

CROWN of the CONTINENT and the GREATER YELLOWSTONE

MAGAZINE



UNIVERSITY OF
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CROWN of the CONTINENT and the GREATER YELLOWSTONE

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University of Montana field course class on mountain geography in Yellowstone. Rick and Susie Graetz

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Cover photo: The village of Polebridge snuggles up against the northwestern border of Glacier National Park. Rick and Susie Graetz

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PRESS

As we head into this New Year and our eleventh issue, we want to thank our talented designer in UM's Printing and Graphics unit, Neal Wiegert, for his work in creating a lively platform so that, hopefully, you will find the wide range of articles, images, and knowledge enclosed to be interesting, informative, and even inspiring.

As always, we are indebted to our many partners, whose work we are privileged to offer and display. Their willingness to accept our invitation to contribute is greatly appreciated, for they are "the meat" of our magazine. We also want to make note of our two new sponsors, D A Davidson & Company and PayneWest Insurance, whose financial support helps us cover some of the costs of producing the publication. We urge you to note their subtle, timeless, and relevant "ads."

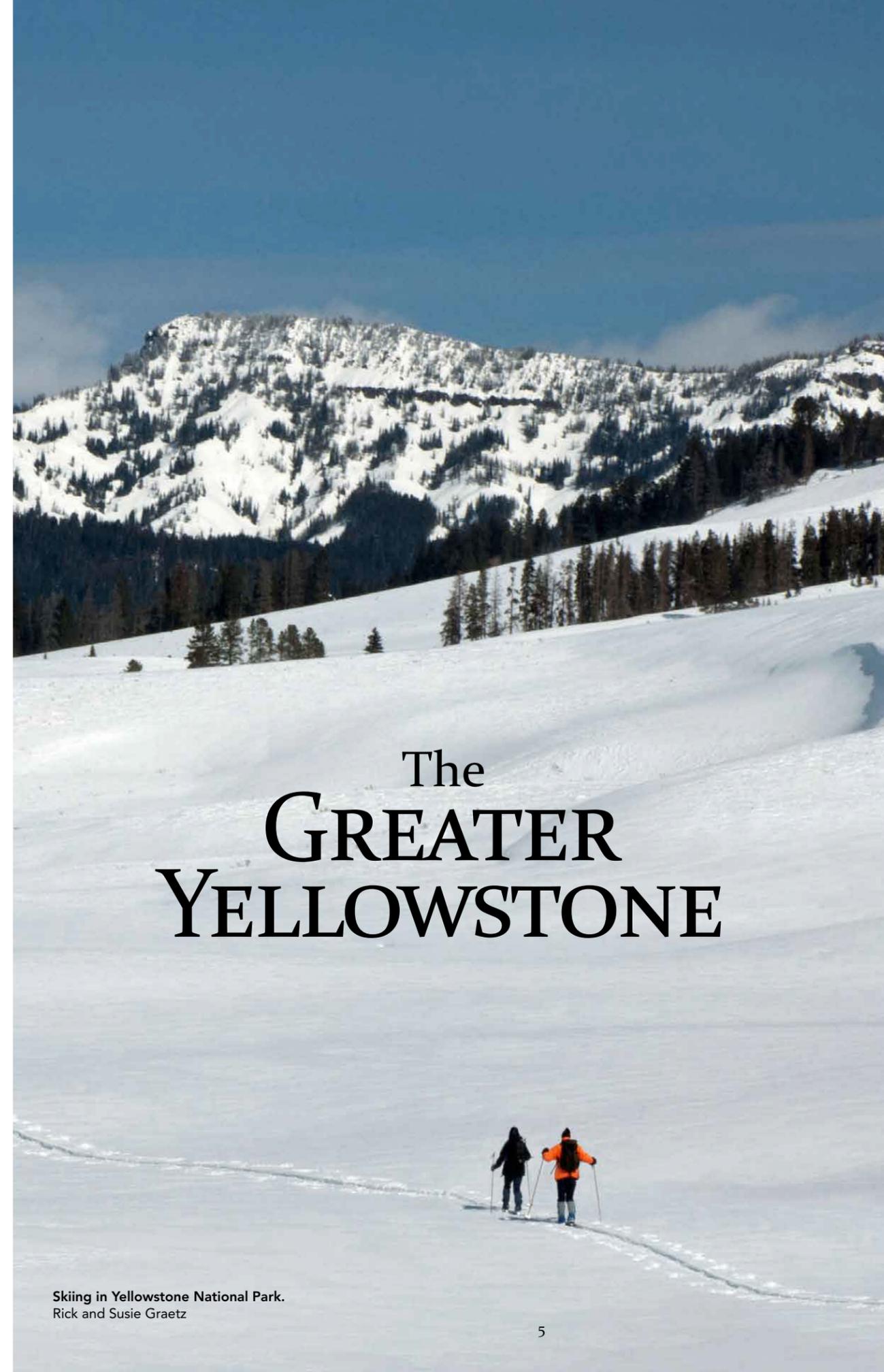
As most of you are aware, 2014 marked the 50th Anniversary of the US Wilderness Act, a piece of legislation that has had a profound effect on many parts of the US, particularly here in the West. Many of our partner organizations celebrated this anniversary by sponsoring events, conferences, special publications, and encouraging us all to think about the legacy of this historic act as well as its future implications. In earlier issues of our e-Magazine, we carried a number of features that focused on several of the individual wilderness areas in the Crown and Greater Yellowstone (the Scapegoat in issues # 3 and 8, the "Bob" in issues # 2 and 4, and the Lee Metcalf in issue #10). Our contribution starts on page 75.

This issue consists of four sections: first is the Greater Yellowstone; second is the Crown of the Continent; the third, the "Bridge," deals with topics relevant to both of "our" ecosystems; and lastly, Field Notes.

After you have perused this publication, we invite you to write to us if you have ideas for future issues; and, in the form of brief "Letters to the Editor," give us the benefit of your comments, impressions, questions, and responses, both to this issue and to our e-Magazine in general. Please send them as e-mail messages to: crown.yellowstone@mso.umt.edu.

Attention all photographers! We are asking for your help in showcasing the sheer beauty, personality, communities, and inhabitants of the Crown and Greater Yellowstone ecosystems. If you are interested in submitting your work for our consideration, please send your contact information to: crown.yellowstone@mso.umt.edu (sample photos or links to professional/personal websites may also be sent). As soon as we have the next issue's content lined up, we will send a submission request to you with the subject matter and details on photo requirements. Come join us and help make our issues even better!

- Jerry Fetz and Rick and Susie Graetz



The GREATER YELLOWSTONE

Skiing in Yellowstone National Park.
Rick and Susie Graetz



Adapted from the book *Knowing Yellowstone*, edited by Jerry Johnson

Understanding Yellowstone's Past to Understand the Future

By Cathy Whitlock

Today, in the Greater Yellowstone Ecosystem and across the West, policy makers are calling for information about how vegetation and natural disturbances, like fire, will be altered by current and projected climate change. Cathy Whitlock, through her study of ancient pollen, charcoal, and other fossils preserved in the sediments of lakes and wetlands, is gaining new insights about climate's role in long-term ecosystem dynamics. Whitlock's work provides useful insights for resource managers as they grapple with the question of how to provide stewardship to our public lands in the face of future climate changes.

- J. Johnson

Above photo: Coring at Dailey Lake. This site provided a sedimentary record that spanned the last 16,000 years. Melynda Harrison

Yellowstone's magnificent scenery is the outcome of cataclysmic volcanism, waxing and waning of large glaciers, and carving of the landscape by mighty rivers. The forest and grasslands that blanket the region are a relatively recent addition, forming on the heels of the last ice age about 15,000 years ago, but they too have been shaped by past geologic events.

Given its dynamic setting, Yellowstone is a wonderful workshop for those who think about environmental history. It is also an area of special concern when contemplating the impact of current and future threats. Questions about the natural resilience of the biota (animal and plant life) to environmental surprises such as wildfire or drought, the rate at which plant communities are capable of forming and dissolving, and the sensitivity of species to changing climate conditions are as relevant for understanding the past as they are for the future. Gaining knowledge about the history of vegetation, fire, and climate is part of the science of paleoecology – the study of past interactions between plants, animals, and the physical world. Paleoecological studies focusing on long-term ecosystem dynamics inform discussions on important management decisions in the Yellowstone region, and are proving pivotal as we confront current and projected climate changes and other human-induced threats.

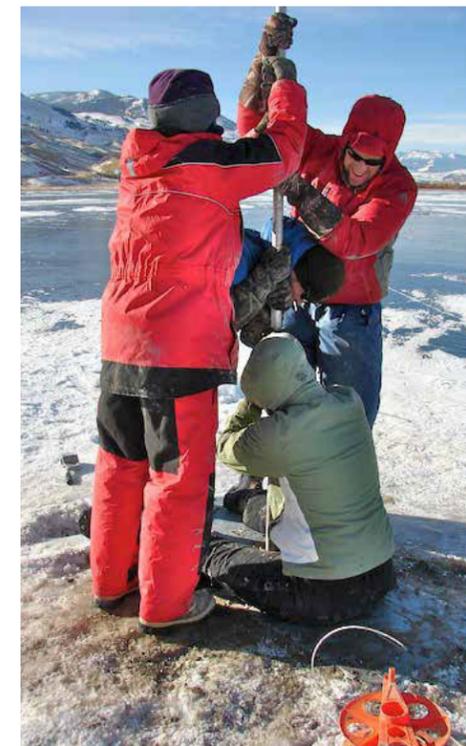
What Do We Do and How and Why Do We Do It?

Historical sciences, like paleoecology, often answer questions through repetitive testing of multiple working hypotheses (theories). Plausible hypotheses are formulated at the outset of a study, and data are used to evaluate the merits of each of them. Some are rejected outright, others are modified in light of new discoveries, and new premises often emerge during the course of an investigation. In the case of Yellowstone, our research and testable hypotheses focus on how ancient organisms, individuals, populations, and ecological

communities have responded to environmental change in the past. We are interested in understanding the biological sensitivity to environmental change that has shaped the ecosystem, while recognizing that events or forces operate on a variety of levels ranging from broad-scale slowly varying changes in climate to abrupt disturbances that briefly affect individual watersheds. In addition to climate, the legacy of glaciers, earthquakes, and volcanic eruptions has also influenced the history and distribution of Yellowstone's animal and plant life, primarily vegetation, in ways that are relevant for the future.

Natural lakes and wetlands are the best source of information on the history of terrestrial environments. Pollen, charcoal, and other fossils preserved in layers of lake sediment provide a script of changes that have occurred in the watershed over thousands of years. The history begins with the deepest layers, deposited when the lake was first formed, and ends with the top layer deposited in the current year. Most of Yellowstone's lakes were created during the final melting of the Yellowstone ice cap (which covered the park in thousands of feet of ice!) about 15,000 years ago, and have held water to the present day. In the intervening millennia, as much as eight meters (26 feet) of sediment have been deposited. Suitable study lakes are selected based on age, vegetation, geological substrate, and climate. Our goal is to capture the range of environmental conditions and biotic diversity that exist in Yellowstone by sampling an array of lakes in different settings.

A variety of hand-operated coring equipment is available to extract lake sediments, and the selection of an appropriate device depends on the historical time span required to answer a particular research question. Information about recent environmental changes, for example, can be found in the upper meter of sediments, which is recovered in a simple tube fitted with a piston, which is lowered into the sediment. Another option is a meter-high metal box filled with dry ice. The sediments



freeze to the outside of the box and the frozen slabs are transported to a cold room for high-precision sampling. Research concerning the entire 15,000 years of history requires a square-rod piston corer attached to metal drive rods. This device takes a series of cores that are five centimeters in diameter and one meter long in vertical succession. Each drive is brought to the surface, the sediments are extruded and then transported to the lab. Lake sediments are usually the consistency of toothpaste, green or brown in color, and have an earthy odor. Hitting an impenetrable surface usually indicates that bedrock has been reached, and the coring is finished. As simple as the process sounds, six strong people or three packhorses are needed to transport the gear to and from a lake, and the actual coring process involves three or four people. In the summer, we use a platform built across two inflatable rafts anchored in the middle of the lake. In the winter, the ice surface serves as our coring platform, but often, deep snow and frigid temperatures limit access.

Although fieldwork may be the most fun, it is the research questions that motivate the project (and usually the funding) and the selection of sites and methods. A good research question is one that has importance beyond the boundaries of the study. Ideally, it addresses a timely or broad scientific question or enables inspection of old findings with a new approach. In addition, such a research question must be answerable by a carefully crafted study and thoughtful selection of study sites, and it ultimately should lead to new questions and research directions.

It's in the laboratory where the hard work takes

place. The cores of sediment are unwrapped, sliced longitudinally, photographed, and described. We then subject them to various analyses in order to learn three things – the watershed history, the lake's age, and the prehistoric vegetation and climate. The lithology or physical composition of the core provides our first clue about the history of the watershed. For example, the

base of most records consists of inorganic clay, silt, and sand. These sediments imply rapid buildup in a sparsely vegetated landscape with unstable slopes – typical of recently glaciated conditions. Higher up the core, the sediments become organic. The transition marks the time that the climate warmed, the lake became more biologically productive, and the watershed was stabilized by soils and plants. Samples are taken to determine the organic versus mineral content, which can tell us about levels of biological activity in the past. Variations in the carbonate content of the sediments are often a good measure of chemistry and pH changes related to water temperature.

Paleoecologists are obsessed with time, even though our ability to measure it is often not very precise. Chronologies for our historical information are based on radiometric dating methods, including Carbon-14 or Lead-210 age determinations. Radiocarbon measurements are made on small wood or leaf fragments of terrestrial plants, on charcoal particles, and sometimes on the organic component of lake sediment itself. Lead-210 dating spans the last 150 years and is used to date recent changes.

The discovery of pollen grains in a core gives us a record of past vegetation. Pollen is produced by

angiosperms (flowering plants) and gymnosperms (seed-producing plants). Wind-pollinated species produce lots of pollen each year, hence, and not surprisingly, we see more pollen from these plants in our lake sediments than from insect-pollinated ones. Sediment samples are taken at regular intervals in the core and treated with a variety of acids and bases to remove everything but the incredibly robust pollen grains, which are mounted on glass slides and examined under the microscope at magnifications of 400-1000x. Plants produce distinctive and often ornate pollen grains, which we identify by comparing them with modern reference material and illustrations in published atlases. It typically takes a trained analyst two or three hours to identify and tally 300-400 pollen grains in a given sample in the core. A typical pollen record will include about 50 different trees, shrubs, and aquatic plants, but most of the pollen in Yellowstone comes from pine and sagebrush. Interpretations based on pollen data can be

improved by the presence of seeds, needles, and other plant remains in the sediments. These remains often provide species identifications and confirm the local presence of a particular plant in the watershed.

Pollen data, tallied from different core depths, are converted to percentages and accumulation rates (number of pollen grains per cross sectional area per year). Changes in the proportion of taxa (that is: taxonomic units or categories of species) through time are the basis for interpreting past vegetation. Because pollen does not have a 1:1 relationship with the plants that produce it, modern studies are needed to interpret past pollen assemblages. There are hundreds of samples from the surface sediments of modern lakes that provide necessary calibration. In Yellowstone, pine dominates the record because in early summer, its pollen production is enormous and the grains are easily carried by the wind. Modern pollen sampling indicates that pine and sagebrush pollen are overrepresented in

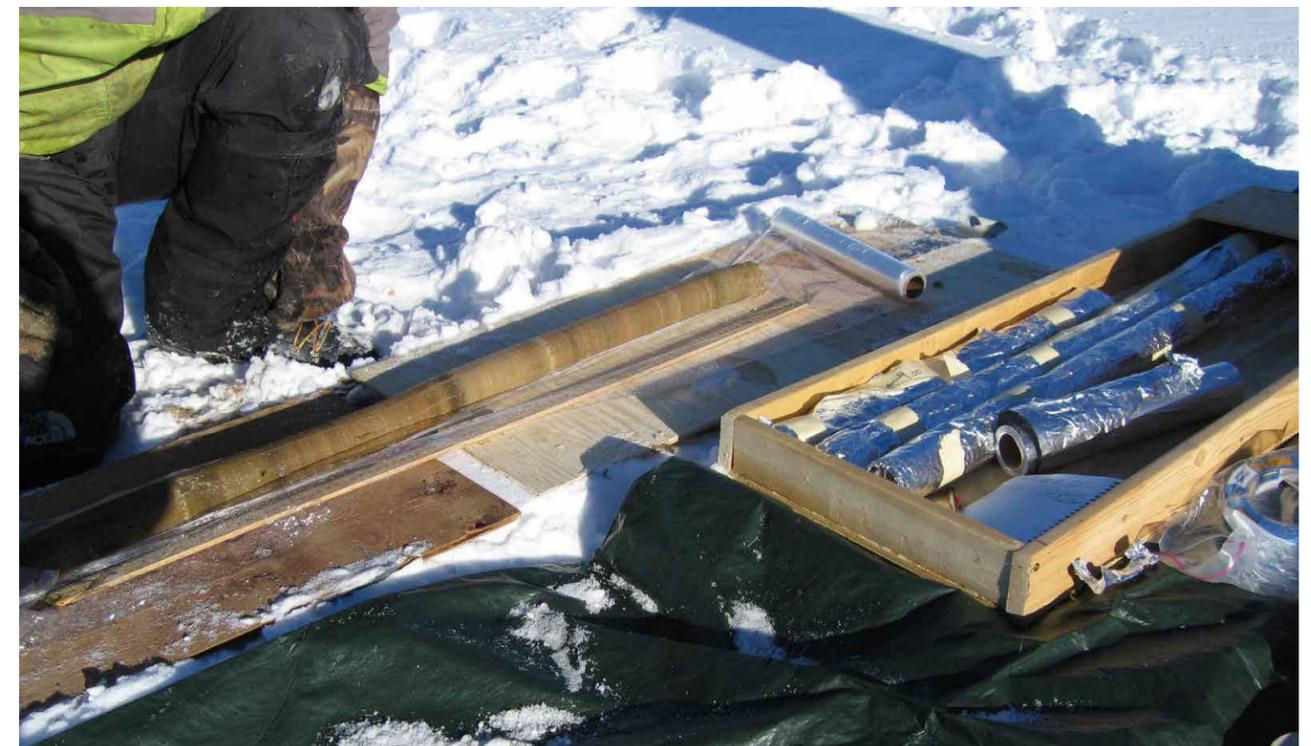
Our research in Yellowstone has helped guide fire history investigations around the world.



Ragweed (*Ambrosia*) pollen is identified by its distinctive architecture. This grain is about 25 microns in diameter. R.J. Nickmann



Photomicrograph of Douglas fir pollen. R.J. Nickmann



One section of a sediment core collected from Blacktail Pond in northern Yellowstone (notice the differing sediment layers). Jack Fisher

lake sediments relative to their actual abundance on the landscape. In contrast, the abundance of Douglas-fir pollen usually underrepresents the number of trees present. We take these differences into consideration when reconstructing past vegetation from pollen data.

Fire history information is based on changes in the abundance of charcoal particles preserved in lakes. Our research in Yellowstone has helped guide fire history investigations around the world. For ten years following the 1988 fires, we monitored the input of charcoal into lakes in burned and unburned watersheds and were rewarded with a rich understanding of how charcoal data register fire patterns across a large natural region. Information from the 1988 fire has improved our



MSU graduate student Teresa Krause, left, professor Cathy Whitlock and undergraduate student Vincent Nagashima study a sediment core estimated to be 7,000 to 8,000 years old. Volcanic ash layers, most notably from the eruption of Mount Mazama, which occurred 7,676 years ago and led to the formation of Crater Lake in southwestern Oregon, have been found in Yellowstone's lakes. Kelly Gorham.

interpretation of longer charcoal records and our ability to reconstruct past fire activity in terms of area burned, intensity of the burn, and fuel type.

Charcoal analysis is based on extracting charred pieces of wood and leaves from contiguous one-centimeter intervals of the core and examining them under the microscope. The data are converted to charcoal accumulation rates. Slowly varying changes in charcoal abundance describe long-term variations in fuel types. For example, forests produce more charcoal than tundra. Charcoal peaks represent individual fire episodes, and they can be summarized to calculate fire-episode frequency or the number of years between fires. Shifts in abundance between grass and wood charcoal also disclose changes in fire regime. Charcoal particles from grass and other herbs point to surface fires that burn ground vegetation and often are not lethal to trees. Wood charcoal indicates crown fires that advance through the tree canopy with serious consequences to the forest.

Multidisciplinary studies, like those underway at Crevice Lake in northern Yellowstone, are collaborative efforts to study and compare as many paleo-environmental data sets as possible. Diatoms, which are the skeletons of microscopic algae, reveal changes in the lake biota that can be tied to changes in nutrients, water temperature, pH, and light penetration. Carbon and oxygen isotopes trace the history of water inputs and evaporation through time that are related to climate. The remains of insects and other invertebrates document changes in bark beetle outbreaks and aquatic biological activity, and geochemical changes reflect nutrient and erosion inputs related to variations in watershed characteristics. Viewing numerous variables of the past expands the information available for environmental reconstructions and also discloses past interactions within the ecosystem that could not have been inferred from a single record.

What Have We Learned?

From the first pollen studies in the 1970s to ongoing investigations, we are gaining a better understanding of the Yellowstone ecosystem and its sensitivity to environmental change. Paleoecologic data have provided information about the plants and animals that

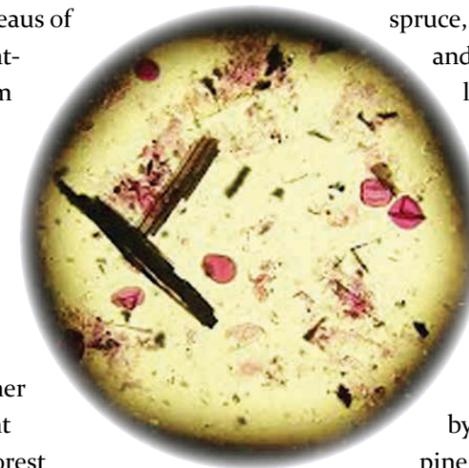
colonized deglaciated landscapes as well as insights on how Yellowstone's history fits into the larger picture of past climate change in the western US. For me, both local and large-scale reconstructions are equally rewarding lines of inquiry. It is thrilling to stand on the shores of Crevice Lake and imagine the evolution of that watershed over several thousand years. What follows are three topics where paleoecologic studies from Yellowstone have led to discoveries that were initially unexpected, but are now seen to be scientifically quite important.

Geology Matters

Today, the vegetation of Yellowstone is strongly controlled by geology and its influence on soil conditions. The broad volcanic plateaus of central Yellowstone support nutrient-poor, well-drained soils derived from rhyolitic lava (a silica rich form of lava that is relatively "thick.") The lack of calcium and potassium and the dryness of the soils limit the success of most conifers. Lodgepole pine is considered a disturbance-adapted tree over most of its range, but on rhyolitic and other well-drained soils, it is the dominant conifer from early to late stages of forest development, generally in the absence of other competitors. Yellowstone's lodgepole forests are considered subalpine in the strict sense, but on more nutrient-rich soil types, comparable elevations would support forests of Engelmann spruce, subalpine fir, and whitebark pine.

Pollen records from the rhyolitic Central Plateau region shed some light on the importance of geology on the development of Yellowstone's forests. Following an early period of tundra vegetation associated with ice recession, the region was invaded by lodgepole. These forests have persisted ever since, and, despite climate changes that transformed the vegetation in other parts of the Park and region, have remained unchanged for the last 11,000 years. This history attests to the tree's resilience (some call it a weed) to variations in climate when it occupies poor-quality soils.

In contrast, pollen records taken from nutrient-rich andesitic (igneous rock) matter in the south and eastern part of the Park and calcareous (calcium carbonate) glacial deposits in the north reveal a more dynamic vegetation history than that of central Yellowstone. Following the early tundra period, these regions were colonized by a subalpine forest of spruce, fir, and whitebark pine. As the climate continued to warm, lodgepole and Douglas-fir moved into the region. Our pollen data suggest that between 11,000 and 7,000 years ago, Yellowstone experienced warmer conditions than today, and this is evidenced by the abundance of Douglas-fir pollen at sites that are presently too high for it to grow. As the climate cooled and became wetter during the last 7,000 years, pollen data suggest that spruce, fir, and pine became more common and Douglas-fir became restricted to lower elevations.



