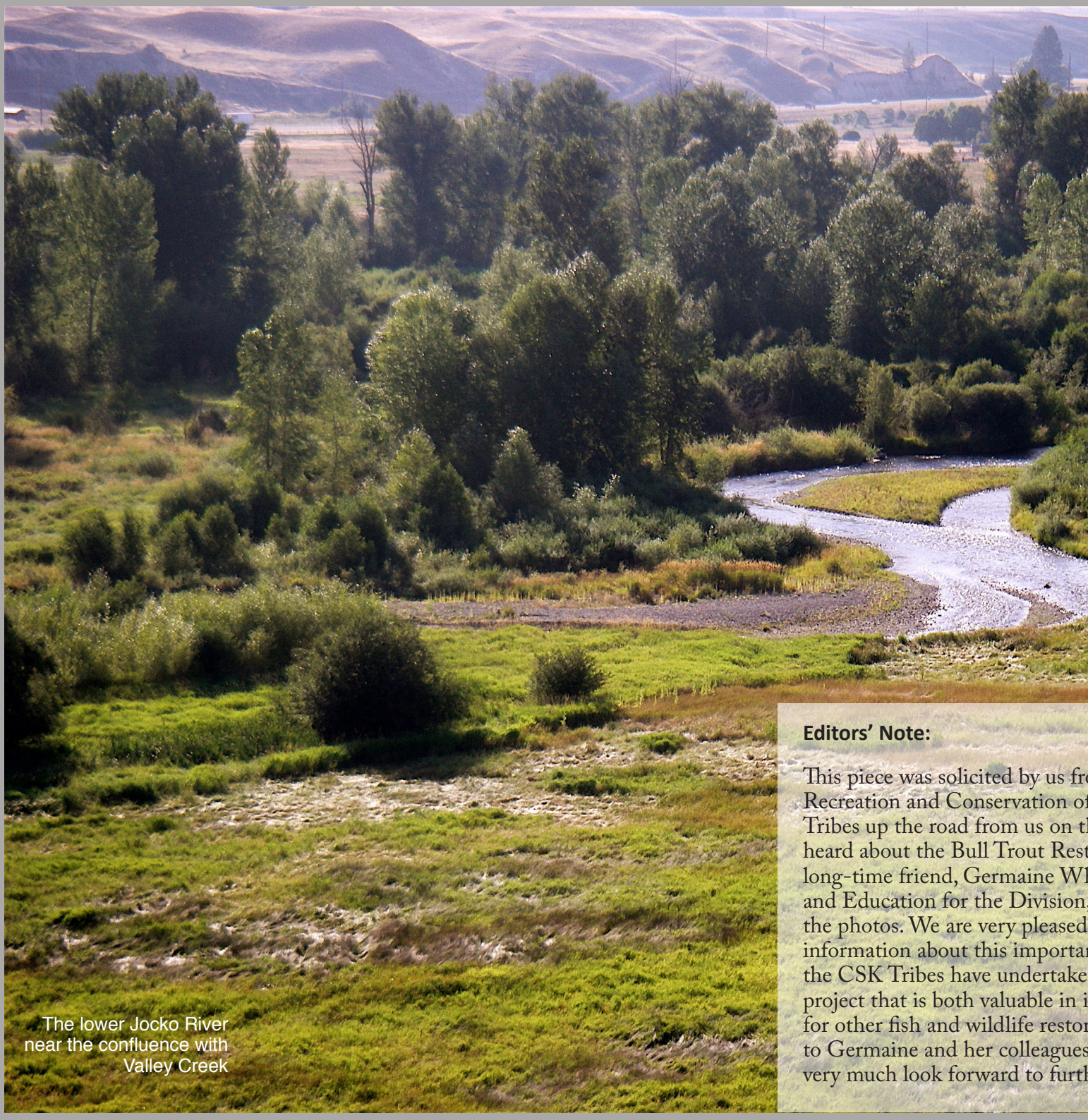
In 1919 Grinnell's friend, Madison Grant, published a history of Glacier National Park for the National Park Service. In a footnote he suggests that a more suitable name for today's Swiftcurrent Lake, the fifth lake, would have been Lake Grinnell. Doubtless Grant thought it fitting because that lake rests in the center of the Swiftcurrent valley, catching the waters of both the glaciers Grinnell spotted in 1885. Today the Many Glacier Hotel sits on the shore of that lake, and it does seem an appropriate feature to name after Grinnell. Perhaps, however, George Bird Grinnell would have thought it more appropriate that those interested in seeing the geologic features that bear his name should have to do a little more hiking of their own and, perhaps, even climb "to the ice."

Rick Vaughan joined the Indiana University Law Library staff in 1990, bringing his broad experience to the technical services department. As the acquisitions and serials control librarian, he oversees both the financial and procedural aspects of the area.

Active in university and national committees, he has served on the Bloomington Library Faculty Council and has chaired the American Association of Law Libraries (AALL) Committee on Relations with Information Vendors (CRIV) as well as the AALL Price Index for Legal Publications Advisory Committee. Long active in the relationship between law libraries and legal publishers/vendors, he has twice served as editor of *The CRIV Sheet* newsletter.

Although he has written numerous articles on issues within law librarianship, his research centers on the life of George Bird Grinnell (1849-1938), American ethnologist, naturalist, writer, and newspaper editor. He is currently working on a biography of Grinnell. His most recent Grinnell related publication, «To the Ice: George Bird Grinnell's 1887 Ascent of Grinnell Glacier,» can be found in the *Journal of the West* (v. 49 no.1).