Charcoal bits and plant pollen. Cathy Whitlock

My thinking about the role of geology goes like this: If Yellowstone were not a hot spot with active rhyolitic volcanic eruptions, the vegetation and its history would surely have been like the rest of the region, and much of the Park would now be covered by forests of spruce, fir, and whitebark pine, not just lodgepole pine. Without glaciation, northern Yellowstone and the Hayden Valley would not have been mantled by glacial deposits rich in calcium

and potassium. The Lamar Valley would have been covered by closed forest rather than sagebrush steppe and grassland and unable to support the elk, bison, and pronghorn that winter there today. What makes Yellowstone so interesting is that all of these geologic events did occur and combine to shape the special ecosystems of today's Park.

The Human Factor

We were involved in two investigations to ascertain whether, following the creation of the national park in 1872, lake sediment in the northern regions of the Park revealed any environmental changes. In particular, we were looking for possible disturbances

caused by increased ungulate populations in the early 20th century, such as a pulse of erosion or nutrient enrichment of lakes. The research involved sampling, establishing the age with Lead-210 dating methods, and analyzing the fossils and chemistry of the uppermost sediments of five small lakes in the area. The end results suggested no broad-scale change related to ungulate numbers.

This study was recently expanded upon at Crevice Lake in the Yellowstone River canyon. Pollen, geochemistry, paleomagnetism, and microfossil records, examined at ten-year intervals over the last 2,600 years suggest that the last 200 years of environmental history has been relatively modest compared with previous centuries. In comparison, dramatic adjustments in the lake and watershed occurred in response to dry conditions between BC 150 and AD 1100 (the so-called Medieval Climate Anomaly).

The combined findings of the two studies imply that Yellowstone today is a relatively pristine, naturally functioning ecosystem. Human-related impacts since Park establishment have left little trace in the sediments of lakes and, by all measures, most pale in comparison to natural variations of the more distant past.

Climate Change

Yellowstone now faces an ever-greater threat. Future climate model projections suggest changes in temperature and precipitation will affect the distribution of Yellowstone's species. Present climate forecasts focus on the consequences of doubling CO₂ in the atmosphere – something that is expected to occur in the next few decades. Under this scenario, as levels of greenhouse gases increase, the Yellowstone region will become warmer in both summer and winter, summers drier, and winters wetter. The future includes more rain, less snow, earlier snowmelt, and prolonged summer drought. Measurements and field observations taken in the last 20 years suggest that this climate trend is already underway.

High-elevation organisms will likely be the most impacted, because climate warming will shift suitable habitat to ever-higher elevations, and eventually, no elevation in the Yellowstone region will be high enough to sustain those populations. Whitebark pine is an example of a highly vulnerable species. The seeds of whitebark pine are an important food resource for grizzly bears and red squirrels. Its loss could lead to the collapse of a vital ecosystem in the Park. Studies to date

In the Yellowstone region, knowledge of the past has led to renewed appreciation of the importance of geology, natural disturbance, and climate in shaping the diversity of plant and animal communities that exist today.

suggest that some species will survive with only modest change (e.g., lodgepole), the ranges of others will shift, and some species (e.g., whitebark pine) will be lost from the region altogether.

Certainly, we are at a stage in resource management where climate change science must be part of every natural-resource discussion.



Taking a core sample from a floating mat at the edge of Blacktail Pond in northern Yellowstone National Park. Christy Hendrix



Evidence of this and previous fires is found in the layers of charcoal deposited in lake sediments. NPS, Yellowstone National Park

Conclusion

Paleoecology is a fascinating subject in its own right, but, more than that, the scientific discoveries that it provides are the foundation for understanding current and future ecosystem dynamics. Without information on the historical range of environmental variability, it would be impossible to evaluate changes evident today or likely to occur in the future. In the Yellowstone region, knowledge of the past has led to renewed appreciation of the importance of geology, natural disturbance, and climate in shaping the diversity of plant and animal communities that exist today. It has also pointed to new research that considers how prehistoric peoples and recent stewards of Yellowstone have maintained natural resources. Finally, it provides insights that will help us evaluate the impact of current and future changes in climate and land use.

Much of Yellowstone's past remains unknown, and in most respects, our understanding is rudimentary and incomplete. For example, recent drought in the region is profoundly altering the landscape and drying up wetlands. What is not clear is whether drying of this magnitude has ever occurred before and what the lasting ecological consequences might be. Such information would help resource managers to assess the current peril. The paleoecologic research that began in the Yellowstone region in the 1970s still holds the key to critically important questions. Those mysteries will continue to motivate creative scientific investigations for decades to come.

Cathy Whitlock is a Professor of Earth Sciences at Montana State University and MSU Director of Montana Institute on Ecosystems. Her research focuses on the ecological consequences of past climate change and the long-term linkages between fire, vegetation, and climate.



Smart, Strong and Innocent... three vacationing University of Montana summer school students, David DeLap, Andy DePirro and Quinn Blackburn, inadvertently trump a professional climbing party. DeLap Collection, University of Wyoming.

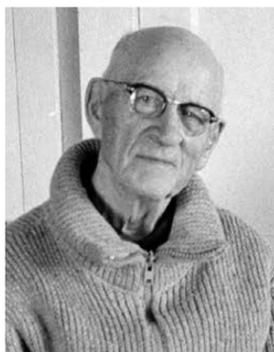
BY THE SEAT OF THEIR PANTS

By Rick Reese

Two hundred miles south of Bozeman, the Teton Range rises some 7,000 feet above the floor of Jackson Hole; and the Grand Teton itself soars nearly a thousand feet above neighboring peaks. More than a hundred climbing routes and variations—from moderate to extreme—have been established on the peak, but most would agree that even the easiest require climbing skills and roped protection. After repeated attempts in the 19th century, the first documented ascent of the peak was finally accomplished by the William Owen party in 1898.

For 25 years following the Owen ascent, the peak remained unclimbed – until three summer-school students at the University of Montana ventured forth in August 1923. In 1980, fifty-seven years after their climb, I had a wonderful opportunity to visit with and record the remembrances of one of these students, Bozeman’s David DeLap.

Shortly you will hear DeLap, a MSU engineering student who was attending UM for summer school, describe part of their climb in his own words. He met Quinn Blackburn and Andy DePirro, both geology majors at the UM, through a Missoula hiking group.



David DeLap at 89 years young. Rick Reese

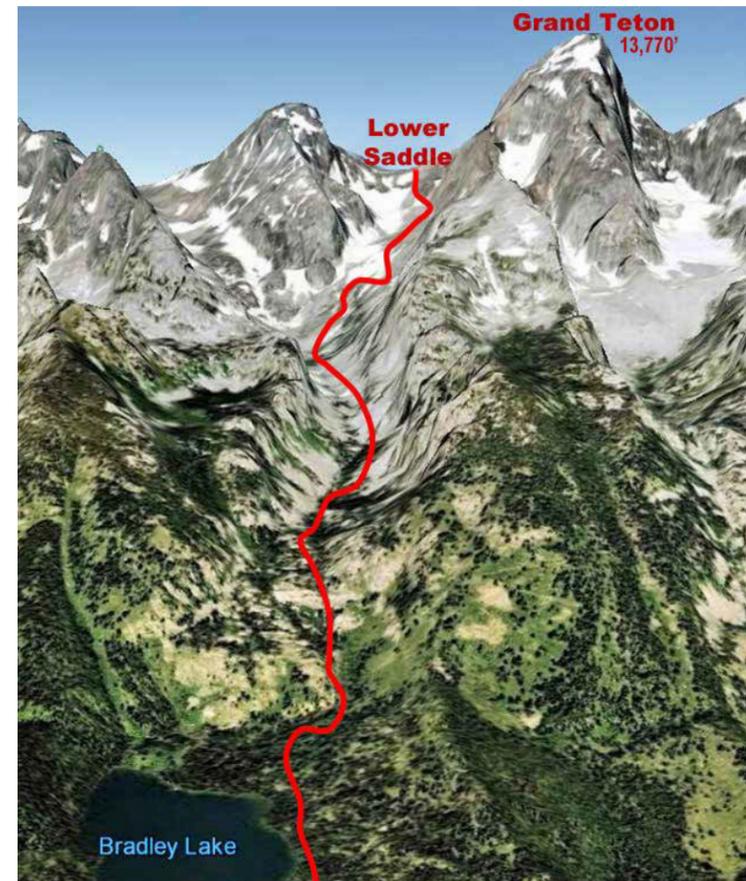
The three were already talking about doing a trip through Yellowstone in DePirro’s Model T when Blackburn noticed a big mountain on the map south of Yellowstone and immediately suggested the three of them climb the Grand Teton. Their enthusiasm was matched only by their naiveté.

“This was just a vacation trip. We wanted to see Yellowstone Park and we wanted to see the country between here and there, and we allowed one day to climb the Grand Teton. That’s all we needed anyhow.”

These three were smart, and very strong hikers, but they had no rock climbing experience whatsoever. They had no rope, no climbing gear, knew nothing of Owen’s route, and, ominously, would encounter ice-covered rock on the steepest, most exposed section of peak. They were completely innocent. When the aspiring climbers arrived in the Tetons, they heard that “professional mountaineers from the East” were there, preparing to attempt the second ascent of the Grand. It would be many years before they learned this group was supported by the National Park Service and led by Professor Albert Ellingwood, one of the most accomplished American climbers of the day. Ellingwood’s party had detailed information about the 1898 route, but they shared little of it. They did, however, tell the Montanans that Bradley Canyon provided the best approach to the peak. When DeLap said they had only one day for the climb, some of Ellingwood’s party were amused.

They camped near Bradley Lake, and the next morning entered trail-less Bradley Canyon. In scarcely six hours, they climbed 5,000 feet to the Lower Saddle, stopped for a bacon sandwich, then continued another 1,400 feet to the Upper Saddle, the point where all previous attempts—save Owen’s—had failed.

Searching for a route through the vertical rampart above, Blackburn and DePirro explored south, while DeLap traversed north several hundred feet along a harrowing, ice-covered ledge and onto the imposing west face until he could go no farther alone.



With no maps, the 5,000 feet from the lake to the Lower Saddle took them just six hours. Google Map



Most climbers camp at the Lower Saddle in order to make an early start for the summit. NPS



Upper Saddle, where all previous attempts—save Owen’s in 1898—failed. Red line: the trio’s search routes for a way up or around the rampart. Rick Reese

And I wiggled my way across there and climbed up on the ledge. I walked about 60 feet on the ledge and then the ledge continued, but the rock above it was overhanging. The ledge [The Crawl] was so narrow that half of my body overhung that fall.

Retracing his route back to the Upper Saddle, DeLap told his companions he may have found a way and led them back across the traverse to what is known today as the Double Chimney.

[After the Crawl, Rick Reese added, “They reach the chimney, and they make a three-person ladder to get Blackburn on top.”]

So, Blackburn took over, and I sure was glad that he did. He said, “You two men stand here together.” And he lay down on his back in that niche and let his legs, below his knees, hang down vertically at the edge of that lower end.

View looking down from The Crawl, an 18-inch wide ledge with an overhang above and a 2,000-foot drop. Jason Wine



Blackburn and DePirro on the summit with the pennant left by Billy Owen, who is credited with the first ascent of Grand Teton. They took photos, recorded their names on a register Owen had installed, and left their own on the back of a bank deposit slip. DeLap Collection, University of Wyoming

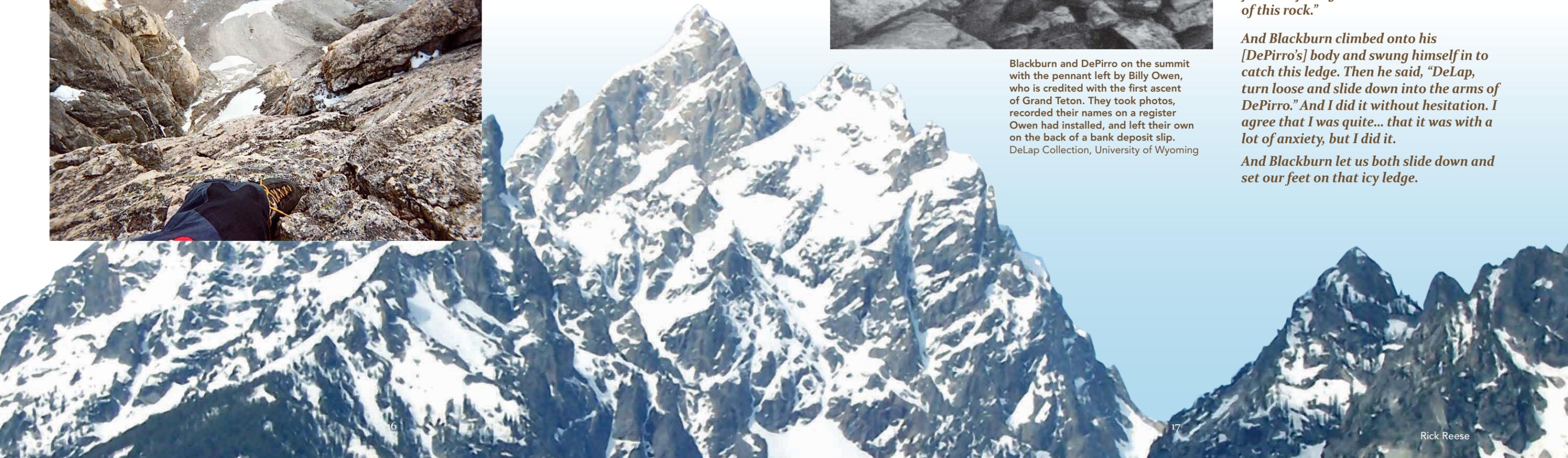
He said, “DeLap, raise DePirro up so he can get ahold of my feet.” And I lifted him up so he got ahold of his feet and climbed on over his body. Then Blackburn got up and said, “DePirro, take off one pair of your trousers.” And he took a pair off, and DePirro held on to Blackburn’s feet and wedged himself into that niche. Blackburn came down and held on to the top of these trousers and let the legs hang down to me so I could get ahold of them. And I twisted the legs of those trousers and climbed that... and that’s the only rope we had.

Another hour-and-a-half of climbing into the unknown and the summit of the Grand Teton was theirs. But it was getting late and they now faced the daunting task of descending the icy chimneys and the traverse back to the Upper Saddle. Again, ingenuity and good luck saved the day.

Blackburn said, “DeLap, take ahold of the top of this rock and stretch yourself out as far as you can. DePirro, take ahold of DeLap’s legs just above his knees and let your body dangle down over the lower end of this rock.”

And Blackburn climbed onto his [DePirro’s] body and swung himself in to catch this ledge. Then he said, “DeLap, turn loose and slide down into the arms of DePirro.” And I did it without hesitation. I agree that I was quite... that it was with a lot of anxiety, but I did it.

And Blackburn let us both slide down and set our feet on that icy ledge.





As darkness approached, the three used their linked bodies to rappel down (red line) a more difficult part of the upper peak. Rick Reese



Two days after the three Montanans summited... Professor Albert Ellingwood is shown roped up on The Crawl. Denver Public Library

Now below the serious climbing, but in darkness, the Montanans descended 3,000 feet into Bradley Canyon to spend the night. By 9 a.m. the next morning they were back at their Model T and headed for Missoula.

Two days later, Ellingwood and party, equipped with rope and gear, started from a camp high in Bradley Canyon. They were approaching the summit, certain they were about to score the second ascent of the Grand. Then they saw the footprints of the three Montanans in the summit snow. But as Delap said, "One day's all we need anyhow."

***In grateful acknowledgement to Leigh N. Ortenburger (1929-1991) for researching and documenting the 1923 Grand Teton climb by DeLap, Blackburn and DePirro. Ortenberger, a Grand Teton historian with a huge climbing reputation, calls the feat, clearly "...one of the extraordinary achievements of 20th century American mountaineering."*

Rick Reese taught college in Montana, was the principal founder and first president of the Greater Yellowstone Coalition, served as director of the Yellowstone Institute, and retired from the University of Utah. An experienced mountaineer, Rick was a climbing ranger in Grand Teton National Park for seven years in the 1960s.

We urge and encourage you to see and hear the six-minute video of the trip as narrated by Rick Reese with excerpts in David Delap's own words and containing more photography.

To do this, hover your cursor [HERE](#) then click on the far right, blue icon that appears.



The Yellowstone River & Yellowstone Lake PART II

By Rick and Susie Graetz



A cutthroat trout navigates the waters of Yellowstone Lake. Jay Fleming, NPS

Six hundred and thirty thousand years ago, molten rock filled two large cavities below Yellowstone's Central Plateau. Lava, forced to the surface, formed a bulge that resulted in an incredible explosion estimated to have been 1,000 times larger than the 1980 Mount St. Helens eruption; the future Yellowstone National Park literally blew up. The two volcanic chambers that spewed their contents collapsed, creating an enormous caldera (crater) 30 by 45 miles wide. Eventually, rhyolite lava filled much

The lake's size, as well as the surrounding beauty, is what commands the attention of anyone viewing it.



Pelicans find the lake to their liking. Rick and Susie Graetz

of the depression, establishing the Yellowstone plateau. Later, during the ice age, a 3,500-foot deep alpine glacier ice cap covered the area. As the monumental glacier moved, it most likely ground out a segment of the southeast rim of the caldera allowing Yellowstone Lake to take form.

Positioned at 7,733 feet above sea level, Yellowstone Lake stretches 20 miles north and south and 14 miles east to west, giving it the distinction of being the largest high mountain lake on the North American continent. Even though it is frozen for more than half of the year and extremely cold even in the summer, it is thought the water at some of its greatest depths is boiling. In the West Thumb region, it has been measured to be 320 feet deep. This grand body of water, with its sweeping vistas and fir-bedecked shores and coves, at one moment can present a scene of serenity and calm or an ocean of chaotic white caps stirred up by a howling wind.



Before it begins its 600-mile odyssey to meet the Missouri, the Yellowstone River mellows out in Yellowstone Lake. Jim Peaco, USGS



Left: Stevenson Island on Yellowstone Lake. Larry Mayer.
Below: Exploring the Southeast Arm of the lake by canoe. Neal Herbert, NPS



Lake thermals in action. Rick and Susie Graetz

Trappers and the first wanderers into what would become Yellowstone Park praised the lake for its wild beauty. In summer, Indians lived on its shores and sat beneath the same moon that today continues to send a seemingly endless river of sparkle across its surface. For the first serious explorations into the area, viewing this splendor became the goal.

Strange and interesting happenings occur under Yellowstone Lake's surface. In the mid-1970s, Bob Smith, a University of Utah geophysicist, was examining seismic activity of the lake's basin. He noted that sediments on the bottom moved and would at times tilt upward to the north, although the river or, at this stage, the water in Yellowstone Lake, flows from south to north.

The Molly Islands in the lake's southeast arm serve as a white pelican rookery. Even in high water years, the small islands protrude, and nesting is possible. One spring, during a normal water year, researchers found one of the islands completely submerged and all the young birds drowned. Apparently the tilting of the lakebed poured more water into the southeast section. The center of this action appears to be occurring just north of where the river leaves the lake at Fishing Bridge.

And the caldera has not been stable. In the 1920s, elevation benchmarks were installed in various places along the park roads. New readings taken in the mid-1970s in these places by the US Geological Survey showed the entire caldera had risen about 30 inches since 1923. Further studies confirmed it rose another 10 inches between the mid 1970s and 1984.

According to Smith, the caldera then began lowering by less than one inch a year from 1985 to 1995. This information came from using a Global Positioning System to get exact measurements. Since then, it appears an uplifting is again taking place, but more so in the northwest segment of the caldera. Yellowstone Lake seems not to be affected and remains at approximately the same level. Smith calls it “the huffs and puffs of the Yellowstone Caldera” and says this can go on for “tens of thousands of years without an eruption.”

The cause of the subsurface activity? Tectonic, hydrothermal, or the movement of or cooling of molten rock... it could be any one or all.

The lake’s size, as well as the surrounding beauty, is what commands the attention of anyone viewing it. Sharp peaks of the Absaroka Range line the entire east shore. Mount Sheridan at 10,308 feet looms like a lofty island to the south and the more subdued highlands of the Central Plateau slope off to the west.

With all its mystery, variable conditions and grandeur, the lake also provides the Yellowstone River with a spot to rest before continuing its journey north and east, connecting the mountains to the prairie.

Leaving the vast and enchanting lake, the Yellowstone River resumes its travels, cruising under Fishing Bridge before tumbling through LeHardys Rapids (created by a fault), then holding back as it lazily forms long smooth arcs in the pastoral Hayden Valley, prime grizzly bear and cutthroat trout habitat.

Rick and Susie Graetz are photographers, writers and adventurers. Rick teaches geography at the University of Montana, and Susie is Managing Editor of the UM Press.

Yellowstone Lake looking south. Larry Mayer



EXPLORING YELLOWSTONE

FIRST EXPLORATIONS

PART THREE

By Rick Graetz

THE HAYDEN GEOLOGICAL SURVEY

Three expeditions to the Yellowstone Country in the period early autumn 1869 through summer 1871 led directly to the creation of Yellowstone National Park.

Above photo: The 1871 Hayden Geological Survey camped on the northern shores of Yellowstone Lake. William Henry Jackson, USGS

Nathaniel Langford of the 1870 journey was correct when he stated the following:

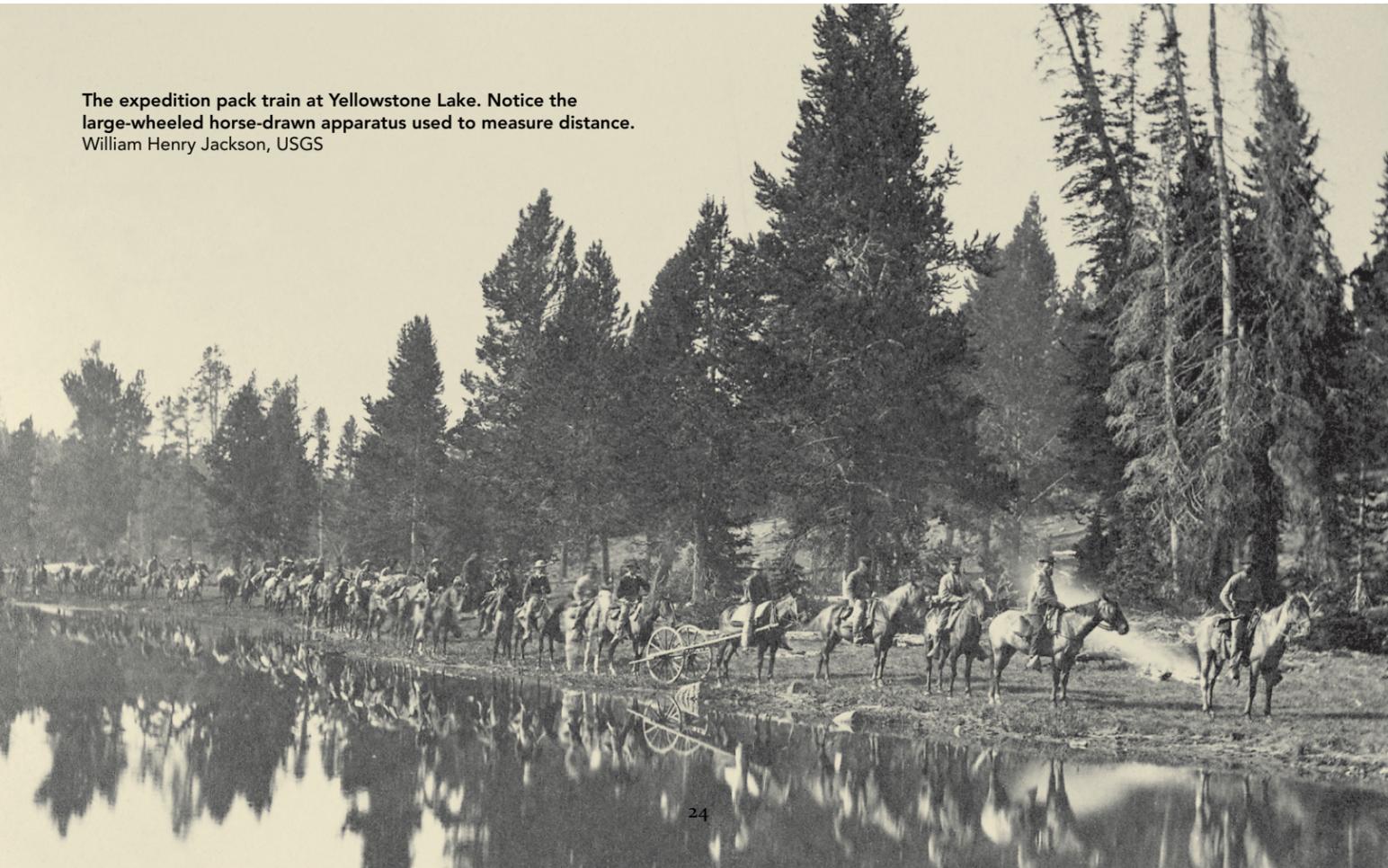
"We trace the creation of the park from the Folsom/Cook expedition of 1869 to the Washburn expedition of 1870, and thence to the Hayden expedition of 1871. Not to one of these expeditions more than to another do we owe the legislation (March 1, 1872) which set apart this 'pleasuring-ground for the benefit and enjoyment of the people.'"

THE HAYDEN GEOLOGICAL SURVEY 1871

Ferdinand Hayden was appointed in 1867 as Geologist-in-Charge of the United States Geological and Geographical Survey of the Territories under the US Department of the Interior.

His promotion was owing to legislation passed by Congress in 1853, titled the Pacific Railroad Survey. Its purpose was to determine the best routes for railroads to reach the West Coast from the nation's heartland. Great surveys, created by this legislation, gathered some of the nation's top scientists, engineers, geographers, and explorers to map the vast expanses of the western United States. Hayden was to concentrate his tasks on the Idaho and Montana regions and, in particular, the Yellowstone country.

The expedition pack train at Yellowstone Lake. Notice the large-wheeled horse-drawn apparatus used to measure distance.
William Henry Jackson, USGS



Hayden crew in camp. Thomas Moran seated left/center.
William Henry Jackson, USGS



The first boat ever launched on Yellowstone Lake – The Annie.
William Henry Jackson, NPS

In March 1871, with a \$40,000 stipend to finance the survey, Hayden commenced to plan the expedition. Utilizing the valuable information provided by the 1869 and 1870 survey teams, Hayden carefully selected his 32 crew members. Especially critical were photographer William Henry Jackson and artist Thomas Moran. It was their labors, put on display in Washington DC, that excited members of Congress and President Grant enough to pass and sign the legislation that created Yellowstone National Park.



Castle Geyser and the Crested Pool. William Henry Jackson, NPS

After gathering their supplies and making plans for an escort with the US Army at Fort Ellis at Bozeman, the expedition headed out on July 15, 1871. They pointed east and then turned southeast following today's Trail Creek into the Paradise Valley. Base camp was set up at the Bottler Ranch, near today's Emigrant, and on July 21, 1871, near today's Gardiner, they entered Yellowstone.

For the most part, Hayden took the same trails as the previous explorers did, with the exception that they went counterclockwise around Yellowstone Lake. They also made their way farther east and north than the others and surveyed the Lamar River Valley.

Their work finished for the season, the Hayden Survey left Yellowstone on August 26, 1871, camping just north of Gardiner on the Yellowstone River. A couple of days later, while at the Bottler Ranch, Hayden wrote a letter to Dr. Spencer Baird, Assistant Secretary of the Smithsonian Institution.

His words in part:

Dear Professor Baird, We have completed our survey of the Upper Yellow Stone. Our map is now complete of every stream emptying into the Lake or River above this point. Henry Elliot and young Carrington returned in seven days with a wonderful sketch of the Lake ... Henry Elliot has sketched all the Craters, the Geysers in motion, the Mud Springs, etc. We have a splendid lot of specimens also. We have about 400 negatives... The Lake has been well photographed.

Yours Truly, F.V. Hayden.

William Henry Jackson with his "camera pack" on Mount Washburn. The rock cairn was built to use as a survey point. NPS.



The most important result of this expedition, in addition to the sketches and paintings by Thomas Moran and the photographs by William Jackson, was Hayden's lengthy report detailing the findings of his party. So intent on preserving the Yellowstone region, he presented his account, photos, sketches, and paintings to Senators, Congressmen, and his superiors in the Department of the Interior, and nearly everyone else who could possibly influence the founding of a park. Hayden also published articles in national magazines and spent much personal time and effort trying to convince Congress to establish the park.

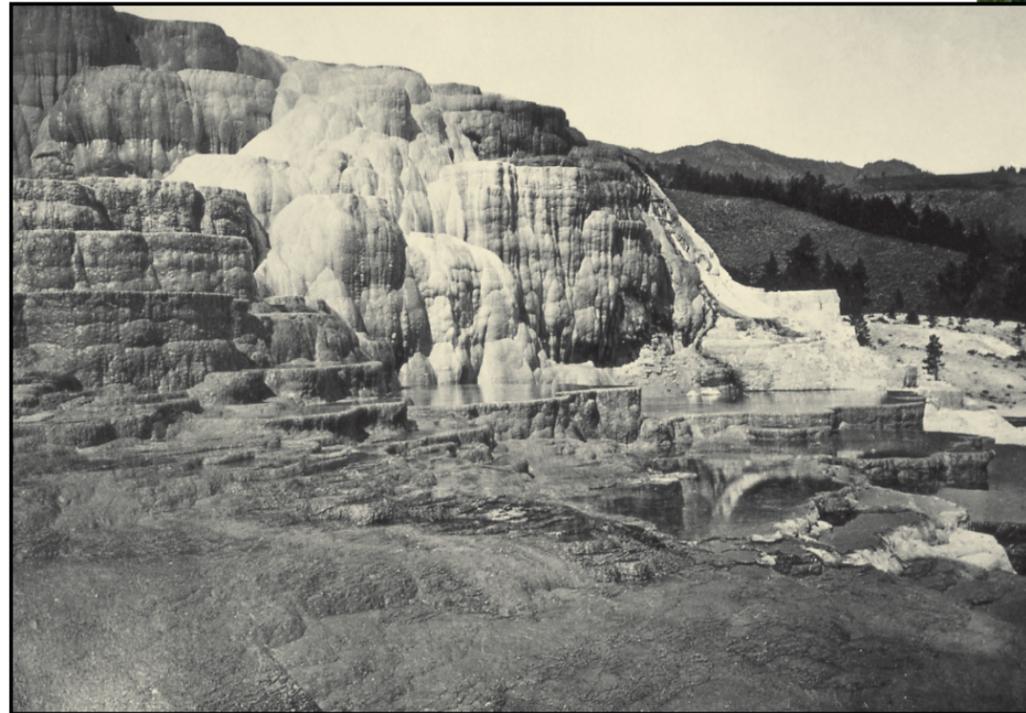
On December 18, 1871, a bill was introduced simultaneously by Senator S.C. Pomeroy of Kansas and Congressman William H. Clagett of the Montana Territory, for the establishment of a park at the headwaters of the Yellowstone River.

"The bill now before Congress has for its objective the withdrawal from settlement, occupancy, or sale, under the laws of the United States, a tract of land fifty-five by sixty-five miles, about the sources of the Yellowstone and Missouri Rivers, and dedicates and sets apart as a great national park or pleasure-ground for the benefit and enjoyment of the people."

Legislation was approved by a comfortable margin in the Senate on January 30, 1872, and by the House on February 27.



Soda Butte, a dominant thermal formation rising where the Soda Butte Creek and Lamar valleys join. William Henry Jackson, NPS.



The Mammoth Terraces in 1871. William Henry Jackson, NPS.

On March 1, 1872, President Ulysses S. Grant signed the bill into law, establishing the Yellowstone region as a public park, memorializing the results of three years of exploration by Cook-Folsom-Peterson (1869), Washburn-Langford-Doane (1870), and Hayden (1871).

Now a national park, its biggest challenges lay ahead. Congress did not appropriate funds for

management or a salary for the first superintendent, and much was to transpire before this wild landscape was fully protected. Those stories will follow in future issues of this e-Magazine.

Of special note...

The names of the leaders of the three expeditions are well etched into the history of Yellowstone National Park. However, Gustavus Cheyney Doane, has never fully received the credit he is due. While he is listed as a leader of the 1870 Washburn Expedition, he was also a member of the 1871 Hayden Survey. Ferdinand Hayden commented on Doane's journal, *"I venture to state, as my opinion, that for graphic description and thrilling interest it has not been surpassed by any official report made to our government since the times of Lewis and Clark."*

Filled with facts, scientific description, and showing an awe of the landscape, Doane's account was reliable and without exaggeration, and is considered a more truthful depiction of what the explorers saw and experienced.

Rick Graetz is a professor in the UM Geography Department and Co-Director of the Crown of the Continent and Greater Yellowstone Initiative.

Early fall snow is a consequence of high altitude growing conditions.
JohnAshley.com

PURPLE GOLD

By Sarah Prellwitz

Three days into my first visit to Idaho, I was invited to pick huckleberries in the nearby mountains with my friend Tiff and her family. Each year, Tiff and her husband, Josh, load their kids into a large-wheeled truck full of picnic supplies and shuttle everything an hour north across the desert plains from Rexburg to their favorite picking site in the Targhee National Forest. Intent on reaching the patch before noon, we were all up early packing the truck; and even though it was early September, the western air had me pulling on a sweatshirt, but I was promised the heat would engulf us by the time we started picking.

Tiff reached out to Josh as he passed by, “Don’t forget the bear spray,” she said.

“Do you put it on your skin like bug repellent?” I naively asked. Unnecessarily-loud laughter answered my question.

Evidently, grizzly and black bears find the sweet tart taste to their liking as much as humans do. Perhaps even more so since berry season occurs right before hibernation, and berries are an excellent source of carbohydrates. Kim Annis, a FWP bear manager, explains, “Bears need a rush of nutrients and calories in the months before they go into their winter dens; it is a feeding frenzy called hyperphagia. They may consume up to 30,000 berries to reach the 20,000 plus calories a day they need to gain their winter fat.” While bear encounters aren’t frequent, they are still likely to occur. Some mountain rangers suggest bringing a dog to alert pickers about any bears in the area.

Before now, I had never set foot on a mountain. During the thousand-mile drive out west from Wisconsin, the first mountains I saw didn’t necessarily impress me, but once in the forest, I realized my gross misconception. I never fathomed Nature’s cradle could be so fertile. Nestled among towering pines and surrounded by patches of succulent berries, it was surprisingly easy to forget that I sat high above the valley. The hazy breath of the “Hucks” reminded me of picking strawberries with my mother in Alabama when I was five years old. Or the time I was twelve and chattering with excitement as we planted our first blueberry bush in a small square of Wisconsin soil.

While “huckleberry” is used to describe a number of blue-fruited plants, this particular berry can be found only in the western United States and Canada, and has become a symbol of the West, infiltrating the manufacturing industry in the form of jam, soap, ice cream shakes, and candles. Similar in appearance and taste to the blueberry

(although huckleberries are thought to be richer and less gritty), it descends from the plant family Ericaceae (Greek for “heather”; flowering plants commonly found in acidic/infertile soil). The name “huckleberry” derives from the English name “whortleberry,” which is itself a derivation of the bilberry, and its cousins include the cranberry, blueberry, rhododendron, and azalea; however, unlike its eastern counterparts, the Western huckleberry belongs to the genus *Vaccinium*.

Most commonly found in mountain ranges similar to the Rockies, huckleberries require elevations of 2,000 to 11,000 feet in which to grow. They flourish where other plants fail because of their preference for acidic soil. Interestingly enough, even the forest fires that scourge the mountainsides from time to time support the berry’s growth by adding nutrient-rich ash to the soil and allowing more sunlight to enter the forest. Hucks grow best in partial, but not complete, shade.

On that September afternoon, little did I realize I was participating in a deeply-rooted ritual of the Western United States. American Indians dwelling in the Rocky Mountains found the periwinkle colored berries both edible and delicious and came to rely upon them as a staple in their diet and a means of trade. The Algonquins, the earliest recorded tribe to gather “blue berries,” would dry the fruit with leaves and then mash it into a powder to be served to the sick or turned into a primitive ancestor of plum cake. Lewis and Clark, observing their native guides harvesting and drying the berries in anticipation of winter months, often ate them in a pudding during the course of their trek.

Settlers following the paths of the natives fell in love with the tart-sweet rush of the huckleberries and often picked in tandem with the tribes, their camps set on opposite ends of the berry patches.

Huckleberries remained a bit of a hidden treasure until the 1920s, when canning became a widespread method of preserving produce. Before then, huckleberries were dried or eaten fresh off the stem. Furthermore, the skins,



fragile as a childhood memory, tear easily and rot the berries. The only picking methods are by hand or using special rakes (descendants of the salmon-bone combs used by Native Americans). Huckleberry plants can take as many as fifteen years to mature from seedlings. These requirements negate mass gathering of huckleberries, making them unlikely candidates for commercialism.

Unavailable in grocery stores, they can only be found at farmers' markets (where they are often frozen and/or cost as much as forty-seven dollars per gallon) or in the wilderness. Efforts to introduce huckleberries to new territories have been largely unsuccessful, however, scientists at the University of Idaho are currently researching their domestication. Dr. Dan Barney, a horticulturist at the University of Idaho Sandpoint Research and Extension Center, states in *Growing Western Huckleberries*, "This publication is not intended to promote commercial production of western huckleberries. While huckleberry domestication shows great potential, most attempts to grow huckleberries commercially in fields have failed." And then in the end he states, "The following recommendations are intended to provide a starting point for your own experiments in home or commercial huckleberry production."



JohnAshley.com

This would enrage the memory of Henry David Thoreau, who was a firm believer in straight-from-the-stem produce and believed selling berries at the market reduced them to "mere provender." In his famous novel *Walden*, he declared, "As long as Eternal Justice reigns, not one innocent huckleberry can be transported thither from the country's hills." A declaration that, thus far, has generally held true.

Huckleberries are sometimes referred to as "purple gold" because they are challenging to find and pick, but are

so worth the effort. Families tend to guard their favorite picking sites the same way fishermen guard thriving streams. Reflecting back on my huckleberry experience, I'm surprised Tiff and her family allowed an outsider to enter their haven. Most likely, they knew I was unfamiliar with the Idaho landscape and would never be able to lead another human being to that spot. I wonder, if huckleberries became a mainstream product, would traditional picking areas become memories and legends? It depends upon the dedication of Westerners to the berry culture.

Though huckleberries remain restricted to their natural nursery lands, their fame has exploded across the West. The huckleberry is the state fruit of Idaho and huckleberry-flavored treats perch in the pantries of homes and freezers of restaurants. Back in Rexburg, Jeff Chesterson, an employee at the ice cream shop, Scoops, proudly claims that huckleberry is one of their most popular flavors, averaging about seventy scoops a week, or three gallons. Kiwi Loco, a frozen yogurt joint down the street, burns through nine liters of huckleberry-flavored frozen yogurt in five days (and promotes huckleberry as the flavor of the month when it's being sold). Perhaps it is their limited availability that makes huckleberries so sought after in

the West, or maybe their rich flavor is the source of their popularity. Were the huckleberry to be introduced to the whole of the US, it would no doubt become a hit, possibly replacing the blueberry in the hearts of Americans, but at the expense of its iconic influence on the culture of the West.

A worthy price to pay?

Sarah Prellwitz is a senior-level English major at Brigham Young University-Idaho. In her free time, Sarah enjoys exploring the great outdoors—especially when she can write about her experiences.

For almost 80 years, D.A. Davidson has invested in Montana's cultural, educational and natural resources. In addition to helping you with your financial future, our company and employees volunteer time and donations to ensure The Last Best Place is always The Last Best Place – a return we can all agree upon.



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The Art That Created The Park

By Rick Graetz

Thomas Moran, one of the most valuable members of the 1871 Hayden Geological Survey of Yellowstone, was a Philadelphia-based artist when Jay Cooke, the director of the Northern Pacific Railroad, recommended him to the expedition leader Ferdinand Hayden. Presenting him as “an artist of Philadelphia of rare genius,” it was Cooke, as well as the magazine *Scribner's Monthly*, who funded Moran's participation in the expedition.

In his over 40 days spent in the Yellowstone country, Moran sketched and documented more than 30 different locations within the future Yellowstone National Park. It was his artistic talent, along with William Henry Jackson's photographs, another member of the survey, that captured the nation's imagination and, importantly, that of Congress

Their work, especially Moran's paintings, exposed the magnificence of the Yellowstone region more than any of the written or oral descriptions, and persuaded the US Congress and President Grant that Yellowstone ought to be preserved.

The American public especially took notice of this Northern Rockies wonderland when Moran unveiled his first huge painting of *The Grand Canyon of the Yellowstone*, which the US Government purchased in 1872 for \$10,000.

Yellowstone National Park today can boast of having twenty-two original Moran paintings in its collection. Prints of these watercolors can be viewed at the Mammoth Hot Springs Albright Visitor Center in Yellowstone.

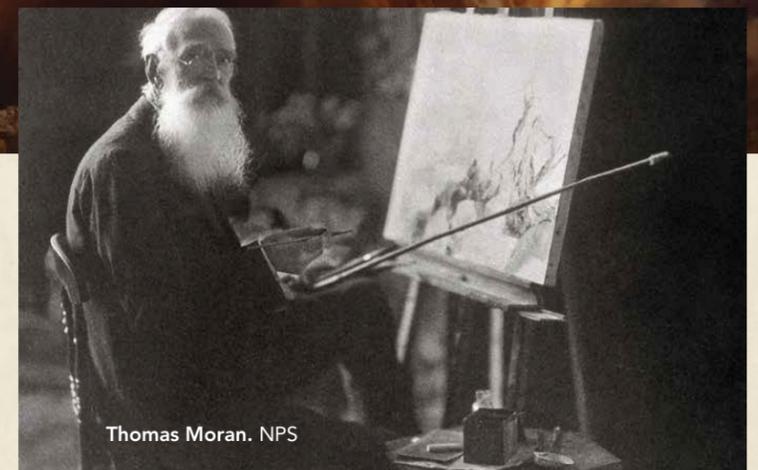
As great as Moran's impact on Yellowstone was, Yellowstone also had a significant influence on him. His first national recognition as an artist, as well as his initial financial success, resulted from his link to Yellowstone.

Rick Graetz is a Geography professor at the University of Montana.



Lower Falls in the Grand Canyon of the Yellowstone. The Smithsonian

MORAN.



Thomas Moran. NPS



Great Blue Spring of the Lower Geyser Basin. Whitney Museum of American Art



Lower Yellowstone Range. Archives & Special Collections, Mansfield Library, UM-Missoula



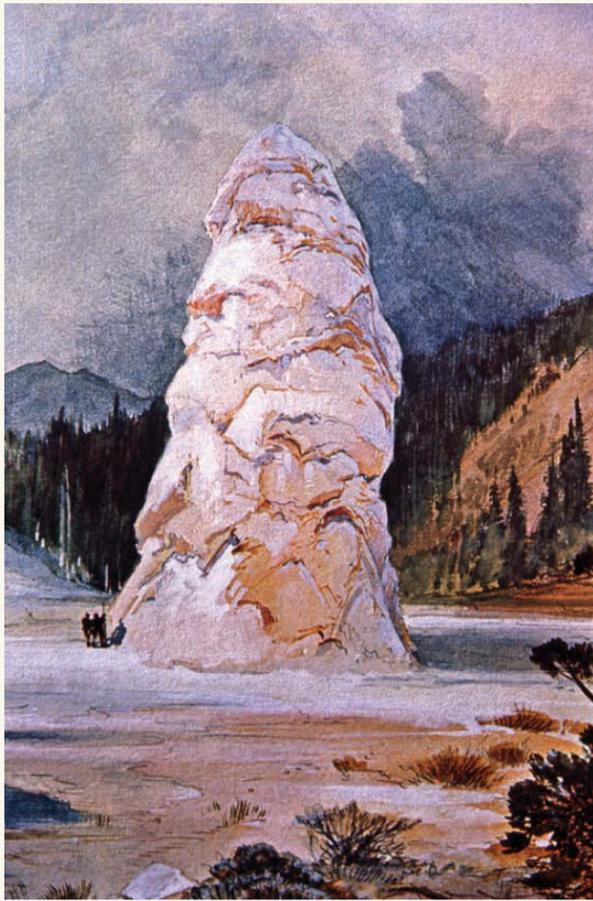
Rainbow over the Grand Canyon of the Yellowstone. The Smithsonian



Yellowstone Lake. Archives & Special Collections, Mansfield Library, UM-Missoula



Tower Falls and Sulphur Mountain.
Archives & Special Collections,
Mansfield Library, UM-Missoula



Liberty Cap. Yellowstone NPS



Lower Falls of the Yellowstone River. Yellowstone NPS



Castle Geyser, Upper Geyser Basin. Archives & Special Collections, Mansfield Library, UM-Missoula

ATLAS OF YELLOWSTONE

Reviewed by Rick Graetz

W. Andrew Marcus, James Meacham,
Ann Rodman, Alethea Steingisser

Hardcover - 296 pages - Published by
the University of California Press
More than 500 maps, including detailed
topographic maps of Yellowstone and
Grand Teton National Parks and other
areas of the Greater Yellowstone.

The authors: W. Andrew Marcus
is a professor in the Department
of Geography at the University of
Oregon. James E. Meacham is Senior
Research Associate and InfoGraphics
Lab Director in the Department
of Geography at the University of
Oregon. Ann W. Rodman is a GIS
Specialist at Yellowstone National Park.
Alethea Y. Steingisser is Cartographic
Production Manager in the Department
of Geography at the University of
Oregon. Additionally, more than 100
other individuals, all with expertise in
their fields, have contributed to this
undertaking.

One of the authors states, "Creating
the Atlas of the Yellowstone was a
monumental task"- an understatement
indeed! I have reviewed many books
over the past 30 years and found this
one to be the most difficult I have ever
tried to write about... and for good
reasons.

The dictionary defines an atlas as:

at·las *noun* /atləs/

1. a book of maps or charts.

To some, that could sound fairly
boring, and doesn't come near to an
accurate description of this tome.
Oh sure, there are hundreds of maps,
nearly as many charts, a few graphs,
and even fewer photos, but what makes
this book invaluable is the writing.
Someone (or in this case, "someday")
sat down and put all sorts of

fascinating, important, and just plain
interesting historical, geographical,
and scientific information into "public
speak." This is a reference book that
can readily be used by children and
adults alike.

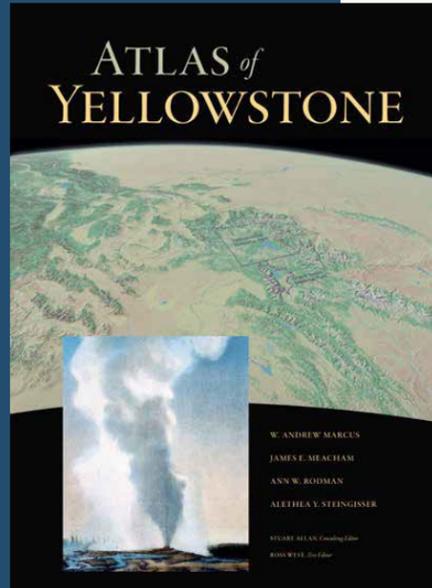
The geysers and about 10,000 thermal
features, as well as the charismatic
wildlife are visited. Revealed are at
least 112 separate topics including
American Indians in the Park,
early-day explorers, Yellowstone
art, climbing in the Grand Tetons,
elevation and landforms, overall
geology, hydrothermal areas, climate,
thermophiles, and place names.