Restoring



The lower Jocko River near the confluence with Valley Creek

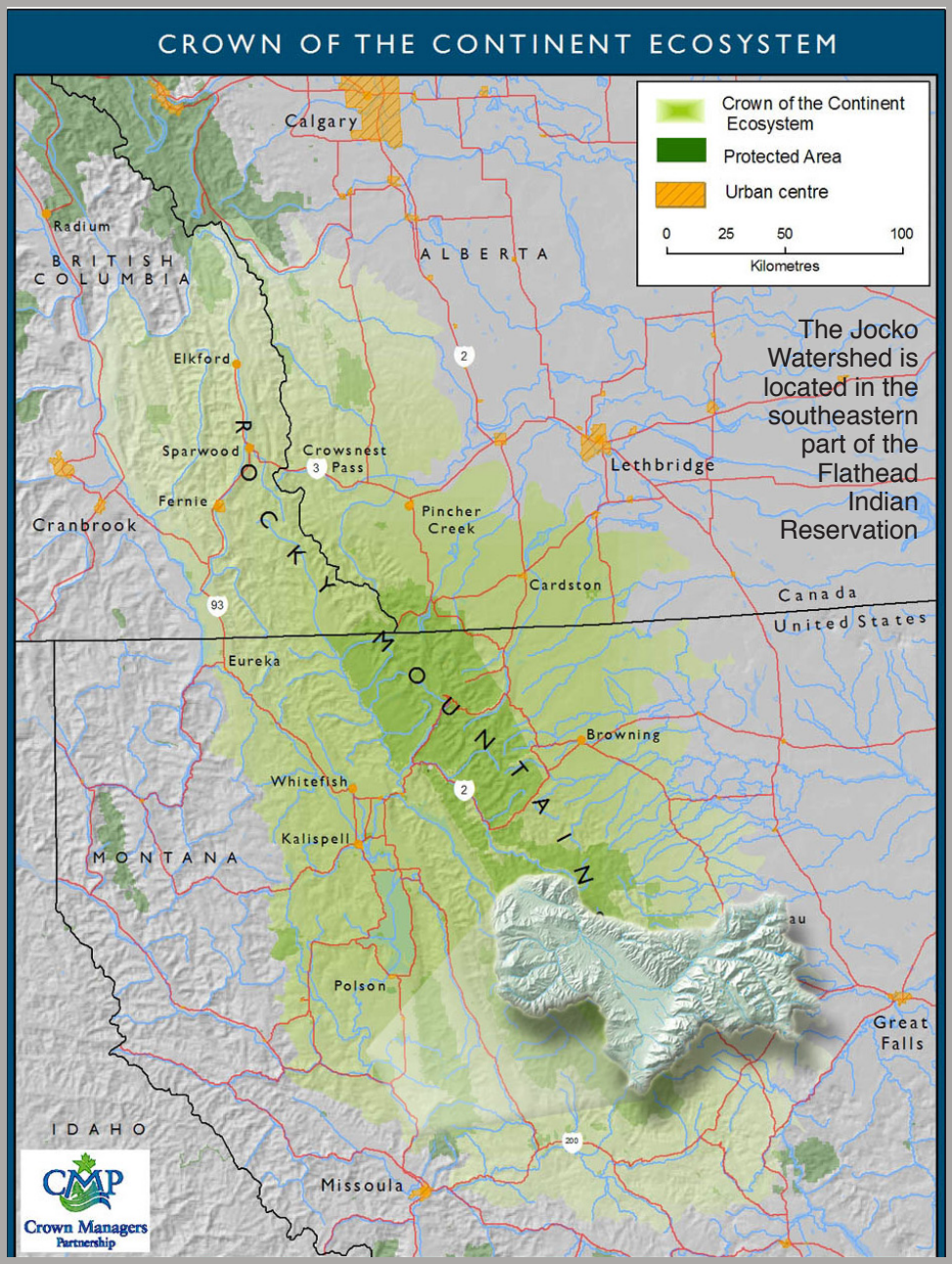
Editors' Note:

This piece was solicited by us fr
Recreation and Conservation o
Tribes up the road from us on t
heard about the Bull Trout Rest
long-time friend, Germaine Wh
and Education for the Division.
the photos. We are very pleased
information about this importa
the CSK Tribes have undertake
project that is both valuable in i
for other fish and wildlife restor
to Germaine and her colleagues
very much look forward to furth

the Wild

om the Division of Fish, Wildlife,
f the Confederated Salish and Kootenai
he Flathead Reservation after we had
toration Project in the Jocko Valley. A
hite, who is in charge of Information
, generously submitted this piece and
to be able to provide our readers with
nt restoration project, one of several that
n over the past several years. This is a
ts own right and a model in many ways
ration projects in the Crown. Our thanks
s for sharing this information with us. We
her collaborations with them.

In 1998, the Confederated Salish and Kootenai Tribes finalized a Consent Decree with the Atlantic Richfield Company (ARCO) to pay for the restoration, replacement, and/or acquisition of injured natural resources in the Upper Clark Fork River Basin (UCFRB), as compensation for natural resource damages basin-wide. Following an extensive natural resources inventory and restoration suitability analysis, the Jocko River watershed was selected as the target restoration watershed.



The Jocko was chosen because it is most similar in size, streamflow, hydrology, and species composition to Silver Bow Creek, the primary areas of injury in the UCFRB. In addition, the Jocko River drainage is a "core area" for bull trout, which are listed as threatened pursuant to the Endangered Species Act. The Jocko River watershed also sup—ports a relatively healthy population of westslope cutthroat trout, a Tribal Species of Special Consideration and a State of Montana Species of Special Concern.

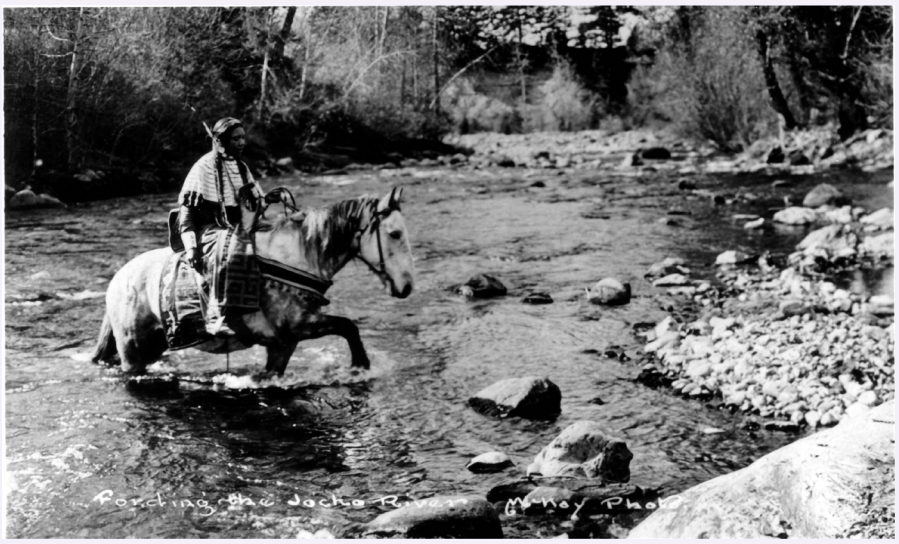
The Jocko watershed was also selected for restoration because it is threatened with further resource injury due to the high rate of development in the watershed. The lower reaches of the Jocko River ecosystem have suffered significant disturbance from land use such as agriculture, irrigation, livestock grazing, transportation, and residential and commercial development. These and other cumulative water quality impacts have destabilized a substantial portion of the Jocko River and substantially modified bull trout and westslope cutthroat trout habitat in the Jocko River, particularly downstream of the town of Arlee. These habitat modifications have exacerbated the problems of competition for existing habitat by brown and brook trout, and hybridization of westslope cutthroat trout with rainbow and Yellowstone cutthroat trout.