For me, it would be difficult to trump
the significant praise that has already
been sung... here are some examples:

"Atlas of Yellowstone shows that
good things happen when top-notch
cartography, tasteful design, solid
research, and compelling geography
come together. The atlas will delight
professional and armchair readers
alike. Its treasure trove of maps
explores wide-ranging topics—from
geology to wildlife to people and
the land. Better still, these well-
orchestrated elements reveal a bigger
idea: the place we call the Greater
Yellowstone." —Tom Patterson,
former president, North American
Cartographic Information Society

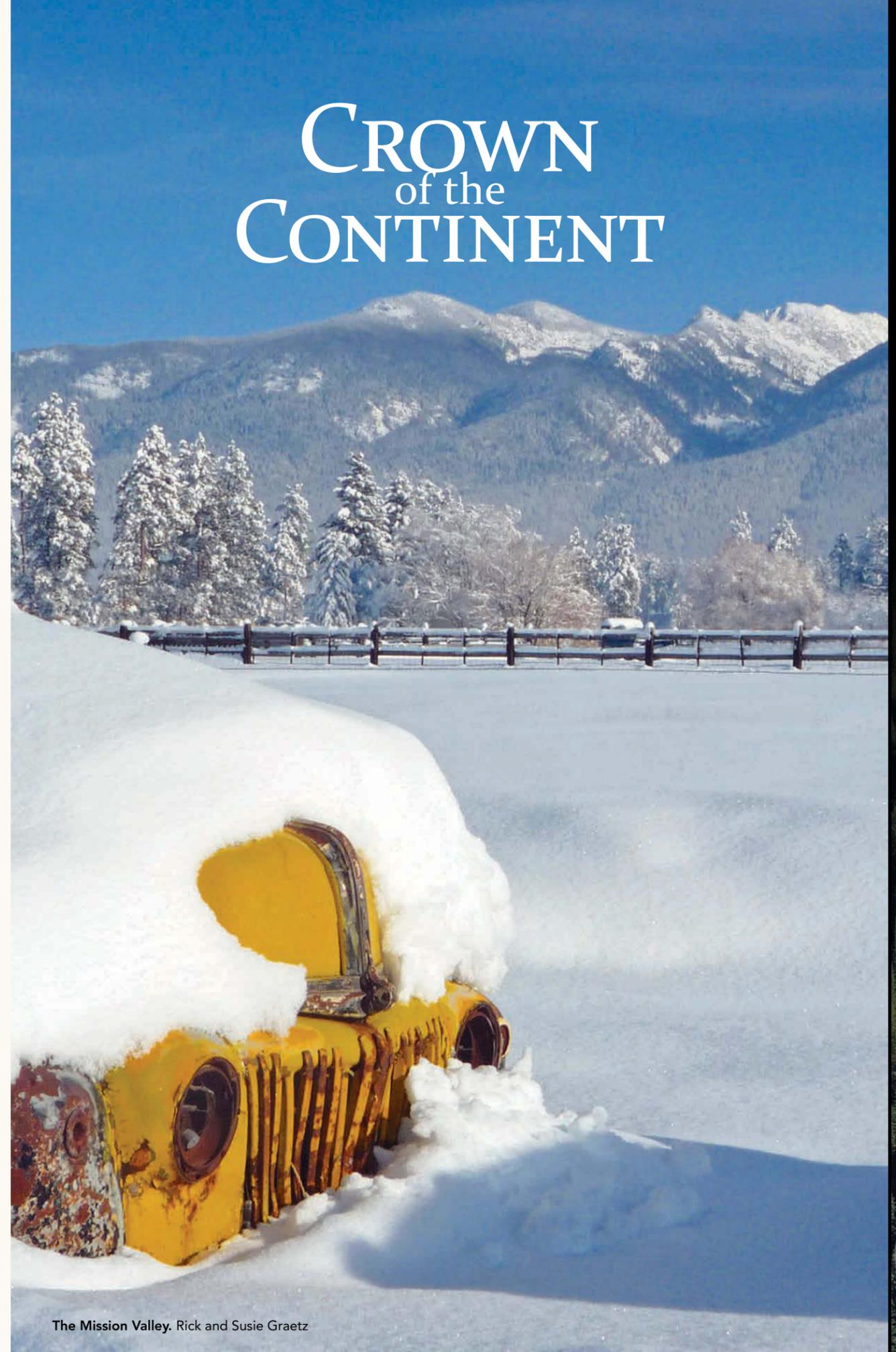
"This thoroughly researched volume
is especially suited for academics
and historians, but would be equally
at home in the library of anyone
who wants to research the depths of
America's oldest national park."
—High Country News

To most folks, the word Yellowstone
simply means geysers and wildlife, but
this exceptional volume will expand
that perspective. Make it a prominent
part of your library, or better yet, set
it on your coffee table, and you'll be
surprised by whom, and how often, it
is picked up.



Rick Graetz is a
geography professor
and Co-Director of the
Crown of the Continent
and Greater Yellowstone
Initiative at the
University of Montana.

CROWN of the CONTINENT

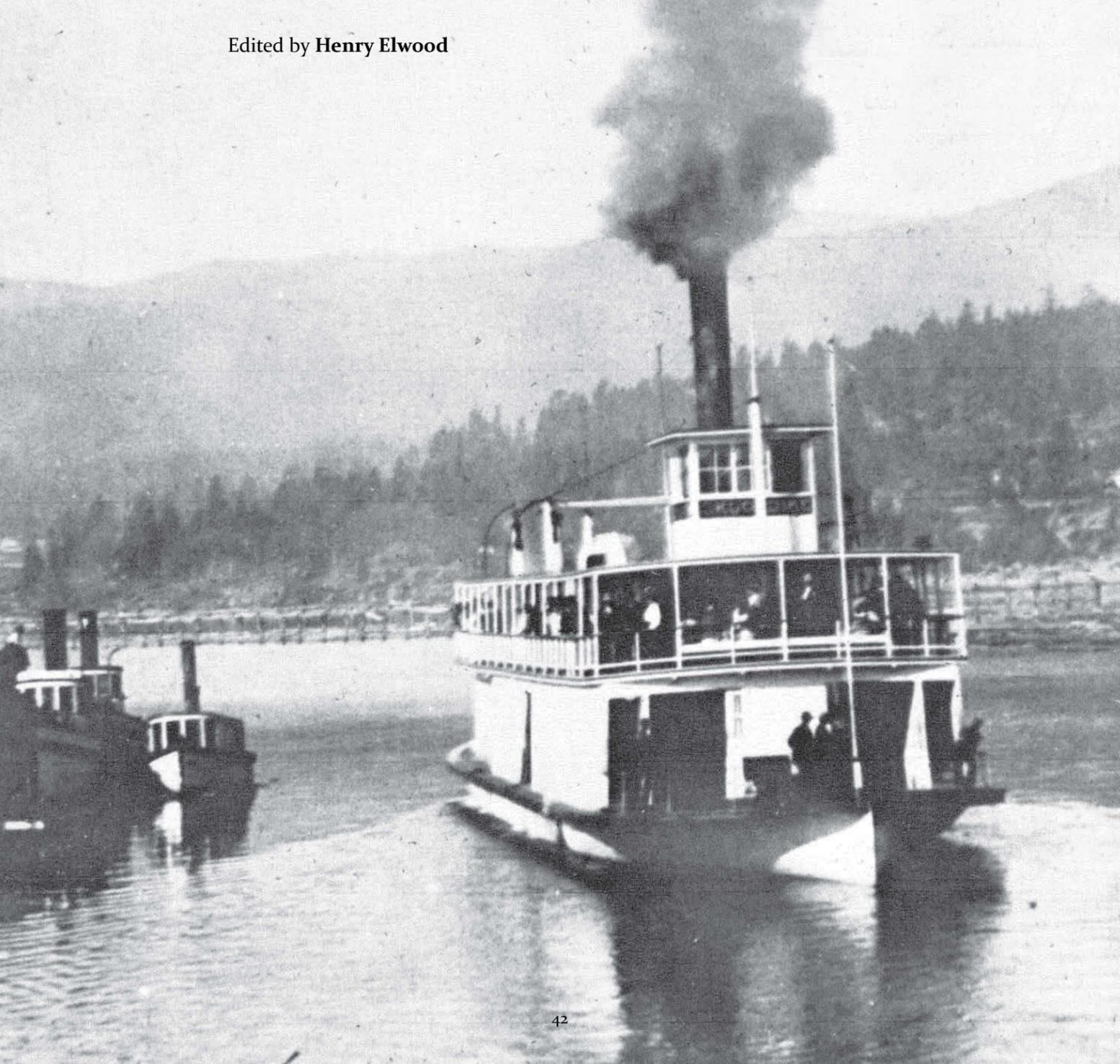


The Mission Valley. Rick and Susie Graetz



STEAMBOATS ON FLATHEAD LAKE

Edited by Henry Elwood



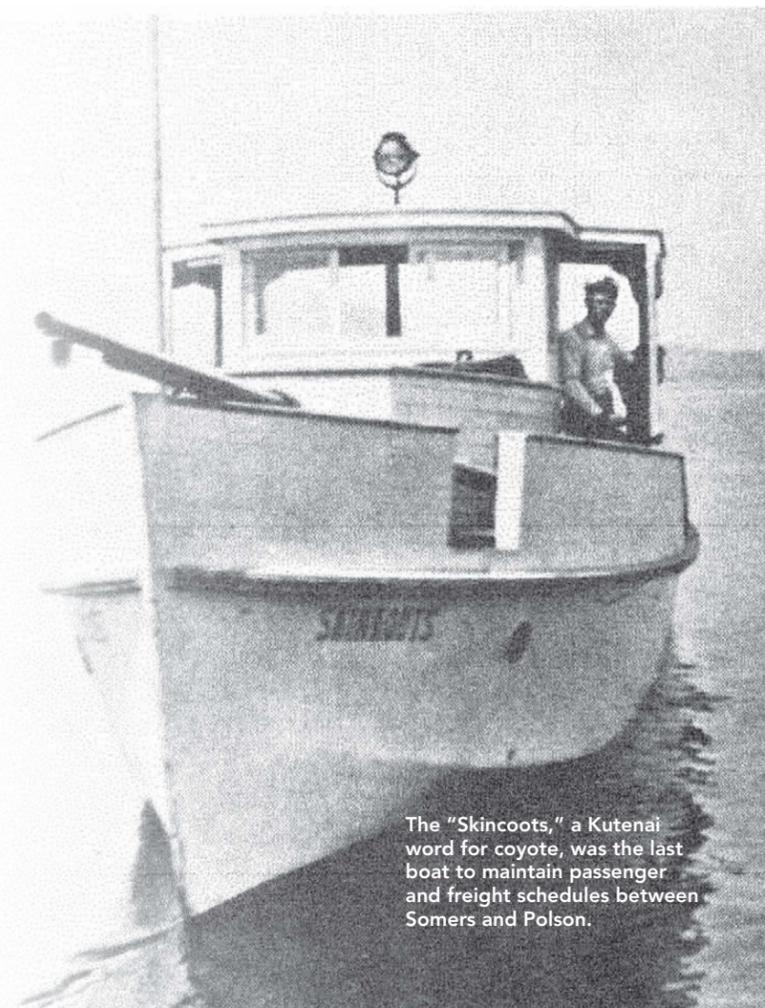
Band concert on the NEW Klondyke complete with band.

Until the early 1880s, Flathead Lake in northwestern Montana represented a formidable barrier, an obstacle to easy access into the upper Flathead Valley. Travel along either the east or west shore was extremely difficult even after the first primitive roads had been built through the rugged terrain bordering the lake.

Limited agricultural activity took place north of Flathead Lake in the 1870s, but it was not until the 1880s that settlers began to arrive in any numbers. Prior to 1885, all of the traffic to and around the lake was by team and wagon. However, in 1887, travelers and settlers rode the Northern Pacific Railway from Missoula to Ravalli. Stages left there three times a week, connecting with the little steamer *US Grant* at Polson.

In 1884, Fred Lingren, Neil and George Nelson, and Hugh F. Sinclair built the *Swan*, a sailboat that could carry twenty tons. Uncertain, unreliable winds on the lake and especially on the river caused the men to install steam machinery, and once rebuilt, they renamed it the *US Grant*, with Captain James Kerr, former Lake Superior commander, as the skipper. The success of this boat led to the construction of others - the *Pocahontas* (1886), the

◀ The Klondyke at the Somers log pond.



The "Skincots," a Kutenai word for coyote, was the last boat to maintain passenger and freight schedules between Somers and Polson.



Remnants of the Demersville docks on the Flathead River. Rick and Susie Graetz

Tom Carter (1889), the *Mary Ann* (1891), and the freight barge *Dora* (1890).

The *Crescent* and the *State of Montana*, both launched in 1891, were built with the idea of navigating the Flathead River as far up as Columbia Falls, but this plan, obviously, was not practical. Polson was the southern port on Flathead Lake, and for a short time Demersville, a few miles up the Flathead River, was the northern terminus. Between 1889 and 1892, materials for construction of James Hill's Great Northern were shipped by Northern Pacific Railway to Ravalli, hauled by wagon across the reservation to Flathead Lake (30 to 50 four- and six-horse freight wagons operated continually between Ravalli and Polson), and sent by steamer to Demersville. In just five days in April 1891, the steamer *Tom Carter* unloaded 586 passengers at Demersville.

The hauling of supplies and equipment for the construction of the Great Northern line down from Marias Pass, across the Flathead Valley and on into Idaho and Washington created a boom for steamboats on Flathead Lake in the early 1890s. At the same time, ever-increasing numbers of farmers, merchants and others were making their way into the upper Flathead Valley, and the need continued for additional boats. Eugene Hodge formed the Hodge Navigation Company and built the *Klondyke* in the early 1890s. This boat plied the lake until 1910 when she was rebuilt and renamed

the *New Klondike*. Making the trip to Polson three times each week, the *Klondyke* left Demersville at 6:00 AM in the morning. Disembarking at Polson, passengers crossed the reservation on stagecoaches and reached the Northern Pacific depot at Ravalli at 6:00 PM that same evening.

With the completion of the Great Northern Railroad into the Flathead Valley in 1892, the end for steamboats on the lake was only a matter of time. The steamboat business, however, received a shot in the arm in 1910 when the Flathead Indian Reservation was opened to settlers. By this time boats no longer traveled up the river to Demersville, and Somers became the principal port at the north end of the lake. Both the Great Northern and the Northern Pacific used the Flathead Lake steamboats as a connecting link between the two railroads, and travelers often made the trip west on one line and east on the other.

Much of the livestock from the farms and ranches south of Polson was shipped on barges towed by the boats to Somers where the cattle were loaded on Great Northern stock cars for shipment to various markets. In 1915 a bumper crop of 417,000 bushels of grain was shipped to Somers by barge from the elevators in Polson. Freight traffic was heavier on the northern run from Polson to Somers, a distance of 35 miles, because the rate was 10 cents per cwt (hundredweight). From Polson to the rail depot at Ravalli, approximately the

same distance, the overland rate was 50 cents per cwt. In 1907, Kalispell considered getting in on some of the lucrative steamboat freighting through a plan to dredge a channel from the mouth of the Stillwater River to the eastern edge of Kalispell. Such a project would have allowed steamboats to travel up the Flathead River to the front door of Kalispell, but nothing ever came of this engineering scheme.

In addition to serving the practical needs of the area, the Flathead steamboats also provided a social service in the form of excursions to favorite picnic spots along the shores of Flathead Lake. Barges were often favorite places for moonlight dancing on summer nights. More than one couple was married on a barge in the middle of the lake on what was known as the "special marriage excursion boat."

The last two of the large steamers were both launched in 1909—the *Montana* (not to be confused with the *State of Montana*) in April and the *New Klondike* in May. The *Montana*, 86 feet in length, was rebuilt by J. W. Swanson from the *Wasco*, which had been damaged by fire. The *New Klondike*, built by Gene Hodge, was 120 feet in length and was capable of carrying 425 passengers and 118 tons of freight.

On its run from Somers to Polson, the *Montana* stopped at these west shore landings: Fessenden's, Coram's, Stoner's, Broderick's, Angel Point, Table Bay,

Rollins, and Dayton. On the return trip, the *Montana* stopped at landings along the east shore: Yellow Bay, Woods Bay, and Bigfork.

As the need for large vessels declined, smaller and speedier boats were built and put into service—the *City of Polson* (launched in 1914), the *Bigfork* (1911), the *Flyer* (1911), the *Kalispell* (1910), the *Eva B.* (1908), and others. The *City of Polson* was regarded as the fastest boat on Flathead Lake, making the Somers to Polson trip in two hours, 20 minutes. The *Skinkoots* was the last boat to maintain a regular freight and passenger service. It operated from about 1926 to 1929.

The Northern Pacific completed a branch line to Polson in 1917 and, for all practical purposes, steamboat transportation was over by the 1920s. The Somers Lumber Company and the Dewey Lumber Company tugboats continued for another twenty years.

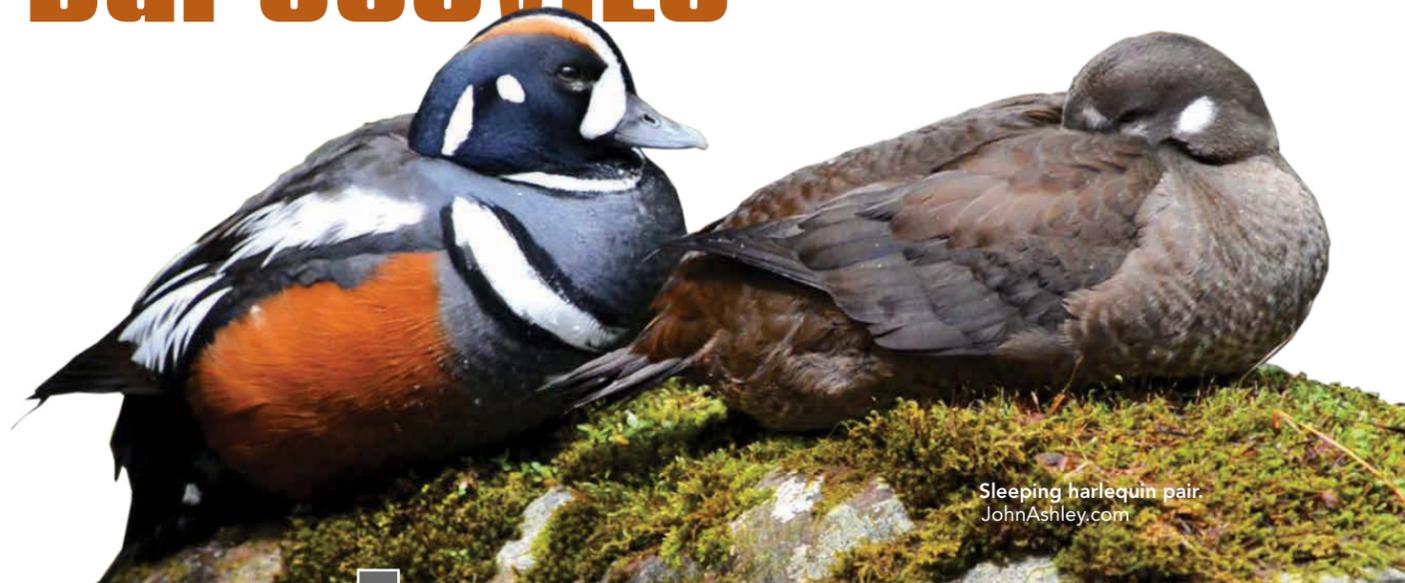
**This article, "Steamboats on Flathead Lake," is taken, in a slightly revised form, from the last chapter of the book, SOMERS, MONTANA - THE COMPANY TOWN, which was published in 1976 by the English Department of Flathead High School of Kalispell and edited by Henry Elwood.*



The Demersville.

White Water Daredevils

By *Melissa Sladek and Terry Peterson*



Sleeping harlequin pair.
JohnAshley.com

Although harlequin numbers are relatively stable throughout the West, it is listed as a species of concern in Montana.

ate summer sun shines through the car window as we drive along Upper McDonald Creek on the Going-to-the-Sun Road in Glacier National Park. Warren Hansen, a University of Montana graduate student, drives slowly, listening to a transmitter-receiver that is tracking harlequin ducks. A faint click, and then a louder and stronger “blip, blip, blip,” emanates from the device. We inch our way along the road, hoping the beeps will increase in strength; soon the receiver is silent. Warren swings the car around and drives back down the road until the radio once more comes to life. Stopping where the signal is strongest, we pull over, gather our gear, and head out on foot toward the creek, eager to catch sight of the bird responsible for the receiver’s activity.

Harlequins are small sea ducks that spend their winters along the coastal waters of North America and migrate inland in the spring to breed alongside mountain streams. These showy birds with their rounded heads and stubby bills are white water experts. In the winter, they live along rocky coasts in the midst of rough surf waters. In the summer, these charismatic ducks make their home in the frothing white water found in fast moving mountain streams. Here, they dive to forage for aquatic insects and are also able to dabble, or walk, along the bottom of the creek searching for insect larvae attached to rocks.

It is these white water divers that I have come to see. I follow Hansen and his assistant, Alaina Strehlow, over a bridge that crosses Upper McDonald Creek. We stop and scan the water. Seeing nothing, we move on, trying to follow the now softer and slower beeps of the receiver. As Hansen leads us through the thick forest canopy alongside the creek, he explains that he and his crew of biologists, volunteers, and veterinarians have surgically attached radio transmitters to 12 females of breeding age. These transmitters track the birds’ movements and identify each bird’s territory, the area used to forage, mate, nest, and raise its young. By studying the quality of each territory, he hopes to identify how both environmental and human factors are affecting the harlequins’ reproductive success.

Although harlequin numbers are relatively stable throughout the West, it is listed as a species of concern in Montana. With a statewide population estimate of only 150-200 pairs, their older breeding age (3+) and low fledgling success make them more susceptible to environmental and human intrusions. In Glacier, a 10-mile (16-kilometer) stretch of Upper McDonald Creek holds the highest density of breeding harlequins in the state, comprising 25% of Montana’s harlequin duck population.

Due to their colorful appearance and their ability to maneuver frothing whitewater rapids, many visitors to the park flock to Upper McDonald Creek in the spring to see the harlequins return. Park biologists are also interested in watching these birds and since 1999 have monitored the numbers of breeding pairs and chicks

reproduced each year. When no chicks were observed in 2010, they began to realize that to successfully manage harlequins, more research was needed.

This is where Hansen comes in. His master’s thesis is a three-year study that began in 2011. In a nutshell, he is looking at two potential factors that might be associated with nesting success: stream flow variation and human disturbance.

The timing and fluctuation of stream flow is important to the harlequin’s nesting success. Waiting for stream levels to drop before laying their eggs and incubating them, females build nests close to the water, usually within one meter of the water’s edge. Although timing and amount of spring run-off is variable from year to year, most streams experience a peak flow followed by a drop off. However, the flashiness of a stream, or how quickly a stream rises or falls in response to weather events, is important. If Upper McDonald Creek is affected by heavy rain or snow melt after reaching its peak flow, the rising water could wipe out the already nesting harlequins.

To determine whether or not stream flow variation shows a correlation with chick survival, Hansen measures the height of Upper McDonald Creek using actual stream data taken on a nearly daily basis from a gauge located just above Lake McDonald. Once he has established an average stream discharge, he can identify significantly high and low water discharge years and compare them with historical brood survey data.

Harlequin hen and her brood. JohnAshley.com



With an average of 2 million visitors a year, human presence is definitely a factor in Glacier National Park. But, it is not understood if, or how, this has an impact on the ducks. So Hansen is tracking his 12 study birds to map each one's territory and identify if it is in a section of creek with high human activity. Using a device called an Automatic Receiving Unit (ARU), he is also recording how frequently harlequins are found in high-human use sections of the creek (pull-outs along the Going-to-the-Sun-Road) versus low use sections.



Harlequin blood samples. Will Klaczynski

In addition, Hansen is documenting the stress levels in his study group by taking blood at capture, sampling feces, and looking at stress hormones in feathers. If there is a correlation between excessive stress levels in ducks whose territories experience high human use, it may be associated with low reproductive success.

This information is important for resource managers, as new strategies could be put in place to protect the birds. But, if it's not people causing lower chick numbers, then it's vital to understand what is. As Hansen explains,

"It's important to be able to document environmental impacts. We can't change snowpack (amounts) or the weather, but it would be great to understand it," and consequently how those impacts might affect the harlequin's ability to survive in the future.

Stepping out of the forest canopy into the bright sunlight, we perch on the side of a steep bank overlooking the creek. Hansen and Strehlow scan the creek. "Over there, two females!" Strehlow proclaims. Using his binoculars to look for leg bands, Hansen determines it's a female and a chick outside of his study group. Nearby, the researchers soon discover 'IG', one of Hansen's 12 banded ducks and the cause of the transmitter's activity. As the scientists observe the birds and discuss their movements, I search in earnest to find these beautifully camouflaged brown-gray females. To my amazement, the female and chick are just below a large boulder in the midst of a swirling rapid. I raise my binoculars once more and, after a minute, see two small gray ducks bobbing up and down. Then, in an instant, they disappear, diving under the water.