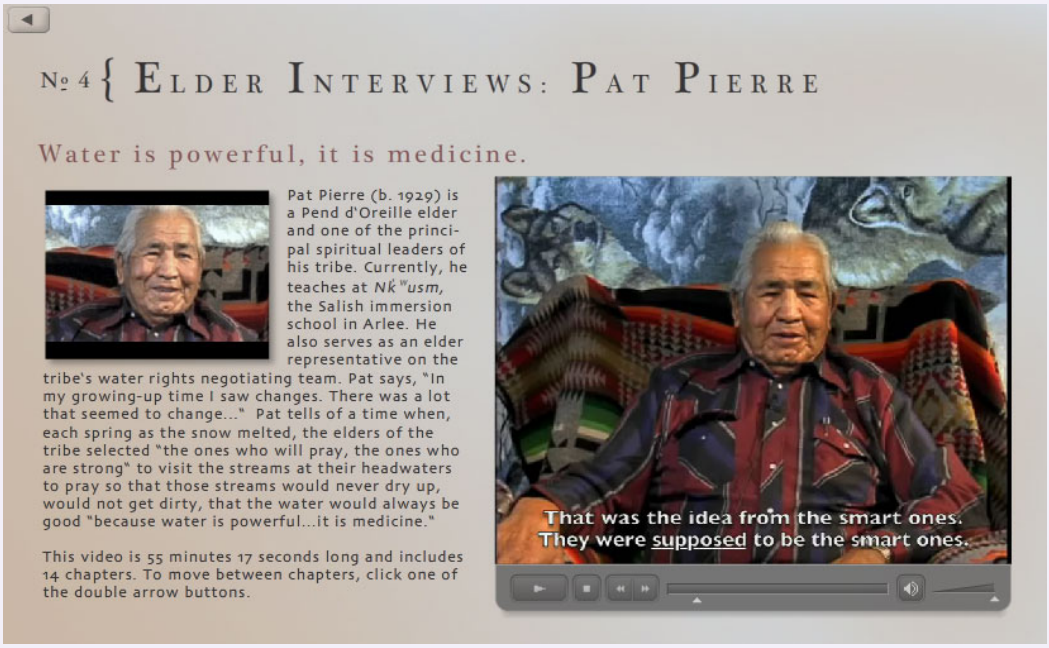
The tribes' approach to watershed restoration in the Jocko River drainage is comprehensive, and includes land acquisition, fish management, information and education, and active and passive restoration components. The Jocko River Master Plan is the road map for the restoration component of watershed restoration effort. This document describes the watershed history, present condition, and gives a vision for the future, and also outlines restoration strategies and techniques. It tiers off of the Riparian/Wetland Habitat and Bull Trout Restoration Plan; Parts I & II (Restoration Plan). Part I of the Restoration Plan provides background information, while Part II explains our approach to watershed restoration. It states: "The basic goal of watershed restoration is to reestablish the natural processes that existed before the watershed was disturbed. Because we believe a comprehensive approach has a greater chance of succeeding, the goal includes reestablishing natural linkages between the terrestrial, riparian, and aquatic parts of the ecosystem. Our focus, however, will be on the protection and restoration of riparian and wetland areas because they have the greatest influence over the health of the watershed."

The Tribes have developed an innovative, 4-part, multimedia education package available through the Tribes and the University of Nebraska Press

An important aspect of the tribes' restoration effort is to educate others on how to protect and enhance these important resources. To this end, we have developed an educational and outreach program, the centerpiece of which is a multimedia information and education package that describes the ecology and importance of bull trout and the relationship between bull trout and the Salish and Pend d'Oreille people. The package is composed of an integrated set of educational materials that include an interactive DVD entitled "Explore The River: Bull Trout, Tribal People and the Jocko River", a storybook, Bull Trout's Gift, a field journal, and a curriculum.

The restoration science and data in the Jocko River Master Plan and the information about the Tribes' long-term relationship with the species gathered from the Salish and Pend d'Oreille elders are linked through this project. The interactive DVD combines extensive text, video, multi-layered maps showing change over time, interviews, animations, audio, and access to a large number of websites of relevance to


The Tribes' long-term and deep cultural connection with the Jocko River has informed their restoration activities as well as their development of the multimedia educational package.



The interactive DVD includes over two and a half hours of elder interviews discussing bull trout, water, and the Jocko River.

the project. We structured the Explore The River DVD so it can reach children at multiple grade levels. We believe that an education program such as this is most effective when it exposes children to the material at the primary grade levels, then re-exposes them at the middle and high school levels, and then again as adults. In this way the message is more likely to be remembered and become part of each individual's worldview.

This multifaceted, multi-age approach will help ensure long-term support for the Tribes' restoration program. Accompanying the DVD is a storybook that targets K-8 students. The story, Bull Trout's Gift, teaches that bull trout need cold, clean, complex, and connected habitats. Through a traditional story it shows the importance of taking care of our streams and the fish and other creatures they support. Reciprocity—giving something back in exchange for all the gifts that streams have given us is the theme of the story. The book is also part of the DVD, but the book itself provides teachers and students with a more traditional, hands-on way of approaching the topic of stream restoration.

To encourage students and their teachers to take what they have learned from the DVD out of the classroom and into the field, we developed an attractive field journal. In addition to a variety of other activities, the curriculum includes lessons that require students to make entries into their field journals.

Through the curriculum, the DVD, storybook, and field journal are supported by a comprehensive set of lesson plans. The lesson plans will provide teachers, who have a limited amount of time, with a well-designed, organized, and thoughtful way to approach and use the materials, which otherwise might seem daunting. The books and DVDs are available through the University of Nebraska Press. The curriculum is available through though the Confederated Salish and Kootenai Tribes or check the website : www.exploretheriver.org for more information.