The chick's ability to navigate these rough waters right from birth amazes me, and I begin to think how incredible this bird is. It's clear why people come from near and far to see them. Perhaps it is the harlequin's uniqueness that draws us to them, and our passion is actually a detriment to the very thing we hope to see. Or perhaps their unique adaptations and particular habitat requirements cannot withstand even the slightest change.

summary

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



Releasing tested and tagged females. Will Klaczynski

Is human disturbance a problem? Hansen found there was actually a greater probability of duck pairs occupying stream pools near the road versus other stream habitat. At times, the areas near the pools do have high human use, but the fact that the birds were found frequently at these pools may be because most of the desired deep-pool habitat is disproportionately closer to the road. In addition, the surveys took place in the spring, when the Going-to-the-Sun Road is typically still closed to vehicles. Further research or monitoring is needed, especially as the road receives more use, to document the ducks' behavioral response to close human activity.

By looking at stress hormones that were secreted during the growth of the feathers, Hansen found that females who exhibited high stress hormone levels were less likely to nest, and concluded that events occurring during the non-breeding season do influence whether or not females will produce chicks.

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

Funding for this project was provided by US Federal Highways, Glacier National Park Fund, and CCRLC's Jerry O'Neal Fellowship.

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THE BLACKFOOT VALLEY...



Will Klaczynski

One of the things that makes Montana special is that there are still places where ecological systems are relatively intact. In many habitats, exotic species have been introduced and/or key native species have been extirpated. Such additions or subtractions can alter the way the remaining resident species interact with each other, making it difficult to understand how communities of organisms function in the absence of man's influence. For example, plant communities that are heavily invaded with exotic species often have fewer native species and altered ecosystem processes than do uninvaded systems. Similarly, communities lacking native predators may function differently than do communities with unaltered collections of native predators. Thus, intact systems provide unique and valuable opportunities to study the relationships among species and understand how ecosystems with their full complement of native species function.

Luckily, the Blackfoot Valley in western Montana still supports intact plant and animal communities. Here, grasslands are mostly free from monocultures of invasive exotic plants, and the native predators that have historically been present in the valley still exist there. This bowl-shaped valley sits at the southern terminus of the 1.5 million-acre Bob Marshall/Scapegoat Wilderness complex that is one of the largest designated Wilderness areas in the lower 48 states. Magnificent peaks provide a backdrop for the rolling prairie that makes the Blackfoot Valley visually stunning. But beyond good looks, the valley is unique because of the diligent work of ranchers, conservationists, and scientists who came together years ago and formed the Blackfoot Challenge, a non-profit organization designed to protect the rural lifestyle of the valley. The Challenge has been instrumental in helping to conserve habitat within the Blackfoot while also respecting the area's historic land uses.

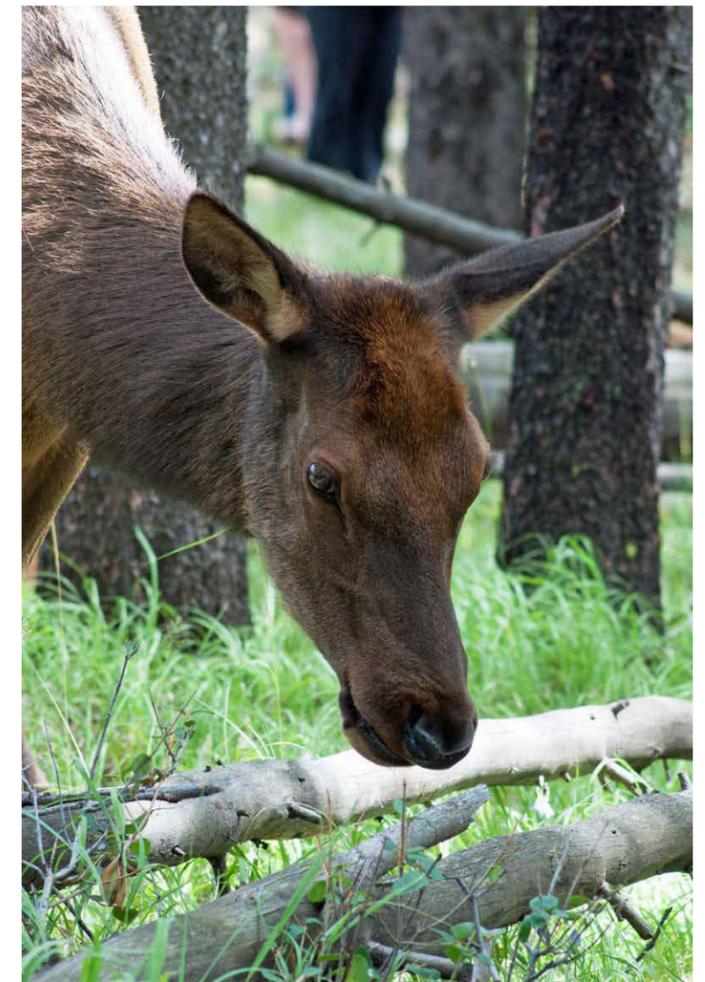
For the past eleven years, Dr. Dean Pearson (US

HOW COMMUNITIES OF ORGANISMS FUNCTION IN THE ABSENCE OF MAN'S INFLUENCE

GUESS WHO'S COMING TO DINNER?

By John Maron

Forest Service Ecologist) and I have been studying the ecological relationships among species that inhabit the grasslands of the Blackfoot Valley. The overarching goal of our work has been to understand how the food web within this diverse native grassland system functions. Food webs at their simplest are a description of who eats whom or what. Graphically, a food web can be depicted as a set of linkages between species, with each link connecting two species, one of which is a consumer and the other is a food resource (either plant or animal). Food webs are often thought of simplistically as a linear food chain, with a single connection between predators and herbivores and another single connection between herbivores and plants. Such linear food chains, however, are mere caricatures of the far more complex networks of feeding relationships that connect species in the real world. For example, predators not only eat herbivores; they can also prey on each other. Making matters more complex, "connections" between species only indicate that one species feeds on another. These connections don't provide information on the importance of that interaction in affecting the abundance of the species involved. For example, plant consumption by herbivores



While large herbivores certainly have an affect on plants, this study mainly focused on how predators and small herbivores affect plant abundance. John Maron

does not always influence plant abundance. Thus, understanding how interactions among predators, herbivores and plants influence the abundance of particular species remains a large challenge in ecology.

Perhaps the most enigmatic of interactions among species in food webs occurs when one species “indirectly” influences the abundance of a third by directly controlling the abundance or behavior of an intermediate species. The most dramatic examples of these “indirect effects” involve predators that alter herbivorous prey abundance, which in turn affects how strongly herbivores control plant abundance.

Interactions such as these are called “trophic cascades” because direct effects of predators on their prey tumble downward through the food web to influence how their prey control plant abundance or plant productivity. The best examples of trophic cascades come from mid-latitude lakes. Many of these lake food webs are comprised of four trophic levels. There are often piscivorous fish (fish-eaters such as bass,

pike, or trout) that eat planktivorous fish (plankton eaters such as minnows, dace, or shiners). Planktivorous fish feed upon small invertebrate herbivores, chief among these being a diminutive crustacean called a water flea (genus= *Daphnia*). These tiny herbivores in turn eat a lot of single-celled green algae. Over the last several decades, ecologists have performed sophisticated experiments where they have manipulated the structure of food webs in entire lakes by adding or removing piscivorous fish. It turns out that adding or subtracting predators from lakes can dramatically alter the amount of algal (algae related) plant production at the base of these food webs. Predator manipulation can turn an entire lake from clear to green or vice-versa. Such striking indirect effects of predators on plant production broadly suggest that predators play very important roles in the functioning of aquatic systems.

Yet, in contrast to lakes, determining the potential indirect effects of vertebrate predators on land has been more challenging. One reason for this is that



Head research technician, Teal Potter, sampling vegetation. Emily Kern



A rodent exclusion study plot. John Maron

terrestrial systems are more open than lakes with their discrete boundaries. This makes experimentally adding or subtracting wide-ranging predators more difficult on land. Due to the challenges of manipulating large predators, most of what we know about their ability to initiate trophic cascades comes from “natural experiments,” where predators have been removed or re-introduced into areas from which they have been historically absent. One well-known example has been the reintroduction of wolves into Yellowstone National Park. Early work suggested that reinstating wolves fundamentally changed elk behavior. Aspen in areas where elk were thought to be under high risk of wolf predation showed fewer signs of herbivore damage than did aspen in sites deemed to be lower risk for elk. Thus, reduced browsing pressure was deemed to be responsible for increased recruitment of aspen and other deciduous trees into areas in Yellowstone. However, more recent research using more sophisticated methods to quantify predation risk for elk has cast doubt on these earlier studies. Whether or not wolf reintroduction has triggered a trophic cascade in Yellowstone has become quite controversial in the scientific literature, in part because “natural experiments” often have many uncontrolled factors that can make their interpretation problematic.

Most of the experimental studies that have examined the indirect effects of predators in terrestrial systems have been carried out on very small scales (i.e. typically in plots several meters on a side). In these experiments, the predators have been diminutive, such as lizards or spiders. Small-scale food web experiments such as these are more logistically tractable than attempting to add or subtract larger and wider-ranging species. In these small-scale experiments, predators can protect plants from herbivore damage by reducing the abundance or changing the behavior of their invertebrate prey. Although these studies have been extremely interesting, they beg the question of whether predators routinely influence the productivity of entire systems (as opposed to in small plots), in the way that has been shown in lakes. The answer to this question remains unclear because ecologists have seldom been able to conduct the terrestrial equivalent of a “whole lake” experiment.

Eleven years ago, we set out to do just that in the Blackfoot Valley. Our overall goal was to understand how the Blackfoot grassland food web functions, and to determine whether predators have strong indirect effects in that system. We excluded all vertebrate predators (except snakes, which are very uncommon at our sites) from large plots (100 m x 100 m = 1 hectare) established



Herbivore Menu: rich, diverse and mostly native grassland. John Maron

at four sites dispersed widely across the valley. This enabled us to measure how vertebrate predators influence the abundance of herbivorous small mammals, primarily Columbian ground squirrels, deer mice, and montane voles.

At each site we also established two additional 1 ha (hectare) plots. The first one is surrounded by barbed wire and excludes elk and deer, but allows smaller predators access. The purpose is to separate the direct effects of those animals on vegetation from the indirect effects of predators on vegetation, through their potential impacts on small mammal populations. The second is a control plot that is open to all animals.

To determine the direct effects of small mammals on vegetation, smaller rodent exclusion subplots are embedded within each large 1 ha plot. By comparing attributes of the plant community in and out of these smaller small mammal exclosures, we can ascertain the extent to which small mammals influence plant community composition and productivity, and whether these effects are greater in the absence or presence of predators and/or ungulates.

To our knowledge this is only one of three studies world-wide of this scale or larger that has attempted to experimentally manipulate vertebrate predator abundance and examine both the direct effects of predators on prey, while also examining whether predators have indirect effects on vegetation. If such indirect effects are strong, the amount of vegetation

in predator exclusion plots should decline, because without predators, small mammal populations that eat the plants or seeds increase.

Our Blackfoot Valley research has been designed to break a very complex system down into simpler component parts, which we call “food web modules.” The first module involves the link between small mammal consumers and plants. How strongly do the small mammals that commonly inhabit western Montana grasslands influence the abundance of particular plant species, or overall plant productivity? Answering this question requires determining the individual impacts of each component small mammal species, which differ in their food habits and behavior. Columbian ground squirrels are herbivorous, and eat primarily grass, flowers, and occasionally seeds. Ground squirrels hibernate from early August through March, so they are active in grasslands for only a small portion of the year. However, we have found that in some years these animals can have large impacts on grass productivity. Through time, increased grass production can lead to the build-up of litter, which can inhibit the recruitment and growth of flowering plants that occur in the spaces between the large bunchgrass species (rough fescue or *Festuca caepstris*) that dominate these grasslands.

Another ubiquitous small mammal in western Montana grasslands is deer mice (*Peromyscus maniculatus*). Mainly active at night, they prey on

insects during a portion of the year and then switch to eating seeds during the late summer and fall. We have performed experiments where we have added seeds of a suite of plant species to plots in and out of rodent exclosures and found that deer mouse predation on these seeds can be quite intense. Particularly at risk are plant species that produce relatively large seeds. In one set of experiments, a former University of Montana Ph.D. student, Mary Bricker, found that seed predation by deer mice greatly reduced seedling establishment of two large-seeded native species, silky lupine (*Lupinus serecius*) and pacoan (*Lithospermum ruderales*). By combining seed addition with careful monitoring of the growth, reproduction, and mortality of these species, Dr. Bricker was able to create population growth models to infer how reductions in seedling recruitment due to seed predation might influence long-term patterns of population growth for these species. Her results indicated that seed predation strongly limits the abundance of these plants.

We know that predation on seeds of other species can have similarly strong impacts on plant abundance. For example, deer mice also eat seeds of some large seeded exotic (non-native) species, one of which is salsify (*Tragopogon dubious*), a dandelion-like forb that is native to Europe but has been widely introduced across the United States. While salsify can be fairly plentiful in disturbed areas, particularly along roadways, it is not a terribly profuse exotic in undisturbed grasslands in western Montana. Exotics that do not occur at high abundance, and hence have few negative impacts on native species, are often called “weak invaders.” In contrast, “strong invader” species like spotted knapweed (*Centaurea stoebe*) or leafy spurge (*Euphorbia esula*) often grow in dense monocultures and have many negative influences on native plants. By excluding deer mice from plots over a long period of time, we have seen dramatic increases in salsify inside plots protected from rodents. In essence, we have turned a “weak invader” into a “strong invader” by eliminating deer mouse seed predation.



Predator exclusion plot showing overhead wires to exclude raptors and flashing on side of fence to exclude weasels. John Maron

The final piece of the small mammal puzzle is montane voles. These animals are herbivorous and tend to focus on grass and sedge species. However, in the dry grasslands of the Blackfoot Valley, montane voles occur at very low densities, typically only 2-3 individuals on a 100 x 100 m plot. Due to their low abundance we have seen very little evidence that montane voles have any significant impacts on grassland vegetation.

In summary, the picture that has emerged over the years from exploring the rodent-plant food web module is that both ground squirrels and deer mice can have strong impacts on the abundance of particular forb species and the overall productivity of grasslands. Thus, there is potential for predators to strongly mediate these effects if they reduce the number of these animals.

This brings us to the second food web module we have been exploring, which is the link between predators and small mammal abundance. For small mammals, the most important predators are not the heavy-hitting charismatic behemoths such as grizzly bears and wolves. Instead, meso-predators such as coyotes, foxes, weasels, badgers, and various birds of prey are likely more important.

But which of these myriad species might be the strongest actors in affecting small mammal abundance? During the first four years of our study, we excluded all predators except weasels. Weasels are very difficult to keep out of plots, and so we conveniently ignored them. But through time we realized that we couldn't continue to do this. So, in 2006 we retrofitted all the fences surrounding predator exclusion plots with small mesh fencing that allows deer mice and small voles to come and go, but doesn't allow entry by weasels. We installed metal flashing on the top of fences to prevent weasels from climbing over. Although ground squirrels cannot easily gain entry into plots from outside of them, they



Ground squirrel dining on silky lupine, *Lupinus sericeus*. Teal Potter

can exit plots by climbing over fences from the inside out.

What we immediately discovered after putting up anti-weasel fortifications to predator exclusion plots is that montane vole populations skyrocketed. Voles went from an average of 1-3 animals per hectare to, in some cases, over 40 animals per hectare. We knew this because we regularly capture small mammals in live traps on each of our three large plots at each site. Interestingly, after reaching peak numbers, vole populations subsequently crash on predator exclusion plots. This sort of volatile population dynamics is not uncommon in some predator-prey systems. Lynx and hares are a classic example of coupled predator-

prey up-down-up-down population dynamics. Hare populations undergo regular peaks, and then crash as lynx begin eating more of the abundant hares. Lynx populations, in turn, follow the hare population decline as food resources lead to their reduced numbers. Paradoxically, however, vole populations crash from peak numbers even in the absence of predators. Thus, release from predation enables vole populations to increase,

but something else leads to their subsequent population crash. The obvious explanation for this would be that vole populations were eating themselves out of house and home on predator exclusion plots. However, this is not the case. Instead, our data suggest that voles shut off reproduction at high population abundance, which subsequently causes their populations to decline.

The boom and bust population dynamics that montane vole populations undergo on predator-free plots stand in stark contrast to what occurs on ungulate only exclusion plots, or controls, where voles occur at low and very stable numbers through time. Unlike the strong impacts of predators on vole populations, we

have found few impacts of predator exclusion on ground squirrel and deer mice populations. We speculate this is the case because ground squirrel and deer mouse populations are fundamentally food limited, so that even in the absence of predators their ability to build up to high numbers is constrained by food resources.

Putting the two food web modules together, what have we learned? We found that ground squirrels and deer mice have strong impacts on grassland plant communities. Interestingly, predators do not have large and consistent effects on the abundance of these animals, although at some sites and in some years we know that badgers reduce ground squirrel numbers. In contrast, one specialist predator, short-tailed weasels, have important effects on montane vole abundance and dynamics. Yet, voles have minimal effects on vegetation, in part because their populations crash immediately after reaching population highs, so animals do not consistently stay at densities high enough to harm plants. These features of the Blackfoot Valley grassland food web explain the lack of trophic cascades.



Rick and Susie Graetz

Although we have not seen evidence of trophic cascades, our research has revealed important ways in which native small mammals influence the abundance and productivity of vegetation. Included in this are ways that small mammals may help limit exotic abundance through seed consumption. Moreover, other aspects of our work have revealed fundamental differences in how native versus exotic plants respond to competition from resident vegetation and seed predation. Our continuing investigations into the functioning of the Blackfoot Valley foodweb are providing insights into the natural history and ecological interactions among species that we hope will be ultimately useful to those charged with managing these impressively diverse and intact grasslands.

John Maron is a professor in the Division of Biological Sciences at the University of Montana. He received his Ph.D. from the University of California at Davis and is a population and community ecologist with interests in food web ecology, plant-animal interactions, and invasion biology.



Silent, Sacred and Wild

By Rosalyn LaPier

As a child I learned that every place had a story and within those stories was an explanation of the Blackfeet relationship to their landscape.

Traveling with my grandmother was a nonstop history lesson. She told whoever was in the car, the story of each hill, bluff, creek, and river. Every place in Montana had a history of human interaction. Some stories were of places the Blackfeet used for collecting plant medicines or food, some were places for hunting, some were places of triumphant battle scenes or, worse, places of massacres and death; and yet others were places of

prayer and ritual. Sometimes her stories of one place led her to tell stories of a distant place. Together, her stories amounted to a kind of journal that told the history of the northern Great Plains. There was never a place in our travels in Montana without a story.

I learned from my grandmother's stories that the Blackfeet did not have our modern American concept of wilderness – as a place “untrammelled by man.”

The ancient Blackfeet, of whom my grandmother spoke, used and understood their landscape in two ways: through its utilitarian purposes and through its role in religion.

The ancient Blackfeet viewed the Sweet Pine Hills (Sweet Grass Hills) as both a sacred place and a place for hunting and gathering resources. Rick and Susie Graetz



One of my grandfather's nicknames was for the prairie crocus, or prairie smoke, which after it flowers has long white hair. Rosalyn LaPier

In ancient times, the Blackfeet had a distinct territory that they called their own, which they used in a multiplicity of ways. The Blackfeet used some places continuously, such as where they lived or gathered resources, or, occasionally, for seasonal activities. Near the edges of their territory, the Blackfeet had what ecologists call buffer zones or rarely used areas positioned between human territories. The Blackfeet managed their landscape, through fire or manipulation, or they intentionally left it natural.

Outside of their territory, the Blackfeet traveled to distant places to collect resources they could not find within their own territory and to trade with other Native groups.

In a story collected in 1910, a Blackfeet man named *Kainai* told of his ancestors' experiences on the landscape. He spoke of how the Blackfeet split their year into two seasons, winter and summer. His ancestors' band lived in a sheltered river valley throughout the winter, which usually lasted six months. Then, during the summer, they moved as many as fifteen times to hunt for food and hides, gather berries and roots, collect medicines and important natural resources, and to conduct their annual religious rituals. The Blackfeet used each place they went to for a specific purpose.

Historically, the Blackfeet divided themselves first into tribes – the *Siksika*, the *Kainai*, the *Apatohsi Pikuni*, and the *Amskapi Pikuni*. Each tribe then further divided itself into multiple family units called bands. Each tribe had between twenty to twenty-five bands. Combined, the four tribes had from eighty to one hundred different bands.

Imagine the landscape of the northern Great Plains, with these one hundred bands living separately from each other and moving from place to place. If each band moved fifteen times during the year, as *Kainai* reported, the bands of the Blackfeet would have used as many as 1,500 different places in a year. It is no wonder that my grandmother had a story for every place on the landscape.



Chief Mountain. Rick and Susie Graetz

Saokiótapi | Prairie People

Prairie People is one of the names the Amskapi Pikuni, the southern Pikuni, called themselves. In the United States they are now officially the Blackfeet. Although they viewed the mountains as part of their aboriginal homelands, they originally saw themselves as residents of the plains.

Kippiaapi | Anemone patens or Pulsatilla patens

Prairie crocus, or prairie smoke as it is commonly called, is a familiar flower on the prairie during the early spring. It translates in Blackfeet to “soon to be an old man,” which refers to the long white “hair” that develops after it has flowered. One of my grandfather Francis Aimsback Wall’s nicknames was Kippiaapi, because he had blond hair as a child.

Kátoyiss | Sweet Pine Hills

Perennially mis-translated as “Sweet Grass,” the Sweet Pine Hills were the final home of Katoyís, also known as Sweet Pine or Blood Clot. He was a human turned super hero who traveled the prairies killing monsters, making the earth a safe place for humans to live. His exploits live on in the historic stories of the Blackfeet.

Nínaiistáko | Chief or Leader Mountain

Chief Mountain, as it is now called, was the home of Ksiistsikómiipi’kssi, a supernatural bird-like entity with feathers of all colors, a beak, and legs of green, and when it opened its eyes, lightning struck, and when it moved its wings, thunder roared. The Ksiistsikomm, or Thunderbird, ruled over the natural phenomena of thunder, lightning, fire, and rain.

There were places on the landscape, though, that the Blackfeet never set foot on. They viewed much of their land as a Holy Land where supernatural entities lived and humans set aside for sacred use.

These Natives of the prairie believed that supernatural entities lived in sacred places on the landscape, and felt that humans should not disturb them, therefore allowing the spirits privacy. The Blackfeet understood that boundaries between humans and supernaturals were necessary, similar to the buffer zones between human groups. It was from within these buffer areas, near, but not inside, a sacred place, that the Blackfeet went to pray or perform rituals. They also went near, but not into, sacred places to gather plants, animals or other natural elements to use within their ceremonies. Even though the Blackfeet left the sacred places of supernatural entities alone, they still recognized their places on the landscape as “used places,” even if humans did not use them.

The Blackfeet also believed that some sacred places were the creation of humans and not the creation of supernatural beings. These places were usually connected to human suffering or the supernatural intervention in the lives of the Blackfeet. Sometimes, they had a similar prohibition against human presence. Some battle sites or burial places were viewed as sacred,

and they did not frequent them. Yet the Blackfeet sometimes created shrines at these places and left offerings or prayers there. Each of these places had a story of its creation on the landscape.

The Blackfeet built various temporary structures for prayer or ceremonies, such as an *O’kan* or Medicine lodge (also known as the Sundance), or sweat lodges. Once the Blackfeet had used these edifices, they were left alone in the natural elements to decay. They also built stone effigies as memorials to leaders who had died. The Blackfeet did not often return to these places or structures on the landscape until a significant amount of time had passed. Special places, which were left alone, free of a permanent human presence, was not a new concept to the Blackfeet. However, those places were usually connected to their religious belief system.

Over the millennia, the Blackfeet territory filled with places and stories. They valued every place in their landscape for its utility or sacredness. Each story of these places became part of a mnemonic historic text that people learned to recount. My grandmother learned this narrative from her grandmothers as a child.

I learned as a child that there were no empty spaces or unused places on the Blackfeet landscape. I learned that the Blackfeet appreciated their land, not for its intrinsic value, but for a longer deeper connection, where humans shared a world with the supernatural.