Arlee 5th graders visit a Jocko River restoration site

Exotic Invasions

By Ray Callaway

Editors' Note:

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ative piece on invasive plant, Ray Callaway, is Professor of Botany and
of Biological Sciences. A widely published and distinguished scientist
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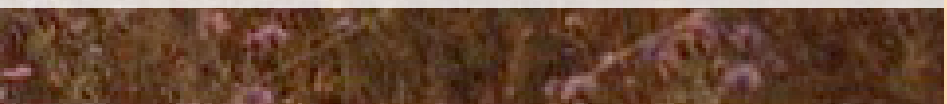
entist in his fields is well established nationally and internationally.
r-flung group of like-minded scientists from around the world,
Alpine Pals." We want to express our gratitude to Ray for contributing
d expect that it will answer many questions that our readers have
ws of this significant and vexing problem for our environment,
ns, including the Crown of the Continent. For additional information
his website at http://plantecology.dbs.umt.edu.



Most of us who live in the Northern Rocky Mountains of the United States and Canada actually live in prairie, or otherwise known as the "intermountain grassland" that carpets the valley floors of the Rockies and forms interlaced mosaics of prairie throughout our mountain forests. Intermountain grassland is not precisely defined by either geography or the plant species that form it, but roughly 15% of Montana is intermountain prairie, and it is this small percentage that sustains the agriculture of the Northern Rockies and provides productive habitat for much of the region's wildlife. Intermountain grassland is slightly different than its much larger grassland neighbors that border it to the east and west, the Great Plains and the Palouse grasslands, perhaps because of different impacts during the last Ice Ages, different collections of animals that live off the grassland, and more complex microclimates. For example, the intermountain grassland of the Bitterroot, Missoula, and Flathead valleys covers terrain that spent much of the last 50,000 years underwater, at the bottom of Glacial Lake Missoula. And for reasons that are not entirely known most intermountain grassland did not appear to come into contact as often with the massive bison herds that shaped the grasslands of the Great Plains. Also, much of the intermountain grassland is not subjected to the consistent bone-chilling winter cold and scorching summer heat of the Great Plains grasslands.

Most of the plants that make up the Intermountain grassland are also found in the Palouse and the Great Plains, but species such as rough fescue, Idaho fescue, bluebunch wheatgrass, arrowleaf balsamroot, and silky lupine are often more abundant and characterize the prairies within the Northern Rockies. More recently, intermountain grassland has become characterized by a new group of species, exotic invaders such as spotted knapweed, leafy spurge, cheatgrass, and sulfur cinquefoil. These invaders, and many others, originate from Europe and Asia where they were shaped by very different climates, geological histories, and interactions with other organisms. These invaders have been intentionally or unintentionally brought to North America by humans who

also originated, for the most part, in Europe. These invasions are peculiar in the context of what ecologists call "local adaptation," the advantage gained by a species that lives in a place long enough to adapt to the local ecological conditions. Local adaptation is one of the most important processes in nature, yet most of the exotic invaders of intermountain grassland have become far more abundant and dominant in their new ranges where almost everything of importance ecologically is different than in their native lands. Local adaptation does not seem to matter very much to these invaders. For reasons that remain mysterious, intermountain grasslands appear to be unusually susceptible to exotic plant invasions, and large areas have been converted from systems rich in diverse native species to almost exotic monocultures within decades. One important factor is human disturbance, which promotes all of these invaders in unknown ways, but ways that put natives at a great disadvantage. However, many invaders also appear to get a leg up on natives through subtle yet powerful changes in the networks of biological interactions among species that make up what we call "communities".

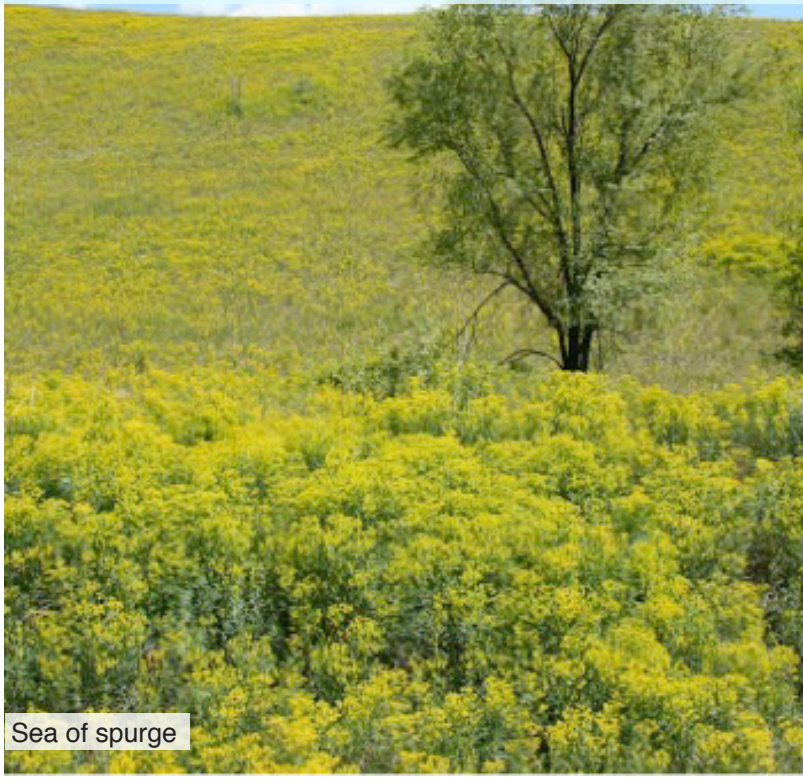
The most obvious change that exotics experience outside of their native ranges is that they escape attack from the many "specialist" organisms, those that have learned or evolved to eat a single species or a suite of closely related species. These specialists are almost always insects and fungi, and these single-minded consumers appear to respond overwhelmingly to plant chemistry. Plants are spectacularly diverse chemical factories, with virtually every species producing a unique cocktail of different chemicals in their leaves and roots. Specialists have evolved to either sequester highly species-specific toxic chemicals away from their vital organs or detoxify them. Oddly, this specialist adaptation comes at the cost of being able to eat other plant species which makes the specialist totally dependent on its target species. In an effort to control exotic invaders in intermountain grasslands, and in other systems around the world, scientists have collected many specialist insects from the original native ranges of the invaders and released them in the new ranges of the invasive plants. The intention is to use specialist insects as "biological controls", and some, like the flea beetle released to attack leafy spurge, have wreaked havoc on the invader in some places. However, the responses of native intermountain species have not been as dramatic. In one case, Peter Lesica at The University of Montana showed that flea beetles reduced the abundance of leafy spurge by almost 40%, but this damage to the invaders did not increase native diversity. Specialist insects can

Ray in Intermountain grassland

"Specialist insects have recieved a lot of attention. They can easily be seen with the naked eye, found, gathered, and released, and they rarely attack other species."

effectively attack and kill spotted knapweed, but other biological controls can stimulate greater reproduction by the invader. Also, Yvette Ortega and Dean Pearson, of the Rocky Mountain Research Station and UM, found that increased seedling survival of spotted knapweed after adults were killed by a biological control weevil (that can be highly effective in some cases) compensated to the point where their knapweed stands were not affected. Regardless, specialist insects are a crucial component of complex networks of interacting species in communities, have had strong effects on some invaders around the world, and also have a great deal of potential to contribute to the suppression of other invaders.

Specialist insects have received a lot of attention. They can easily be seen with the naked eye, found, gathered, and released, and they rarely attack other species. But invaders also escape attack from microscopic specialists that can either kill or weaken them. In native communities, plants interact with hundreds or thousands of species of bacteria and fungi, often at the same time and most of which live in the soil. These soil organisms function in such complex ways that most biologists treat them as a group - the "soil biota". Sometimes, we can find a single soil organism that suppresses an invader, but generally we see and measure the effects of the biota as a whole. Regardless, escape from the soil biota in their native ranges appears to be a major factor in many exotic invasions. When grown in soil from their native ranges for a long time, many plant species accumulate pathogens that suppress their growth, but these soils do not affect the growth of other unrelated native species. This is due to some degree of specialism by soil micro-organisms on certain plant species. These long term effects of the plant on the soil biota and reciprocal effects of the soil biota on plants are called "plant-soil feedbacks". In intact and healthy native ecosystems plant-soil feedbacks are almost always negative, and this means that dominance by a single species is dampened by the accumulation of micro-organisms with a dietary preference. But many invaders escape this accumulation of these microbial specialists when they are brought to a new place and grow in new soil. For example, spotted knapweed is suppressed by



Sea of spurge

negative feedbacks when grown in soil from its native Europe, but in soil from intermountain grassland in Montana the negative feedbacks either do not occur or can actually be positive. In other words, spotted knapweed in Montana suffers far less from accumulating inhibitory soil micro-organisms than our native species, and at times may even benefit from growing in the same soil for multiple generations. Intermountain grassland natives don't.

Scientists who study invasions are similar to scientists everywhere in that they are trained to reduce or eliminate the effects of every process but one, so that we can evaluate the effect of the single leftover process. This is good science, but it sometimes leads to incomplete ecology. We know now that plants, animals, bacteria, and fungi interact in ways that depend on their simultaneous presence. Thus, the scientific elimination of one factor actually affects the performance of the other factors, leading to a bit of a conundrum. So to understand what makes invaders tick we may have to learn at least a little bit about

"Exotic invasions worldwide increase the amount of biomass produced by plants by about 80%, an astonishing effect."

complex networks of other species all interacting at the same time. For example, Tony Caesar, a scientist with the USDA in Sidney, Montana, found that the suppression of leafy spurge by flea beetles and a leaf pathogen working together was far greater than could be predicted by the effects of either working alone. Also, pathogens were much more abundant on leafy spurge in the field when they were being attacked by the flea beetle than when there were no flea beetles. These kinds of synergistic effects are very hard to measure, but may be invaluable for understanding why invaders are such lightweights in their native ranges but punch far above their weight when they are away from home.

The chemicals that attract specialist enemies can be very effective at deterring generalist enemies. Generalists are herbivores that are much less choosy about their diets than specialists. Generalists do not have the extremely specific physiological adaptations necessary to sequester or detoxify single chemicals, but instead are good at tolerating small amounts of many different chemicals. In fact, some generalists may benefit from a mixed diet. However, generalist enemies have largely been ignored, at least explicitly, in the context of invasions because generalist enemies are everywhere and, of course, they occur in both the native and non-native ranges of all invaders. So how can they be escaped? The answer to this may lie in developing a better understanding of what generalists actually prefer to eat. No generalist eats everything, and it stands to reason that generalists might show some degree of local adaptation, learning or adapting to eat local plant species and their species-specific chemicals. Spotted knapweed and many related knapweeds are defended by a bitter tasting chemical called cnicin, and this chemical has not been found in other species. When generalist insects native to Montana grasslands were fed spotted knapweed, they either did not grow at all or grew much more slowly than on a diet of lettuce and bean leaves. In contrast, when generalist insects native to European grasslands were fed the same knapweed diet they grew just as fast on knapweed as on the lettuce and bean salad. This suggests that the European generalists may have adapted or acclimated to cnicin or other defense chemicals produced by knapweed because they have had a very long time to do so; whereas Montana generalists have not adapted to the chemistry of knapweed in the very short time the invaders have been here.

Vertebrates, and especially mammals, are far more likely to be generalists than insects, although mammal herbivores have their preferences. Montana's big native grazers, like elk, deer and bison will certainly consume knapweed and other invaders, but they do not seem to prefer them over native grasses. Montana's non-native big grazers also seem to prefer food other than invaders as well. Matt Rinella of the USDA Livestock and Range Research Laboratory in Miles City estimates that leafy spurge invasion has reduced the cattle-carrying capacity of grasslands by 50-217 thousand animals a year, due in part to the avoidance of spurge by cattle and by the poor fodder it provides. In the Great Plains grasslands of North Dakota, researchers studied the densities of fecal pellets from bison, elk and deer to estimate consumption of leafy spurge and other invaders relative to that of native species. Bison used leafy spurge-infested grassland 83% less than native grasslands and deer use was reduced by 70%. Similar avoidance has been found in other systems with other large generalist herbivores. Our small mammal herbivores may also affect invasions through their dietary preferences. Dean Pearson and John Maron, scientists at The University of Montana, found that deer mice, when given a choice, would eat the seeds of almost any native in the same family as knapweed (Asteraceae) rather than knapweed seeds. When they excluded deer mice from patches of intermountain grassland native asters increased in abundance, but not knapweed, indicating that deer mice controlled the natives they so preferred, but not knapweed. Similarly, Jacob Lucero, now a graduate student at UM, has shown that entire communities of native seed-eating rodents avoid the seeds of the invasive cheatgrass while devouring the seeds of native species. It is not entirely clear why some invaders are so avoided by native generalist herbivores, but this avoidance may give some invaders a strong advantage over natives.