Rosalyn LaPier (Blackfeet/Métis) is an environmental historian, Native language advocate and herbalist. She lives in the heart of Salish country in Missoula and off the grid near Chief Mountain on the Blackfeet reservation. Rosalyn teaches in the Environmental Studies Program at the University of Montana.



The First Peoples Buffalo Jump (formerly Ulm Pishkun) is a place once used by the ancient Blackfeet, who used buffalo jumps to kill bison for thousands of years. Rick and Susie Graetz

Something Sacred

By Gene Sentz

Aldo Leopold spoke of “a sense of place.” When one comes to know intimately a special wild place, one feels the sacred there. We touch the earth and are touched by it. We may not own the deed, but we can get very possessive of a place, especially when we become possessed by its extraordinary landscapes.

The Montana Rocky Mountain Front is my special place.

From Choteau’s Airport Hill, I can see fifty miles northwest across Birch Creek to Feather Woman Mountain. From there southward, seventy-five miles downrange, stands Caribou Peak above Falls Creek. Filling the spaces between are Walling Reef and Old-Man-of-the-Hills on Dupuyer Creek; Mount Frazier and Mount Werner in Blackleaf Canyon; Choteau and Baldy

and Rocky and Ear—mountains, all feeding the Teton; and Chute Mountain above Deep Creek. Castle Reef and Sawtooth guard the Sun River. Across Ford Creek, Crown Mountain and Steamboat keep watch over the Dearborn, and Scapegoat pierces the distant horizon. And that’s only part of it.

The Front was “backbone of the world” to the Blackfeet and other Native Peoples and to the ancients who trekked the Old North Trail. The peaks and ridges were vision quest sites. They’ve been called by different names, but these same mountains remain little changed by millennia. Little more than two centuries ago, no white man had ever seen them, yet now they are sacred in many non-Indian eyes, just as they remain so to the traditionalists of the tribes.

Forest Service evaluations score the public lands along the East Front of the Montana Rockies as the finest unclassified wild country in the lower 48 states. Its scenic splendor is unsurpassed by any undeveloped landscape on earth. Biologists place it in the top one percent of wildlife habitat in North America. The Front is sacred to a growing number of people, however one understands the term “sacred.”

But, as one old-timer who grew up beside the Rockies says, “It’s almost like the original temptation. We have this incredibly beautiful place that we can either leave alone or go in and grab the apple.” Yes, there are those who wish to build roads and carve mines and drill sites here to prospect for potential resources. Their cry is “Jobs! Revenue! Profits!” I hold no grudge against them, but in this case I agree with the great majority of folks who have said, “Leave the Rocky Mountain Front alone. Save this magnificent landscape in its wild state for future generations. Let it be.”

Many people wish to preserve the Front as home for eagles and elk, grizzlies and goats, jack pine and juniper, and other plants and critters, some endangered. Certain economists predict that the long-term benefits of saving it far outweigh short-term profits to be gained from resource and industrial development. Backcountry

recreationists believe too many roads already intrude on public land. And many scientists urge that all remaining wild country be set aside as a baseline from which to compare our mostly developed world.

There are lots of reasons for saving the Front, but the purest I’ve heard came from a crusty old Montana native who told his congressman, “Some places on earth should be left alone even if solid gold lies beneath them. The Rocky Mountain Front is such a place.”

I agree. For me, these special mountains and valleys, in and of themselves, are reason enough. I know them like brothers and sisters and cherished old friends. I keep returning to them. Always, they touch me. I suspect I am possessed by them.

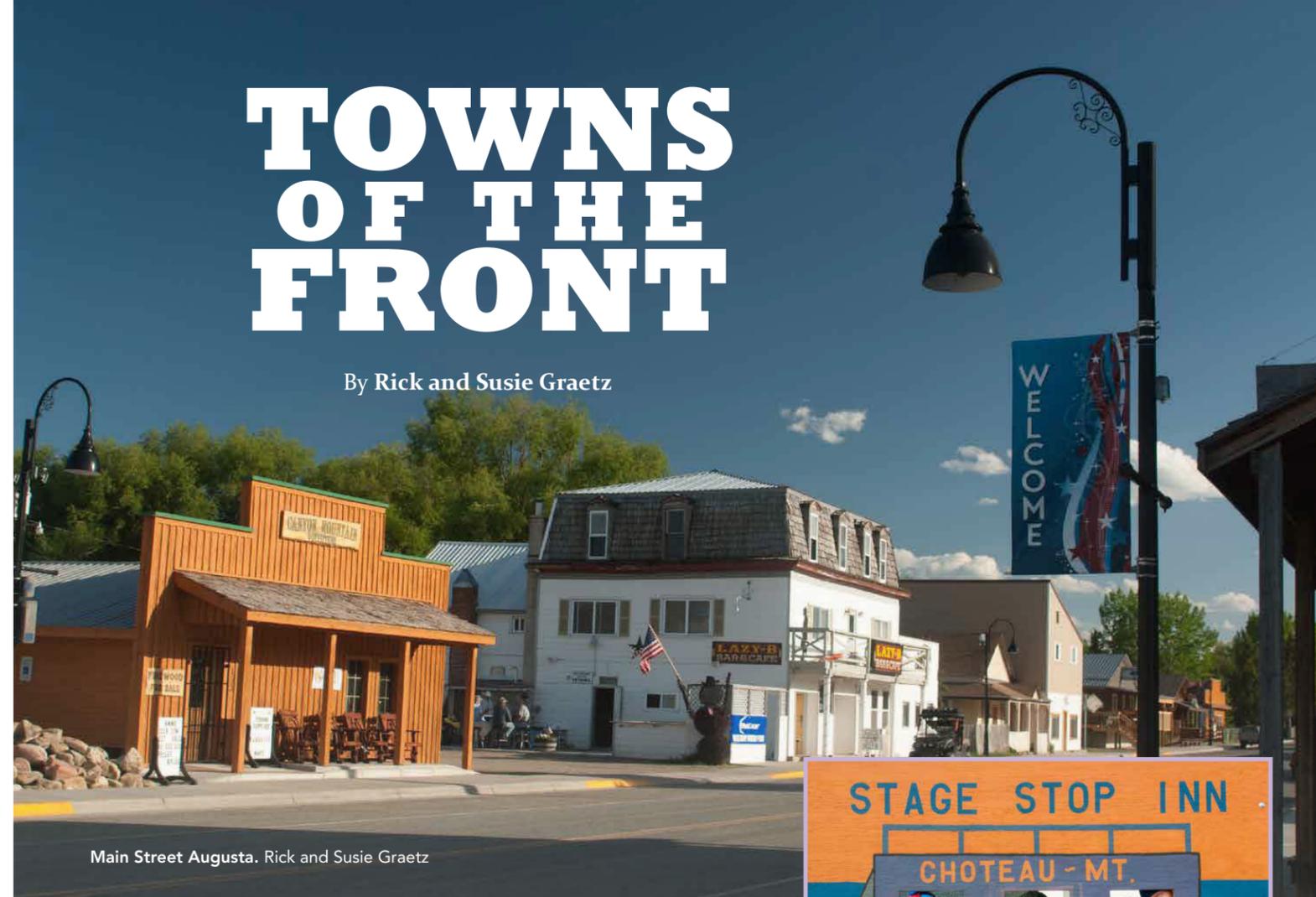
Wallace Stegner described America’s remaining wilderness as our “geography of hope.” The wild horizons of the Rocky Mountain Front and Bob Marshall Wilderness symbolize the geography of hope for an entire continent. It is an extraordinary land. I trust we can keep it. Something there is sacred.

Gene Sentsz, a retired schoolteacher and a fierce defender of the Front, lives in Choteau and spends his time roaming this landscape, and continues packing and guiding with his outfitter friends.



TOWNS OF THE FRONT

By Rick and Susie Graetz



Main Street Augusta. Rick and Susie Graetz

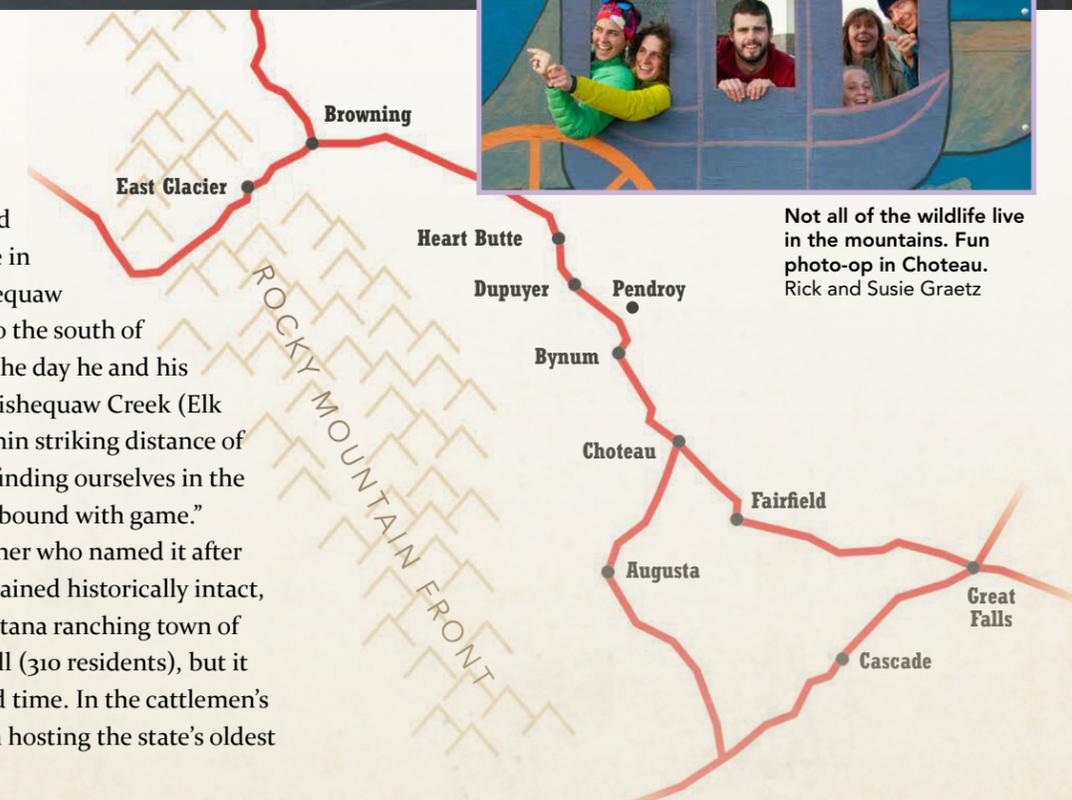


Not all of the wildlife live in the mountains. Fun photo-op in Choteau. Rick and Susie Graetz

AUGUSTA

In early July of 1806, Captain Meriwether Lewis, on his way to the Sun River and the falls of the Missouri, wrote in his journals of viewing “Shishequaw Mountain” (Haystack Butte) to the south of present-day Augusta, later in the day he and his men “hunted and dined on Shishequaw Creek (Elk Creek) and as they passed within striking distance of town, they “much rejoiced at finding ourselves in the plains of the Missouri which abound with game.”

Founded in 1884 by a rancher who named it after his daughter, Augusta has remained historically intact, an excellent example of a Montana ranching town of a century ago. It might be small (310 residents), but it sure knows how to have a good time. In the cattlemen’s tradition, folks here have been hosting the state’s oldest



and one of Montana's most popular rodeos for more than three-quarters of a century. Since the late 1940s, recreation has also become an important industry. Fishing, hunting, wilderness pack trips, backpacking, and hiking in the nearby Bob Marshall Wilderness have all brought new economic development through outfitters, guides, and local dude ranches.

BYNUM

Named for early settlers in the area, in 1881 it was solely a country store. The post office wasn't established until 1885 and the first school in 1899. In 1913, in order to be nearer to the newly built Great Northern railroad from Choteau to Dupuyer, the town picked itself up and relocated a few miles to its present site. A short-lived boom period ensued, but by 1917, the town's population began to decline with the arrival of an extended drought.

Don't be misled by its size (31 people as of 2010). Bynum is home to the Two Medicine Dinosaur Center, a first-class, professional education and research facility. Its star resident is the first infant maiasaura found at the nearby famous Egg Mountain.

PENDROY

Just seven miles north of Bynum and two miles east of Hwy 89 sits Pendroy. Named for Levi Boots Pendroy, a Great Northern Railway employee who helped survey the area, the town was started in 1916 as a railroad branch line from Bynum. It grew quickly and was at its most prosperous level in the 1920s. Today, approximately 150 people live in the Pendroy area.

CHOTEAU

The county seat of Teton County is one of the oldest settlements in this part of Montana. When the Blackfeet Indian Agency was relocated north to the reservation boundary in 1876, the few residents left behind eventually moved three miles to the south of the old fort and established the present-day town. In 1883, it was dubbed Choteau after Pierre Chouteau, who was the head of the American Fur Company. The townsfolk preferred to keep the incorrect spelling so as to distinguish their city from Chouteau County.

Today, this agricultural burg of 1,684 people is a most attractive community, featuring a wide, business-lined main street and a stately stone courthouse that is on the National Register of Historic places. The Old Trail Museum, a complex of historic area buildings, and a dinosaur exhibit that conducts educational field study programs in paleontology, gives an entertaining insight into the area's near and far past.

Pulitzer Prize-winning author A.B. Guthrie, Jr. lived just west of town until his death in 1991.



Small town Bynum is home to big critters.
Rick and Susie Graetz



Teton County Courthouse,
Choteau. Rick and Susie Graetz

FAIRFIELD

Located 12 miles southeast of Choteau, Fairfield sits on a bench overlooking Freezeout Lake with a wide panorama of the Rocky Mountain Front as a backdrop. Fairfield's origins are linked to the Milwaukee Railroad, but irrigation projects in the earliest years of the 20th century allowed for more grain to be grown in the area, drawing people to establish homesteads. Platted in 1916 by Elmer Genger, today it is the "Malting Barley Capital of the World" and a trade center for the farming community.

DUPUYER

Originally a stage stop on the bull-team freight route between Fort Benton and Fort Browning, Dupuyer became a supply depot for local ranchers and miners. The post office was established in 1882, and by 1903, the town had grown into a bustling commerce center. Today, this small country hamlet has approximately 86 residents who lead a much quieter lifestyle.

HEART BUTTE

Named for nearby mountains that look like inverted hearts and located on the Blackfeet Indian Reservation, Heart Butte is, along with East Glacier, one of the closest towns on the Front to the wall of mountains. The post office was established in 1915, and today, approximately 582 people call it home. Situated well off of Hwy 89, Heart Butte can be reached from Dupuyer and from several points farther north.

BROWNING

Named for a US Commissioner of Indian Affairs, Browning is the agency headquarters for the Blackfeet Indian Reservation. Sited at the junction of Hwy 2 and Hwy 89, and only 18 miles from Glacier National Park, it is a tourist stop for gas and snacks and home to about 1,016 full-time residents.

There has been a post office here since 1900, but the town wasn't incorporated until 1919. The Blackfeet National Bank, established in 1987, was the first and only tribally controlled, reservation-based, full-service, commercial bank in the United States. Fully accredited since 1985, the Blackfeet Community College provides a means for a better way of life. This busy, mostly Native American town is also home to the excellent Museum of the Plains Indians. The Tribal Council is working in conjunction with the Nature Conservancy of Montana to protect reservation lands.

EAST GLACIER

Located on Hwy 2 and serving the southeast entrance to Glacier National Park, East Glacier sits hard up against the mountains. This colorful village has approximately 363 full-time residents. Most are professionals who work in the Browning schools and hospital or for the National Park Service. During the tourist season the population swells to about 2,500 folks.

Extensive gardens lead from the chalet-style Amtrak train depot to the grand and historic Glacier Park Lodge with its wonderful lobby pillared by enormous four-story-tall Douglas fir logs.

CROWN OF THE CONTINENT: THE WILDEST ROCKIES

Featuring the photography of Steven Gnam and the writings of Douglas Chadwick, Michael Jamison, Dylan Boyle, and Karsten Heuer

193 Pages – 10 x 12 inches – 150 color photos – 7 color maps – Published by Braided River, an imprint of Mountaineer Books of Seattle

At the University of Montana, I teach a course titled the Crown of the Continent, as well as several field classes within that magnificent landscape. To continually enhance my knowledge of this natural area and to provide more information for my students, I am constantly on the outlook for new and well-written material. In this recently published work, I found a definitive source. Although not a textbook, it has so much outstanding information by way of essays and photos, that it will now become the textbook for all my classes related to this region.

For our readers I have a simple recommendation – get the book!

The highlight of this coffee table masterpiece is the exquisite photography of Steven Gnam, whose pictures we have featured in a previous issue (#6). There are well over 100 photos of landscapes, wildlife, and people. Gnam has the talent and sharp eye to catch the majesty and diversity of one of the most pristine and intact ecosystems in North America.

Complementing Gnam's remarkable images is an information filled essay by award-winning National Geographic writer Douglas Chadwick, who explores the Crown's biodiversity, from wolverines and grizzly bears to marmots and stoneflies. Chadwick shows that connecting key wildlands is not

only critical, but also achievable through community collaboration.

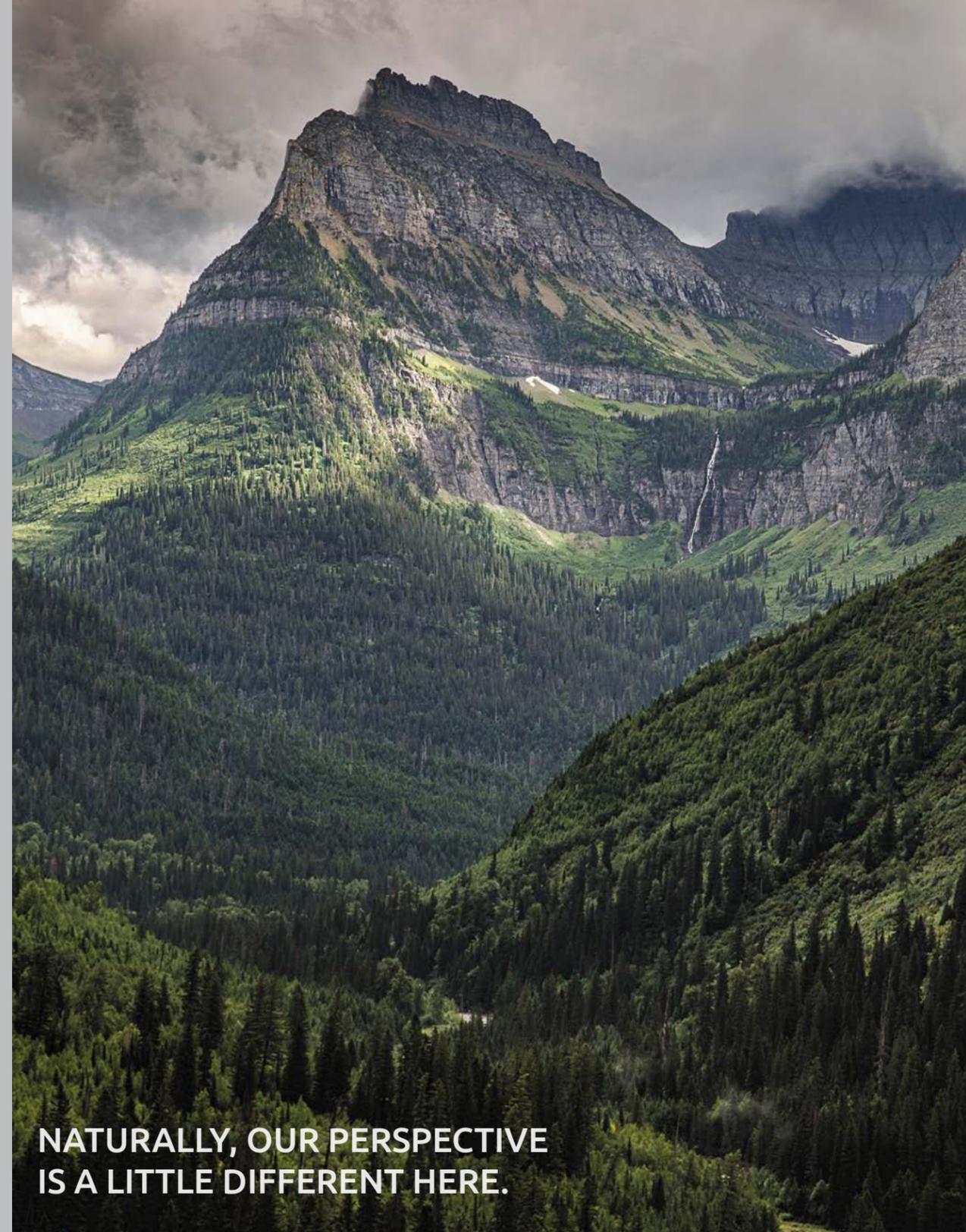
A hallmark of the Crown is indeed the incredibly successful community-based conservation efforts that it has enjoyed. Michael Jamison, National Parks Conservation Association program manager, celebrates and discusses the processes involved in those efforts in his usual lively writing style.

The Crown of the Continent is a huge tract of geography, so how do you best experience it? In another well-written essay, Dylan Boyle, Executive Director of the Crown of the Continent Geotourism Council, outlines by way of maps, directions, and discussion, 13 areas representing all of the Crown's physical aspects.

As a final tribute, Karsten Heuer, Executive Director of the Yellowstone to Yukon Conservation Initiative, discusses the fragile legacy of this natural system that many folks take for granted, assuming it will always remain as pristine, intact, and as rich with biodiversity as it is now. Suggesting that the book can go a long way toward educating people about the value of this place, his final sentence states "for the sake of the Crown of the Continent and all alike within it, don't let it (the book) gather dust."



CROWN OF THE CONTINENT
The Wildest Rockies



NATURALLY, OUR PERSPECTIVE
IS A LITTLE DIFFERENT HERE.

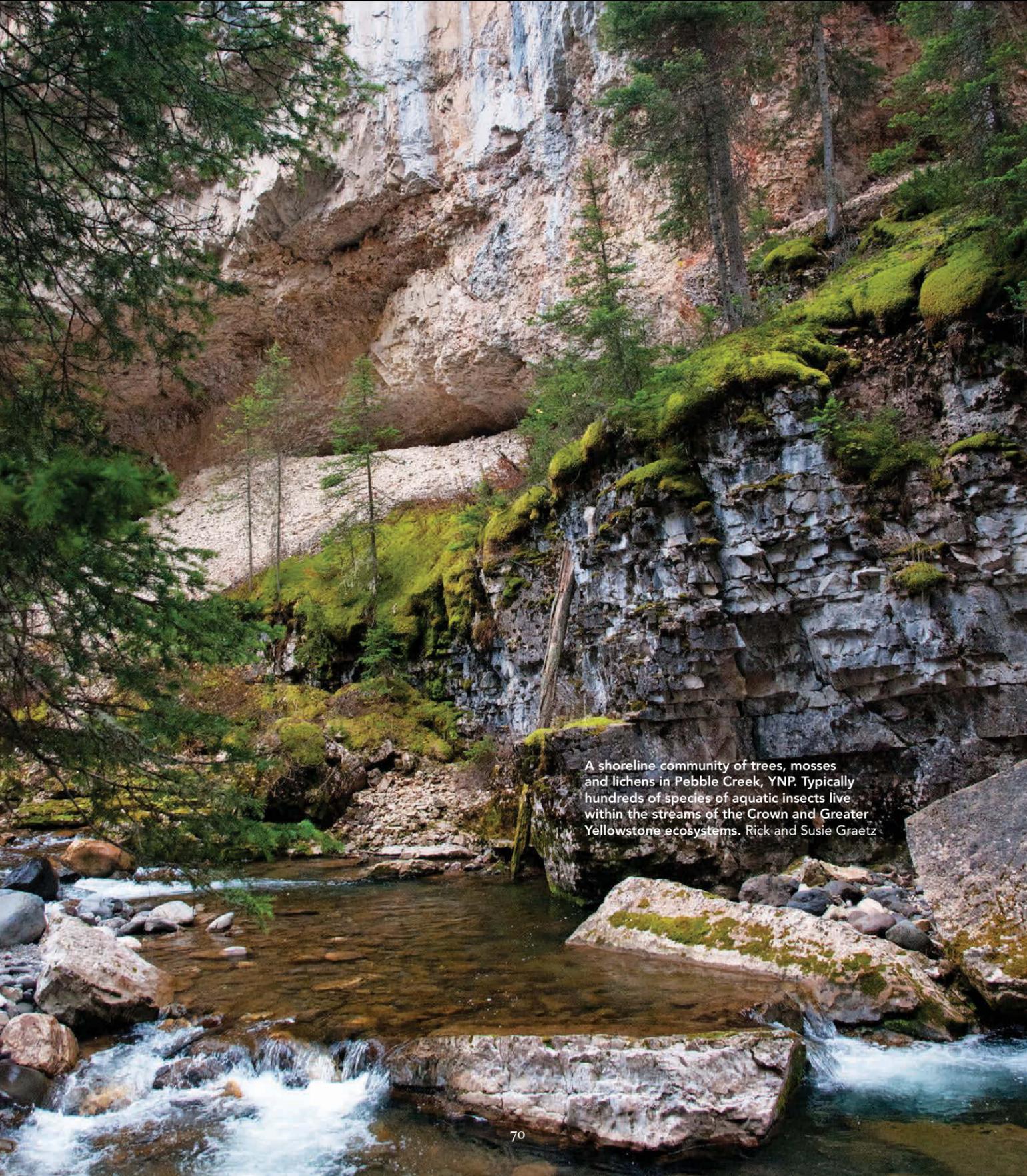
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Rick Graetz is a geography professor and Co-Director of the Crown of the Continent and Greater Yellowstone Initiative at the University of Montana.