In fact, avoidance by generalists and the absence of specialist herbivores may lead to one of the more bewildering effects that invasive plants have on native ecosystems increasing ecosystem productivity and nutrient availability while annihilating native diversity. Exotic invasions worldwide increase the amount of biomass produced by plants by about 80%, an astonishing effect. One might think that this increase in productivity must come with a reduction in soil resources as the invaders use them up to produce all this biomass. However, this is not generally the case. In fact, invaders are associated with increases in some soil resources. For example, plant-available soil nitrogen increases worldwide by about 20% with exotic plant invasions, and spotted knapweed appears to increase plant-available phosphorus in soils. Here in our Montana grasslands, University of Montana graduate student Morgan Luce has shown that leafy spurge, spotted knapweed, and cheatgrass invasions drive native species out of communities, but all three of these invaders roughly double the productivity of grassland in the Missoula and Bitterroot valleys. Also, in a bizarre twist these invaders also roughly double plant-available nitrogen. We do not know how this works; perhaps fast-living and fast-dying invaders simply ramp up nutrient cycling rates over a few years and thus increase soil fertility. On the other hand, perhaps these same native grazers avoid invasive plants and allow them to reach the same productive potential as native plants growing in the absence of their native generalist grazers. When large native herbivores are excluded from native grassland in the Blackfoot valley, productivity roughly doubles, about as much as invaders increase productivity.

The effects of native and non-native grazers on invasions may act in concert with pathogenic soil biota, and their synergistic effects may be powerful. But we also know now that competition among native plant species differs to some degree from competition among native and invasive species, even in the absence of natural soil biota and herbivores. In its native Europe, spotted knapweed is highly suppressed by other European native plants, and experimental removal of these plants results in knapweeds that are almost ten times larger and ten times more reproductive than other knapweeds still growing with

Solidago gigantea, native to Montana but here invasive in Hungary

their neighbors. In identical experiments in Montana the removal of competing Montana natives had no effect. This far greater ability of species from knapweed's native range to suppress knapweed can also be seen where European grasses have been planted or allowed to grow on rangelands in intermountain grassland where knapweed is often much less abundant. The greater resistance of these European natives to spotted knapweed and other invaders may also have a chemical basis. In controlled conditions spotted knapweed and other invaders can suppress plants native to Montana intermountain grassland by way of chemicals released from their roots, leaves, or litter in a process called allelopathy. Some experiments have shown that plant species native to Europe are much less susceptible to the allelopathic effects of invaders from Europe than species native to North America. In a fascinating twist similar things seem to happen when plants native to our Montana grasslands invade Europe. Giant goldenrod is a Montana native that has become highly invasive in central Europe. Robert Pal, a scientist from the University of Pécs in Hungary currently working at UM,

"These new findings and others like them are gradually shedding light on the many different causes of exotic plant invasion."

found that giant goldenrod has far greater effects in the field on the native biodiversity of Hungarian grasslands than it does in its native range in North America, and that the allelopathic effects of giant goldenrod roots are much stronger on European natives than on Montana natives. Such biogeographic differences in the allelopathic effects raise the possibility that plants are adapting to each other's chemicals in ways that are similar to ways that generalist herbivores and plants adapt to each other.

Advancing spurge

In native grasslands of the southern United States, invasion by Johnson grass can reduce native diversity by many times over while dramatically increasing productivity and nutrient availability; as noted this a common pattern for many invaders. However, in this case the weird combination of effects is due to something exceptional. Marnie Rout, while a graduate student at The University of Montana, discovered that the underground stems, called rhizomes, of Johnson grass were packed with bacteria, known as endosymbionts, most of which had the capacity to "fix" unavailable nitrogen from the atmosphere into plant-available nitrogen. When she treated Johnson grass with antibiotics the invader lost its super powers and was no longer a good competitor, its roots no longer produced a well-known allelopathic chemical, and its leaves no longer produced highly effective defensive chemicals. Such effects of endosymbionts may be highly unique, we do not know, but some invaders of our intermountain grasslands also use symbiotic micro-organisms to their advantage. Spotted knapweed is host to many genetic forms of a fungus in the genus Alternaria. While a graduate student at UM, Erik Aschehoug found that knapweed infected with one genetic form of the fungal endosymbiont (comprising a plant-fungus symbiosis) grew much larger than uninfected knapweed plants. Another knapweed-symbiont combination did not produce larger plants but resulted in far more competitive knapweeds…against North American native grass species but not against European native grasses. Later he found that this fungal endosymbiont made knapweed more allelopathic. Very recently, scientists at the University of Idaho have found that cheatgrass also harbors a fungal endosymbiont, the same fungus that produces the morel mushroom in order to reproduce sexually after fires. When cheatgrass was infected with this endophytic fungal symbiont, the invader grew larger and produced more seeds, and these seeds were more heat resistant than seeds from uninfected plants.

These new findings and others like them are gradually shedding light on the many different causes of exotic plant invasions in our intermountain grasslands, which range from the physical disturbance of ecosystems to the presence or absence of micro-organisms with different dietary preferences. Furthermore, these processes appear to act in concerted networks with each other and affect each other in very complicated ways. More importantly, the function of these networks appears to be determined by whether their components have evolved together or not, and we are beginning to see invasions as the undesirable consequence of mixing different components of communities without common evolutionary histories.

Do Those **Things** Really Work?

Editors' Note:

This article and the accompanying Infographic are provided by the Miistakis Institute of Calgary. This Institute, affiliated with the University of Calgary, has the mission of supporting and undertaking both pure and applied research focusing on the ecosystems of the Rocky Mountains and surrounding regions. We carried an earlier and related article to this one in the Autumn 2011 issue of the UM Crown of the Continent E-Magazine which can be accessed on our website at http://crown.umt.edu and clicking on "E-Publications." The Miistakis Institute has been a very important partner of our UM initiative since the beginning, and we want to thank them immensely for all of their wonderful, exciting, and important work as well as for their continuous collaborations. The Institute's website is found at www.rockies.ca.

Over **220,000** large animals have used the crossing structures in Banff National Park

"Do those things really work?" Without fail, this is always the first question posed when I share that some of my work is focused on a wildlife crossing structure research and monitoring project. Many people are now familiar with the iconic wildlife overpasses and underpasses that were first built in Banff National Park, yet there seems to be lingering doubt as to their effectiveness. The very first thing I say in response to this query is ***yes***, these crossing structures absolutely work —over 220,000 large animals have used the structures in Banff National Park since monitoring began more than 15 years ago. Everything from salamanders to grizzly bears now use wildlife overpasses and underpasses to safely cross the bustling Trans-Canada Highway which snakes its way through Canada's first national park. The second thing I mention is that I am pleased to report that wildlife crossing structures are not reserved for parks and protected areas. Within the Crown of the Continent region wildlife crossing structures, including overpasses, underpasses, wildlife fencing, jumpouts, and wildlife crossing guards, have now been built on US 93 North in Montana, and many are now advocating for wildlife crossing structures to be constructed at key sites along Highway 3 in southern Alberta.

Finally, a recent report co-authored by the Western Transportation Institute at Montana State University and the Miistakis Institute has demonstrated that wildlife crossing structures make financial sense. The report focused on a wildlife crossing structure in the Rocky Mountains of Alberta. Using very conservative estimates the report authors demonstrate that following the construction of the wildlife underpass, the overall annual cost to society was reduced from $129,000 to $18,000 per year because there were fewer damaged vehicles, injuries and deaths. The cost also accounts for lost hunting revenues. Most people love wildlife and saving money, so wildlife crossing structures are public infrastructure that people can readily support!

In an effort to elevate the conversation on building or expanding highways with both wildlife and people in mind, the Miistakis Institute has been working with its partners to develop several tools. Miistakis created a "Highways & Wildlife" infographic to clearly convey why wildlife crossing structures are important, how they work, and their cost effectiveness. The infographic strives to debunk some of the myths surrounding wildlife crossing structures.

Miistakis has also partnered with award-winning film maker Leanne Allison (*Being Caribou, Finding Farley, Bear 71*) to create a documentary film called *Highway Wilding*. Build them and they will live—that is the simple message in this documentary that looks at the issue of highways, and some of the pioneering solutions that exist to prevent road kill and reconnect landscapes across highways. In the Crown of the Continent we have one of the last best chances in the world to maintain a fully functioning ecosystem with all the native large carnivores, but roads are a major problem. Everything from grizzly bears to wolverines and ducks to salamanders need to get across roads safely for breeding, to find food, adapt to climate change, or to migrate. After seeing this film you'll never drive down a highway in the same way again. *Highway Wilding* is one of the films selected for the 2012/2013 Banff Mountain Film Festival World Tour. To view a trailer for the film, please click here.

Miistakis would like to acknowledge its road ecology partners and funders: Western Transportation Institute at Montana State University, Parks Canada Agency, Yellowstone to Yukon Conservation Initiative, Road Watch in the Pass, Anatum Consulting, Alberta Ecotrust Foundation, the Galvin Family Fund, Wilburforce Foundation and Woodcock Foundation.

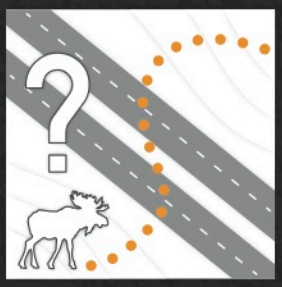
*See next spread for infographic

Highways & Wildlife

1. What is the problem?

1

All wildlife need to be able to move freely throughout their habitat to access water, food, and mates.

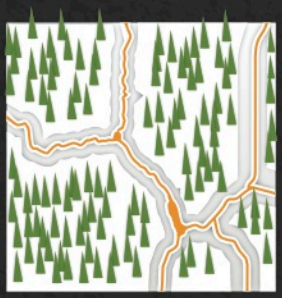


2

When highways are built through habitat, wildlife must find ways to cross.

3

Sometimes vehicles collide with crossing wildlife. These collisions are unsafe and very costly.



4

When highways are built or widened, this fragments wildlife habitat and increases the risk of wildlife-vehicle collisions.

4 - 8

large animal - vehicle collisions take place

every hour

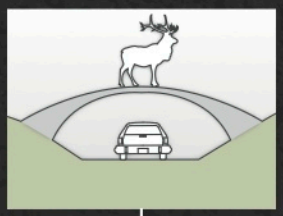
in Canada

Highway Wilding
Wildlife Monitoring and Research Collaborative in the Canadian Rocky Mountains

Miistakis Institute for the Rockies
Parks Canada
Western Transportation Institute

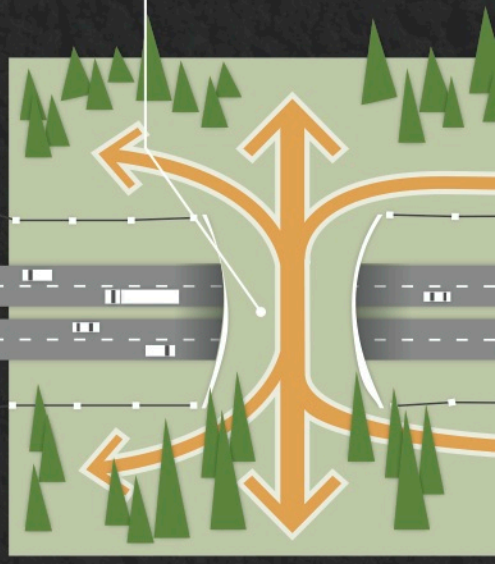
2. What is the solut

We can make highways safer for both wild traffic and wildlife with **crossing structur** and highway fencing.