Editors' Note: One of the most common questions asked by our readers is: "what exactly is an ecosystem?" Used widely by scientists, land managers, nature writers, and outdoor enthusiasts, the term appears many times in each issue. We contacted Ric Hauer, noted scientist and Director of the UM office of the Montana Institute on Ecosystems, for an explanation. Thanks, Ric, well... sort of. At least we now understand that a crystal clear definition remains somewhat elusive, and that the meaning depends in part on the context in which it is used and who uses it.



A shoreline community of trees, mosses and lichens in Pebble Creek, YNP. Typically hundreds of species of aquatic insects live within the streams of the Crown and Greater Yellowstone ecosystems. Rick and Susie Graetz



An assemblage of many individuals from multiple species of lichens and mosses that are part of the larger population of lichens and mosses along Pebble Creek in the Greater Yellowstone Ecosystem. Will Klaczynski



Adult stoneflies of the species *Pteronarcys californica*, commonly known as salmon flies, as they emerge from a stream. Salmon fly populations occur commonly in stream communities. Ric Hauer



Cladonia asahinae, commonly known as the pixie cup lichen, is a species of lichen in the family Cladoniaceae often growing on or associated with mosses, is a good example of an assemblage of organisms at the species level of organization. Will Klaczynski

EVERYTHING YOU WANTED TO KNOW ABOUT AN ECOSYSTEM, But Were Afraid To Ask

By Richard Hauer

Just when the seminar speaker began talking about his experimental chambers, one of my colleagues leaned over and whispered, "Please don't let him refer to these chambers as *ecosystems*." Seconds later, you guessed it, the speaker referred to them as "ecosystems."

Here I was, sitting in an interview seminar with a room full of ecology colleagues on a faculty search for a position in Organismal Biology and Ecology at the University of Montana. The speaker was talking about his research and how he used small chambers as a way of controlling the environment of the test organisms and then changing various factors that would have some measurable effect. By this means, he could make some inferences about what goes on in nature. Disagreement over whether small chambers should or should not be referred to as "ecosystems" clearly illustrates the point that there is considerable misunderstanding and confusion

around the term ecosystem and its use and misuse, even among ecologists. Thus, before getting into a broader discussion on ecosystems, let us first start with a discussion of the root of the science of ecology and use of the term “ecosystems.”

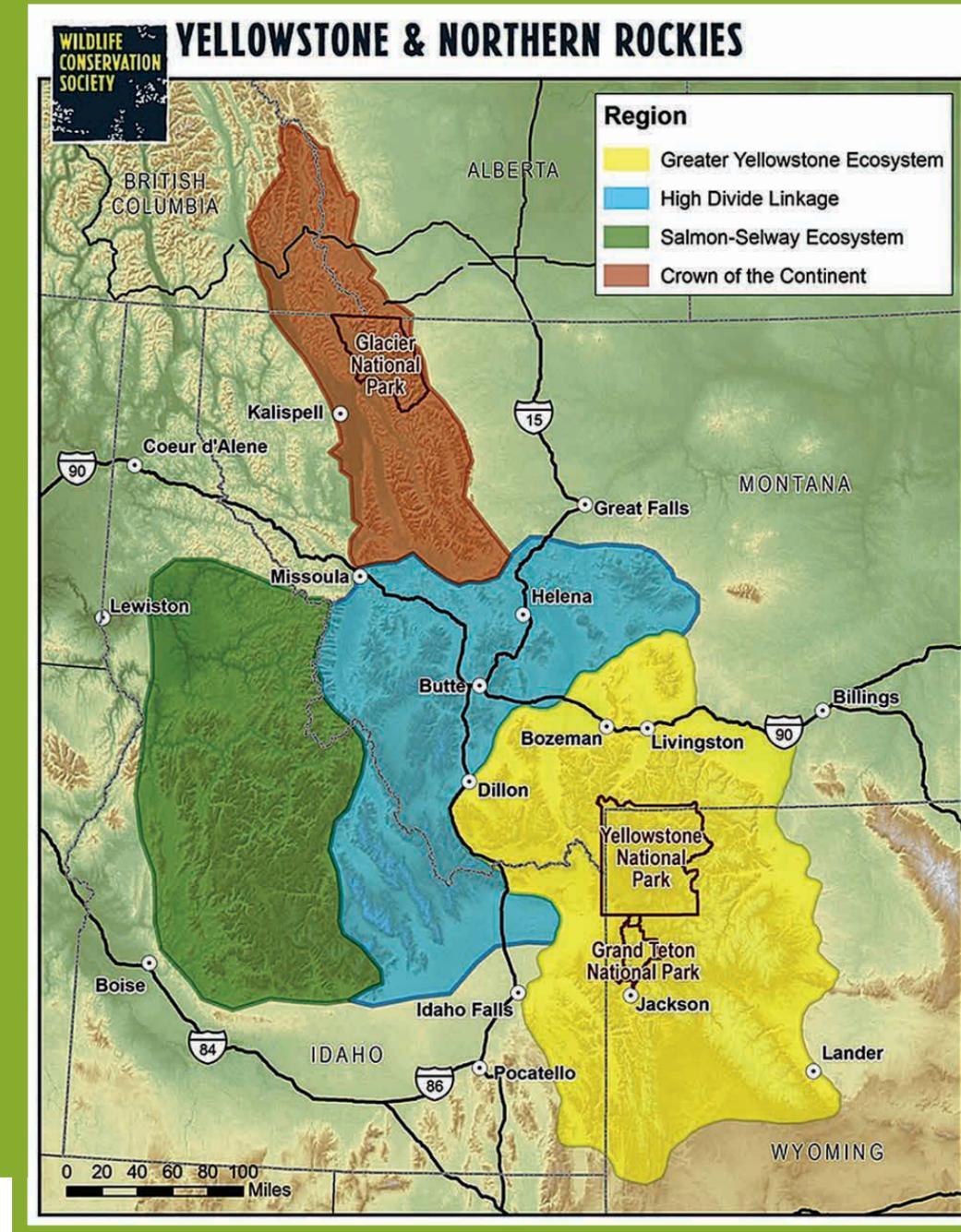
The word **ecology** is derived from the Greek words *oikos*, meaning *household*, and *logos*, meaning *study*. Literally, ecology is the study of relationships between organisms and their environment. The word *ecology* is actually of rather recent origin, being first proposed by the German biologist Ernst Haeckel in 1869. Ecology is largely, but not entirely, concerned with levels of organization beginning with that of the **organism** and continuing up through that of the **biosphere** (Figure 1). More than just a useful rank-order classification, hierarchical theory provides a framework for understanding complex interactions and environmental gradients. It is a holistic approach alternative to reductionism, which seeks answers to questions developed at a higher organizational level by reducing problems to continuously lower-levels of analysis. In short, answers to questions derived at a specific level of hierarchical organization are found at both higher and lower levels. Thus, the ability of the ecologist to conceptually flow between these levels is critical to answering the “Grand Challenge” ecological questions of our times concerning human interactions and our effects on the environment across these spatial scales.

In ecology, the term **population** is broadly used to refer to groups of individuals of the same species that are genetically connected. For example, white-tailed deer in northern Michigan may form a population that is distinct and genetically disconnected from a white-tailed deer population in western Montana. Same species. Different populations. Likewise, **community**, in the ecological sense, includes the populations occupying a given area. Frequently, a community is described by what types of populations are under study or discussion. For example, we may refer to the plant community on a hillside or the invertebrate community living on a stream bottom. All the functionally overlapping communities in a spatially definable area interact with each other and with the non-living environment to form an ecological system or **ecosystem**.

Often the term ecosystem, like community, is defined by the descriptors that go with it, for example, the Flathead River-Lake Ecosystem. Those familiar with the geography of western Montana will immediately recognize that Flathead Lake and its inflowing rivers are imbedded in what we also call the Crown of the Continent Ecosystem. So, here is where some confusion and ambiguity enter the discussion on what constitutes an ecosystem. Ecologists routinely provide a description of their ecosystems; thus, “ecosystem” becomes a term that has remarkable fluidity and is defined by the user, to a degree.

The next level in the ecological hierarchy is the **landscape**, defined as a “heterogeneous area composed of a cluster of interacting ecosystems that are repeated in a similar manner throughout” (Forman and Godron 1986). For example, we may refer to the Northern Rocky Mountains Landscape, the High Plains Landscape or the Yellowstone to Yukon Landscape in which many similarly functioning ecosystems are clustered and typically have geo-physical similarities that link them in character. Landscapes typically contain not only well definable ecosystems, but also connectivity in the flow of plants and animals and the sharing of their distributions between ecosystems. The term **biome** is in wide use and refers to large regional or sub-continental systems. Typically in the science literature a major vegetation type or other identifying suite of environmental characteristics, such as “desert” or “permafrost,” define a biome. For example, the Temperate Deciduous Forest Biome or the Arid Desert Biome are well known and definable biomes. The largest and most nearly self-sufficient geo-chemical-biological system is the **biosphere**, which includes all the living organisms of Earth interacting with the physical and chemical environment as a whole. But, even the biosphere is not a completely independent functioning system, as it relies on energy from the sun to support life.

The scope of ecosystem science, as a discipline in its own right, is expansive. It extends from bounded systems such as watersheds to spatially complex, yet definable geographical areas, such as the Crown of the Continent or the Greater Yellowstone. Studies of ecosystems employ diverse approaches, including ecological theory and modeling, long-term



The Crown of the Continent and the Greater Yellowstone ecosystems are separated by a mere 200 miles. Wild Conservation Society

investigations, comparative research, innovative experimental designs and whole system experiments.

There is no single definition of what constitutes an ecosystem. Some have argued that an ecosystem can be of nearly any size as long as it has some uniform biological character, as did the interviewing speaker at the beginning of this article. However, most ecologists argue that the ecosystem scale should reference large spatial dimensions, contain high heterogeneity (diversity), and have large-scale processes that can be

well defined. Some have gone so far as to suggest that the whole planet is an “ecosystem.”

Generally, ecologists think of ecosystems as having specific, well-definable boundaries with spatial and temporal (time) complexity inside those boundaries. Ecosystem characteristics include energy flow, material exchange between living and non-living components, and processes such as decomposition and nutrient cycling. The Crown of the Continent and the Greater Yellowstone are perfect examples of

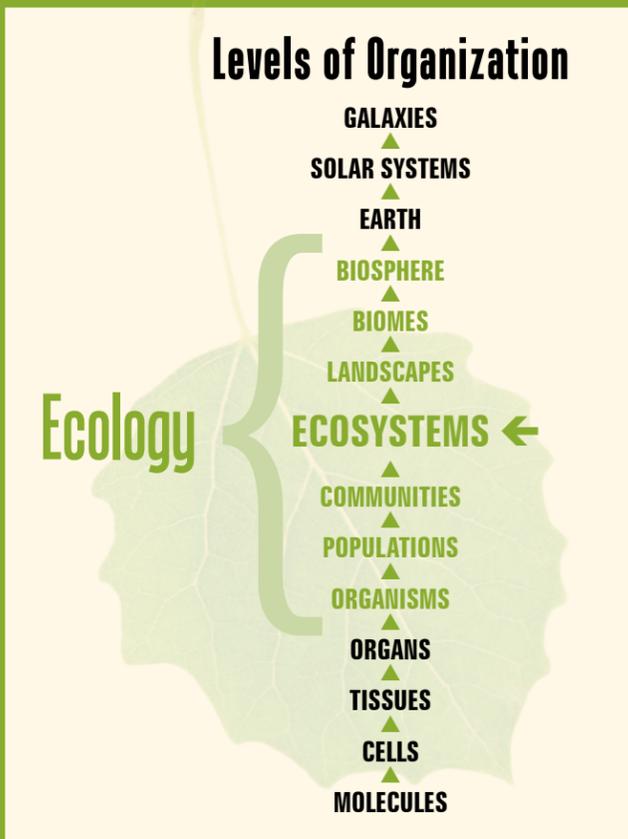


Figure 1. The hierarchy of life and ecology across various levels of organization.

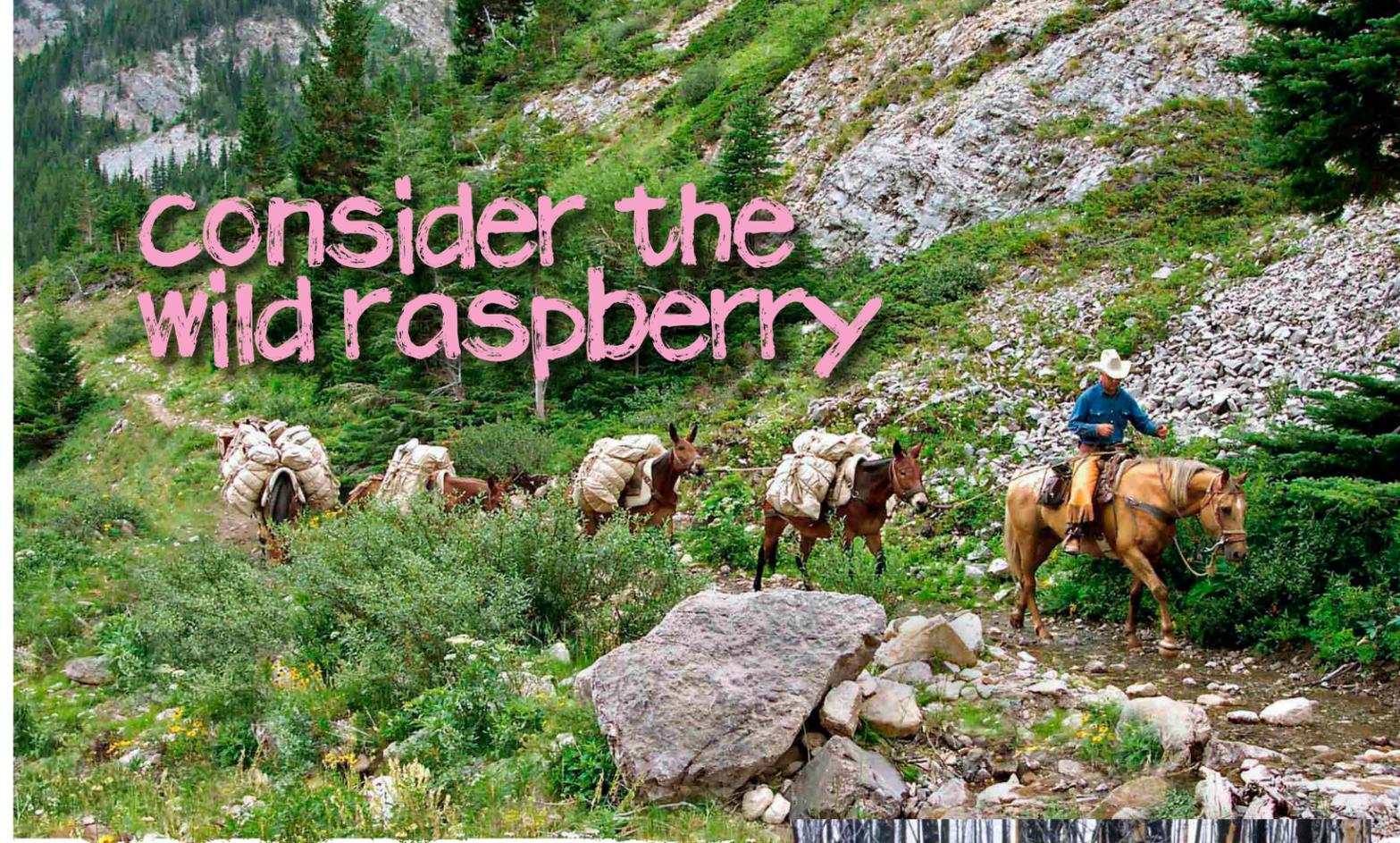
ecosystems. They have well definable boundaries with large communities and populations embedded within them. These ecosystems have properties that are often studied within an academic framework that is multi-disciplinary, drawing from disciplines such as climatology, geology, geomorphology, hydrology, biogeochemistry, microbiology, botany, zoology, and genomics, to name but a few. The Crown of the Continent and the Greater Yellowstone are important, iconic ecosystems of Montana. Other key ecosystems of Montana include the High Plains of eastern Montana and the Rocky Mountain Front. These each have well definable physical and ecological unifying structure

and function. However, it is critically important that these ecosystems not be viewed as isolated, stand-alone systems that are independent of or without the interdependence with their surroundings.

The hierarchy of organized life on Earth on both sides of the spatial scale of the ecosystem is very fluid, and hard definitions are in ways somewhat arbitrary. However, most breaks between levels are highly fluid in a functional sense. Even the distinctions between the organism and the population to which it belongs can become blurred. For example, the individual organism cannot reproduce without its population. Similarly, the community is dependent on the cycling of materials and the flow of energy through the ecosystem in which it exists and participates. Both the Crown of the Continent and the Greater Yellowstone are dependent on their connectivity to other ecosystems and their imbedded character within the biosphere. The implications of this are truly profound for both what we refer to as the “Natural World” as well as that of “Human Civilization,” for the two are inextricably linked on this planet such that it is entirely a mistaken notion that human civilization can exist separately from the natural world. Indeed, we humans are dependent on a well-functioning natural world with ecosystems that are sustainable and interconnected.

Dr. Richard Hauer is the UM Director for the Montana Institute on Ecosystems. He is Professor of Limnology at the Flathead Lake Biological Station

In 2011, the Montana University System Board of Regents approved the creation of the Montana Institute on Ecosystems, an institute that would span the university system with office hubs at both the University of Montana and Montana State University. The purpose of the Institute is to foster collaborative research and education at the ‘ecosystem’ spatial and temporal scales.



consider the wild raspberry

By Rob Chaney for the *Missoulian*

It grows on the rockiest, sun-baked sides of the mountain. It spurns moist creek bottoms where its lookalike thimbleberry cousin thrives. It doesn’t need the loamy soil huckleberries like. Yet it’s the sweetest berry in the backcountry.

Wilderness works the same way. It lacks the paved roads of a national park. It often hides its wonders behind mundane forest like pearls beneath an oyster’s drab shell. By federal law, it’s “an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain.”

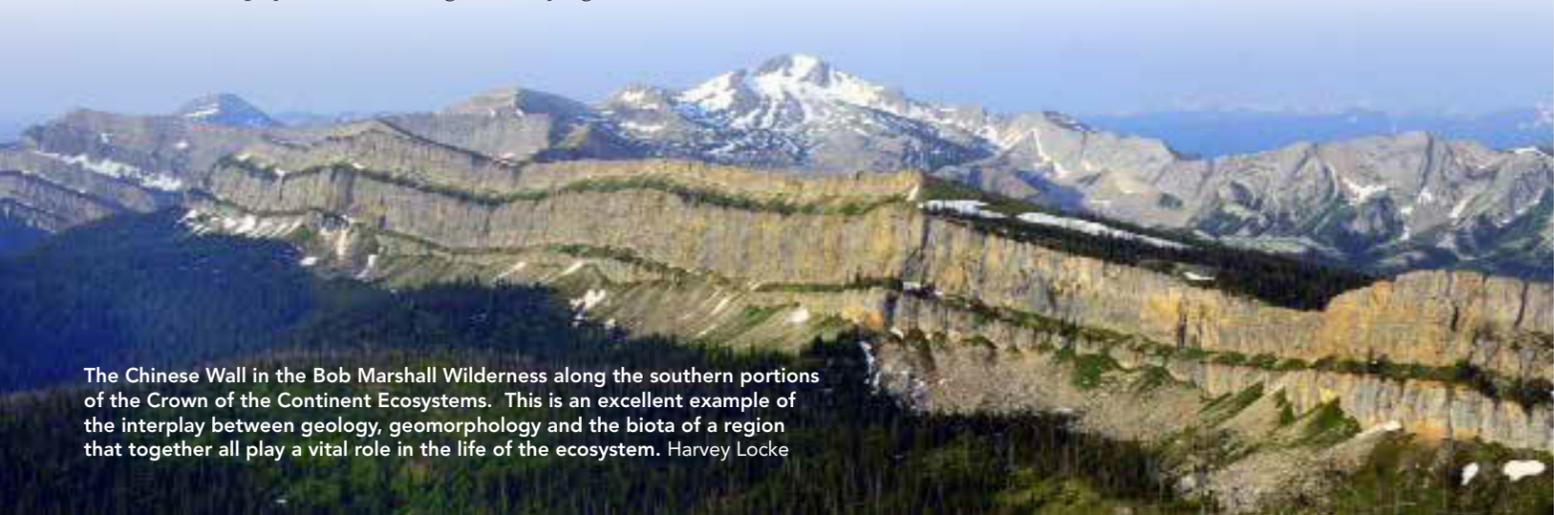
“One of the most misunderstood lines in the 1964 Wilderness Act is that wilderness will be untrammelled – not untrampled,” said Carol Treadwell, executive director of the Bob Marshall Wilderness Foundation. “People think that means you can’t have trails. What it means, what (act author) Howard Zahniser means, is it’s uncontrolled. It’s a wilderness thing to let wilderness be wild, to let nature take its course.”

Growing up in Choteau, Dropstone Outfitting owner Maggie Carr spent several years maintaining trail for the US Forest Service.

“Sometimes people think, ‘Oh, it’s going to be like going to Glacier,’” Carr said of her guests. “They expect something more



Top photo: Rocky Mountain Front rancher Dusty Cray heads up to his hunting camp. Rick and Susie Graetz. Bottom photo: Three generations of the Grimes family hike in the wilderness. L-R: Kevin, Brian, and Pat. Rick and Susie Graetz



The Chinese Wall in the Bob Marshall Wilderness along the southern portions of the Crown of the Continent Ecosystems. This is an excellent example of the interplay between geology, geomorphology and the biota of a region that together all play a vital role in the life of the ecosystem. Harvey Locke



park-like and controlled, and it's not like that. If we're going on a route where the trees are down, or there's high water, we have to figure how to get across that. We are in a wilderness, and that's part of the adventure."

It's something of a party game among wilderness advocates to debate exactly what Zahniser was getting at when he put "untrammled" in his "Definition of Wilderness" at the beginning of the act. Wilderness historian Kevin Proescholdt traced it back to namesake Bob Marshall himself, who in his 38-year life was famous for 50-mile day hikes and equally tenacious efforts to protect wild country.