Bridging

Tunnelling

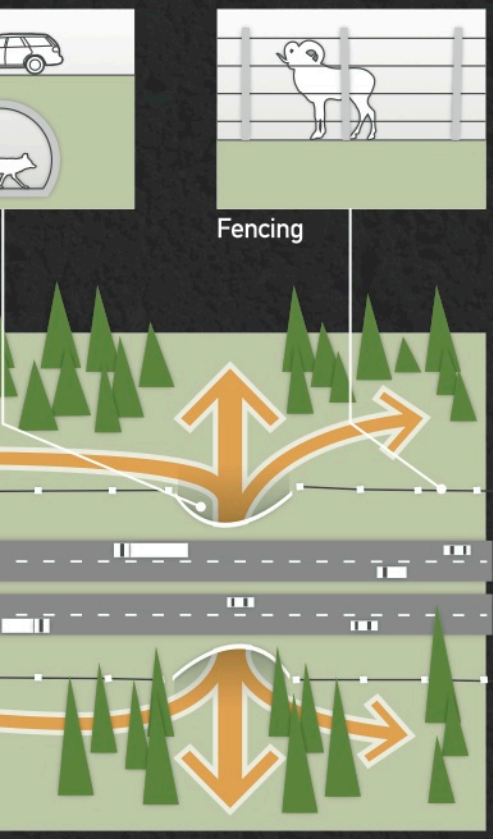


3. Do crossing stru

Absolutely! Scientists have now collected fifteen years of data on wildlife using highw crossing structures. While some animals t time getting used to these structures, man different types of animals -- from salaman grizzly bears -- now use them regularly.

tion?

llife and people by separating
res -- including bridges, tunnels,



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3 sec

average time in seconds between vehicles on the Trans-Canada Highway in Banff National Park

15 years

number of years of research on crossing structures in Banff National Park

95 %

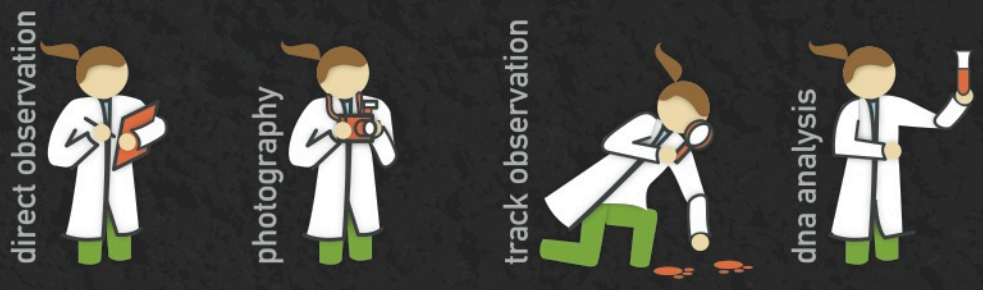
reduction in wildlife-vehicle collisions on highways with crossing structures (deer, elk, & moose) recorded in Banff National Park

200,000 +

large mammals detected using crossing structures in Banff National Park

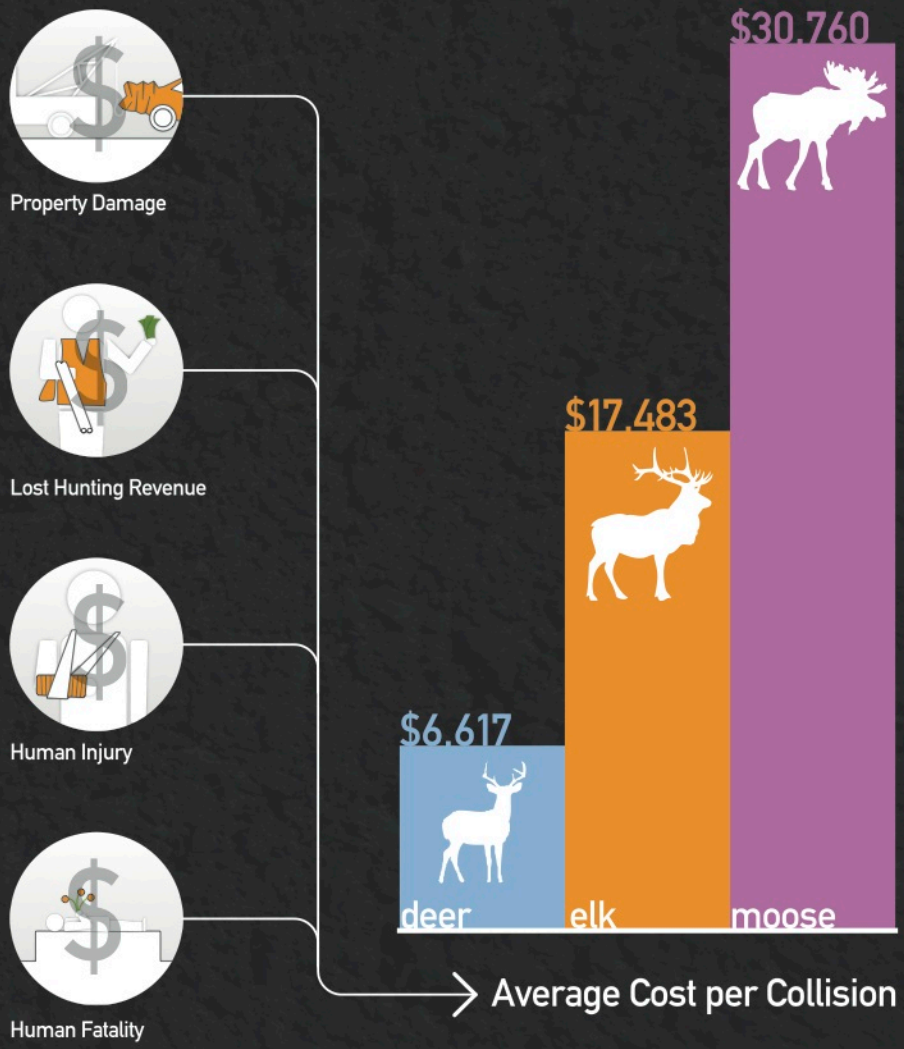
4. How do we know they work?

Scientists have a variety of ways to measure the use of crossing structures by wildlife. These include direct observation, motion-sensing cameras, track observation, and DNA analysis (of fur captured from crossing animals).



5. Are they cost effective?

Yes! At sites where there are regular wildlife crossings, the cost of collisions -- including property damage, loss of hunting revenue, human injury, and human fatality -- far outweighs the cost of building bridges, tunnels, and fencing. By installing crossing structures, the Trans-Canada Highway near Dead Man's Flats in Alberta has saved over $85,000 per year!



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