"In describing the self-sufficiency required in wilderness, (Marshall) wrote

◀ In his short lifespan, Bob Marshall was responsible for creating many millions of acres of wilderness. In August 1940, the 950,000-acre Bob Marshall Wilderness was created in his name. The Wilderness Society
The North Fork of the Flathead River flows for more than 50 miles below the USA Canadian border and defines the western boundary of Glacier National Park. Rick and Susie Graetz
▼



From the northern slope of one of the Bob Marshall's highest summits, Rocky Mountain Peak, hikers look east toward the Rocky Mountain Front and the prairie beyond. Rick and Susie Graetz

"This is inconceivable under the effete superstructure of urbanity; it demands the harsh environment of untrammled expanses,"

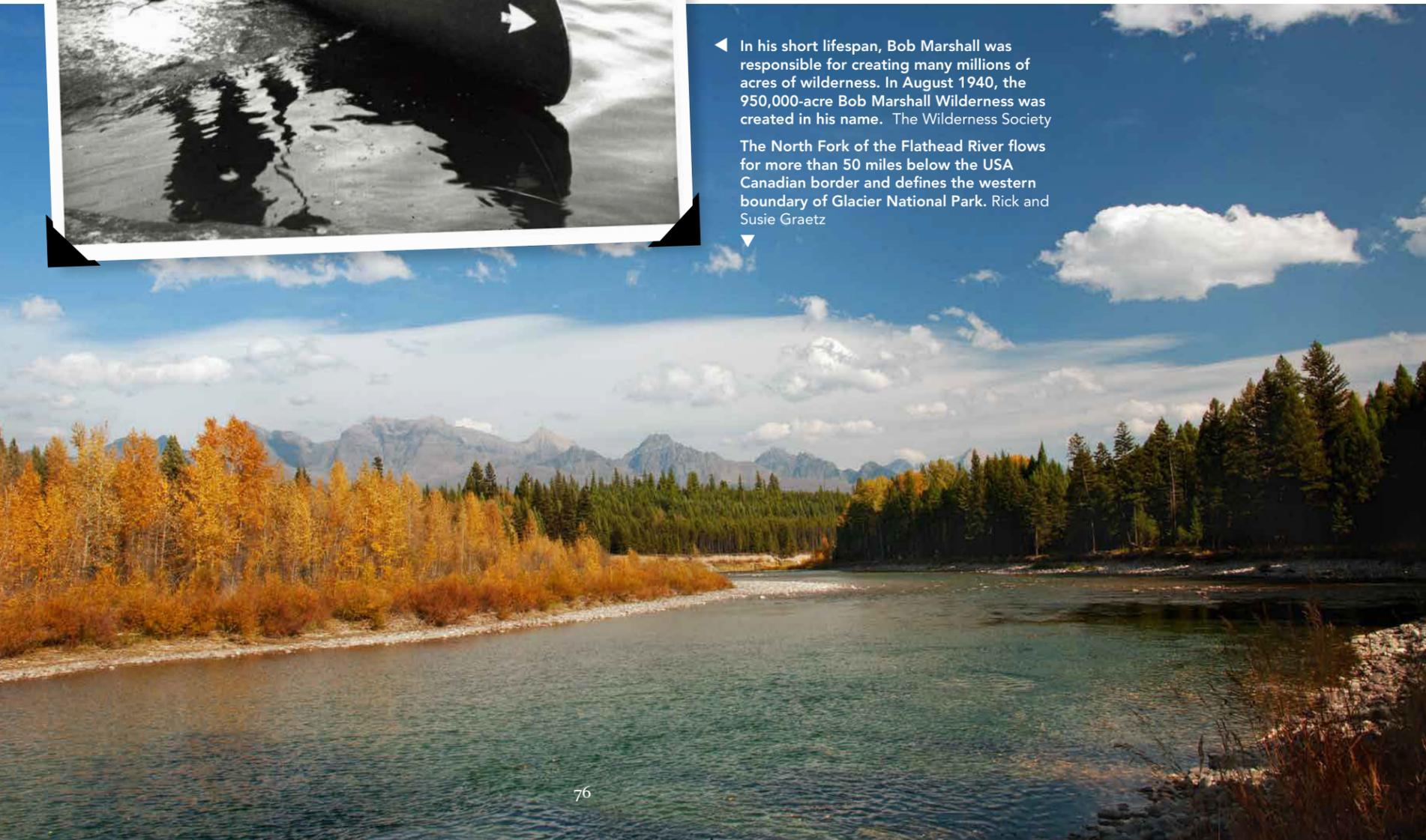
Proescholdt noted that 1930s wild-country advocates weren't as concerned with ecological or evolutionary protection. Marshall focused his short life on experiencing every remote place he could reach, and then trying to save it for others to experience as well. It would take another 50 years before the concepts of migration corridors and linkage areas revolutionized wilderness choices.

The child of a wealthy Manhattan family who grew up to survive an Arctic shipwreck and a grizzly attack, Marshall was the first white man to scale Alaska's Brooks Range and co-founded the Wilderness Society in 1935.

He refuted the idea of land use by the greatest good for the greatest number, writing, "we would be forced to change our metropolitan art galleries into metropolitan bowling alleys. The Library of Congress would become a national hot dog stand, and the new Supreme Court building would be converted into a gigantic garage where it could house a thousand people's autos instead of Nine Gentlemen of the Law."

As chief of the Forest Service's division of recreation and lands, Marshall helped designate 5.4 million acres of national forest as primitive lands protected from logging and other development. He's also credited with designating 16 natural reserves on Indian tribal lands. Two years after his death in 1939, the Forest Service dedicated 950,000 acres along Montana's Continental Divide in his memory as a primitive area. The Bob Marshall Wilderness was one of the original parcels entered into the National Wilderness Preservation System created by the Wilderness Act.

The act performs a balancing act, defining wilderness as federal land that "(1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation."



Medium colored green denotes Wilderness areas in the Crown and Greater Yellowstone ecosystems. NFS

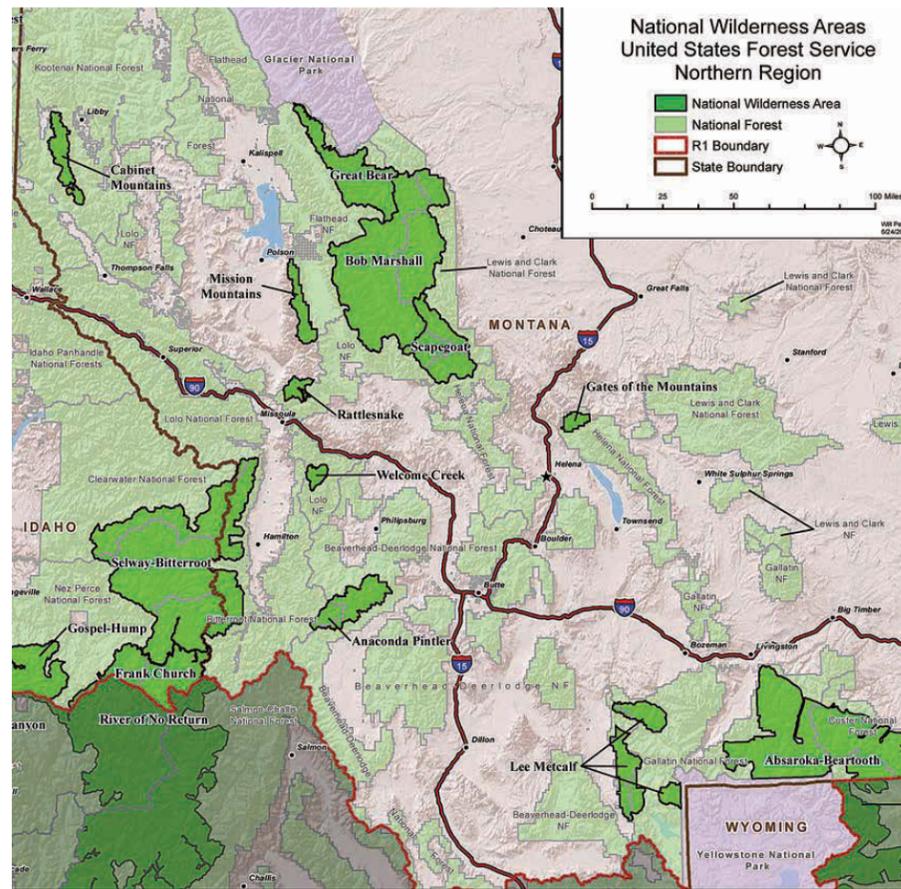
The interests of wildlife and lifestyle often clash. “That debate in the conservation community is a big national discussion,” said Larry Campbell of Wilderness Watch. “Some people are seeing wildlands through the eyes of recreation, at huge damage to wildlife and conservation values. They’re wheeling and dealing with recreation. It should be about protecting natural creatures and natural processes.”

Campbell points to maps in US Sen. Jon Tester’s Forest Jobs and Recreation Act that offer small patches of new federal wilderness in the West Pioneer Mountains surrounded by larger tracts of recreation areas. These places are free of some of the Wilderness Act’s stricter provisions, such as the use of snowmobiles and bikes in the backcountry. The compromise severs the habitat connection between the two wilderness areas, Campbell said, trashing their natural value.

The Scapegoat has similar tradeoffs in the Tester bill. Proponent John Gatchell of the Montana Wilderness Association acknowledged the bill didn’t deliver an ideal result. But he added the Wilderness Act itself embodies compromise and a commitment to letting lots of people have their say.

“The Wilderness Act, when I look at it, has exemptions for airfields, motorboats and water developments,” Gatchell said. “The Forest Service and the other agencies have huge discretion for fighting fire and insect disease. Its passage involved those compromises. The Great Bear Wilderness (just north of the Scapegoat) has the Schafer airstrip. That was (former Montana Democratic) Sen. Lee Metcalf’s decision. It was a non-conforming use, but he felt that to carve it out and have a giant hole in the wilderness was worse. Compromise has always been a part of nature in American democracy.”

Wilderness Society Montana state director Scott Brennan added that bills like Tester’s and the Rocky



Mountain Front Heritage Act reflect a different way of looking at land management.

“We believe we’re likely to get better results when we sit down with diverse interests, and not just look at what’s going to be wilderness and what’s not,” Brennan said. “It’s a better approach to look at whole landscapes. Are there other protective designations that would be helpful besides wilderness?”

Compromise is a fact of life for Rocky Mountain District Ranger Mike Munoz. For 15 years as the Forest Service line officer responsible for much of the Scapegoat and surrounding national forest, Munoz has balanced his limited resources and endless to-do list against a landscape with an agenda of its own.

“Howard Zahniser, in writing the act, clearly indicated at the time that we should be guardians and not gardeners,” Munoz said. “But there’s a realization that in fact, we can’t just sit back and not do anything with the landscape. Humans have impacts. And sometimes we have to cross over to gardener-type activities.”

Keeping that area accessible takes both Forest Service and volunteer efforts. The Bob Marshall

Wilderness Foundation pledged a “50 Miles for 50 Years” effort in 2014 to clear trail, cut downfall and generally maintain the three parts of the complex: Scapegoat, Great Bear and Bob Marshall wildernesses. That’s bringing more than 300 volunteers on 40 projects to donate their strength and sweat.

Today, hikers along the Straight Creek Trail to Green Fork pass through old-growth forest, fresh charcoal from the Elbow Pass Complex and shoulder-high new growth from the Canyon Creek fire. The Green Fork cabin stands surrounded by charred trunks, but the views of the surrounding mountains remains spectacular. And the hike up Green Fork Creek to Halfmoon Park and Scapegoat Mountain validates every good feeling Bob Marshall expressed about the place.

There, seven miles of sheer cliffs snaked along the Continental Divide. The headwaters of the Dearborn River rise just below Scapegoat Mountain, flowing through rolling hills on its way to Devil’s Glen and the Mighty Missouri River. In the jumbled scree fields below the cliffs, wild raspberries grow.

“It’s a great thing – you get in there and it surprises you,” Bob Marshall Wilderness Foundation’s Treadwell said. “The forces of nature just surround you and you have these life-changing experiences. It humbles you. The landscape itself is so big. It’s just you and nature, not four walls.”

Rob Chaney covers the outdoors, environment and science for the Missoulian. Rob is a frequent contributor to our e-Magazine

* In honor of the 50th Anniversary of the Wilderness Act, the Missoulian and their partner papers have published the book, *50 WILD PLACES Celebrating Montana’s Outdoors*. The book is available at the Missoulian, local bookstores and on Amazon.com.

CONGRESS THROWS A 50TH BIRTHDAY BASH FOR THE WILDERNESS ACT

Through the Rocky Mountain Heritage Act and the North Fork Preservation Act, the US Congress and Senate have bestowed upon Montana a timeless gift... Precious wildlands and freedom from pollution threats that will bring solace and enjoyment to future generations.

It wasn’t wrapped in colored paper and didn’t have a huge bow, but on Friday, December 19, 2014, in the year of the Wilderness Act’s 50th anniversary, President Barak Obama signed legislation creating the first new wilderness acreage in Montana in over 30 years. The Rocky Mountain Front Heritage Act overall, allocates nearly 270,000 acres of protected land to Montana... 67,000 extra acres of national forest lands to the Bob Marshall Wilderness Complex (50,401 allocated to the Bob and 16,711 to the Scapegoat). And it also creates a new federal Conservation Management Area (CMA) containing 208,000 acres of public lands on the eastern slope of the Rocky Mountain Front. The purpose of the CMA is “to conserve, protect, and enhance for the benefit and enjoyment of present and future generations the recreational, scenic, historical, cultural, fish, wildlife, roadless, watershed, and ecological values of the area.”

Also, a whopping 383,000 acres, home to the greatest array of plants and animals in the Rocky Mountains, including grizzly bears, wolves, bald eagles and other rare and endangered species, have been protected from energy development by the passage of the North Fork Preservation Act. Politicians, sportsmen, recreationists and government agencies have worked toward this end for the past forty years. Signing of the Act now formally completes an agreement with British Columbia and the Canadian government to protect the entire drainage of the river from mining and drilling.



Scapegoat Mountain is one of the iconic landmarks of the 1.5 million-acre Bob Marshall complex. Rick and Susie Graetz

1913 - 2013 UM COLLEGE OF FORESTRY AND CONSERVATION TURNS 100

By Chad Dundas

The forestry college appears to be in fine shape as it crosses over the century mark. After experiencing a slight decline from 2000 to 2008, current enrollment has held steady or increased each year since at more than 750 students. As of fall, 2014, that included around 50 master's



The entrance to the Forestry Building, aka "The Shack," ca. 1919

degree students and 60 PhD students in addition to the 781 working on undergraduate degrees in the college's five majors: Ecological Restoration; Forestry; Parks, Tourism, and Recreation Management; Resource Conservation; and Wildlife Biology. Approximately half the students are female, a number that has grown significantly since the program began. Dean James Burchfield estimates the faculty now brings in \$13 million a year in new sponsored research while instructing students in an ever-evolving curriculum.

The first rangers came to UM in January 1909, four years after the creation of the US Forest Service. Their arrival was not without controversy, as the US Treasury Department cut the program's funding near the end of 1910. The student newspaper cried: "Foresters Declared Illegal Students," and the fledgling school might have perished entirely had University President Clyde Duniway not stepped in and secured the funding to keep it open.

On March 21, 1913, the Legislature gave its stamp of approval, and during the next few years, the school buttressed its ranger program with expanded courses on botany and biology. Even as the college evolved, however, the primary focus remained on providing the Forest Service with trained woodsmen. During its first few decades, the curriculum adhered to a decidedly technical bent.

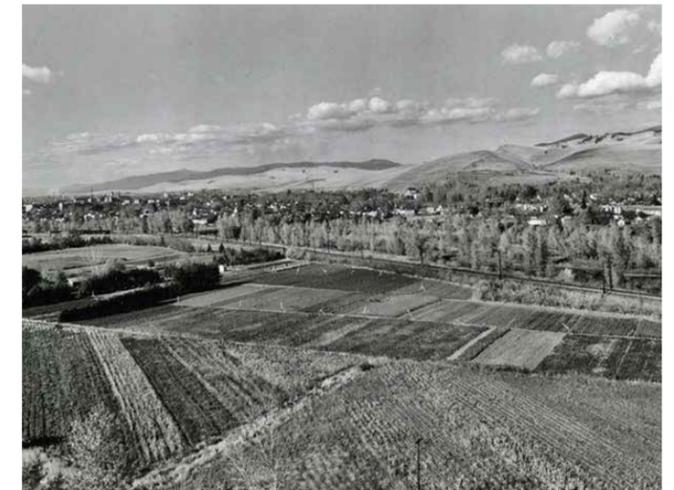
"At the time, there was the thought that foresters could do anything," Zane Smith says about the road-building, ax-wielding, altogether ranger-centric education he received while attending UM in the early 1950s.

Now eighty years old and a self-described "third-generation forester" who had a thirty-four-year career in the Forest Service, Smith terms his years on campus as a time of great transition for the program. The faculty's old guard was giving way to new blood. The education was rigorous, but when they weren't chopping or scouting or measuring, forestry students reveled in campus life, which Smith says prepared him for the real world as much as anything.

By the early 1970s, the passage of legislation such as the National Environmental Policy Act (NEPA) and the Clean Water Act represented a dramatic shift in the national



Students identify various pinecones for a class.



Open campus space was once used as a forestry nursery.

land-management plan. UM's program, which had been trending toward including more elements of conservation and natural science anyway, moved quickly to evolve with the times.

UM's greatest contribution to that evolution arguably came in the form of the 1970 Bolle Report, a 33-page study of federal clear-cutting practices in the Bitterroot National Forest commissioned by Montana Senator Lee Metcalf. The report, bearing the name of UM forestry dean Arnold Bolle, charged the government with poor land-

management practices, asserting that wildlife, watersheds, and preservation were "after-thoughts" compared to "the single-minded emphasis on timber production." It marked the first time the college had publicly broken ranks with Forest Service dogma. The study constituted what UM natural resource policy Professor Martin Nie calls "a major flashpoint in American environmental history" and spurred considerable changes to America's natural resource laws.

In April 2003, the school officially became the College of Forestry and

Conservation. As the country's forest policies changed and the science associated with natural resource management continued to advance and improve, so too did the school itself, adding avenues of study, areas of emphasis, and new majors. "That's the thing I think makes this college so interesting," Nie says. "If you just went down this hallway, you'd see we have a fire ecologist, a forest ecologist, a sociologist, a recreation person, a policy person, and, writing professor. It's that eclectic."

As much as the science and bureaucratic policies change, students still flock to Montana for the same reason today as they did 100 years ago. To know what that reason is, all you have to do is look out the window: Wilderness.

A native Montanan, Chad Dundas earned a bachelor's degree in journalism and an M.F.A. in English-creative writing, both from UM. He covers mixed martial arts for ESPN.com and lives in Missoula.

This is an abridged form of the original article from the Spring 2013 issue of *The Montanan*.



UM field course at the Lubrecht Experimental Forest. Will Klaczynski

B/W photos courtesy of archives & special collections, Mansfield Library, UM.

MONTANANS... LEAVE OUR PUBLIC LANDS ALONE

By Troy Carter for the Bozeman Daily Chronicle July 8, 2014

Montana Public Lands/ Conservation Poll*

Two-thirds of Montana voters oppose selling public lands to reduce the federal deficit, including 51 percent of Republicans, according to a statewide poll released Monday.

More than four-fifths of those surveyed – 86 percent – said conservation issues are an important factor in gaining their support in the upcoming elections. Only 13 percent

said conservation was insignificant in deciding to support an elected official.

“It appears Montanans have a love affair with their public lands,” said Rick Graetz, co-director of the University of Montana’s Crown of the Continent and Greater Yellowstone Initiative, which funded the poll. “There is clearly something going on here because I don’t think we could have said the same thing quite as powerfully 40 or 50 years ago.”

The survey sampled 500 registered voters and was conducted by a bi-partisan research team of Public Opinion Strategies and Fairbank, Maslin, Maullin, Metz and Associates. The survey had a margin of error of plus or minus 4.38 percent.

The survey directly addresses

proposals by congressional Republicans to reduce the federal budget deficit by selling public lands. Broken down by party affiliation, 51 percent of Republicans, 67 percent of independents, and 84 percent of Democrats rejected the idea.

The survey found that more than two-thirds of Montanans – including majorities of Republicans, Democrats and independents – support the Rocky Mountain Heritage Act and the North Fork Flathead Watershed Protection Act, with a majority saying Congress should take action on these proposals now.

The survey found that Montanans are more likely to support decisions that protect public lands and oppose decisions that limit access or develop them at the expense of conservation

and recreation values. According to pollster Lori Weigel, that’s because Montanans have strong personal connections to the outdoors.

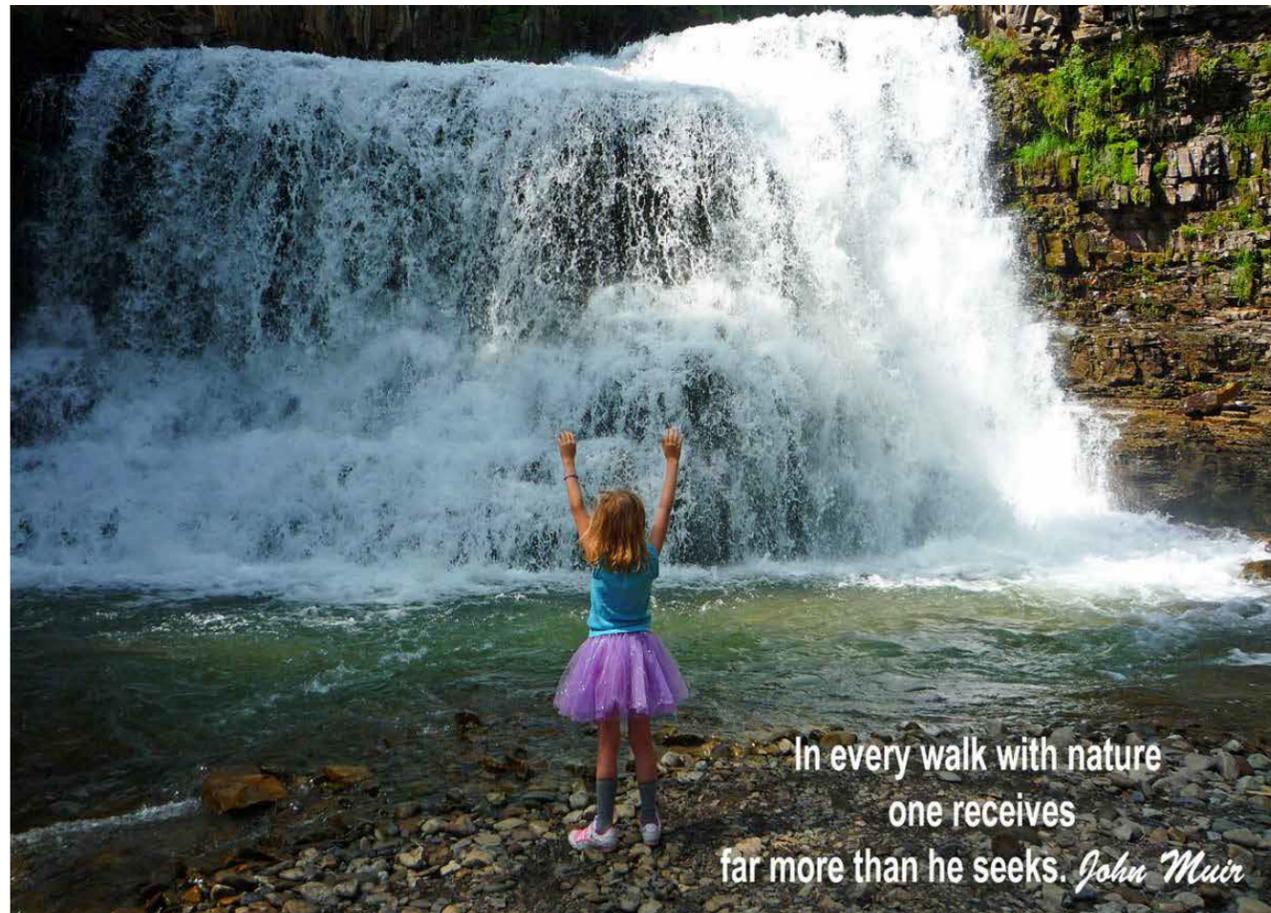
“Three-in-five Montanans believe public land helps attract good jobs and employers to the state, and a majority believes Montana is uniquely qualified to attract new innovative companies due to the presence of public lands and the Montana lifestyle,” she said.

On the 50th anniversary of the Wilderness Act, the survey found 78 percent of voters consider the state’s existing wilderness areas to be a good thing for Montana. A majority of voters also supported expanding the size of areas protected by the Wilderness Act, but such expansion is most likely to garner support if proposals are crafted locally with community input.

“Montana has a great tradition, going back more than a 100 years of folks from all political persuasions and interest coming together to bring back wildlife by protecting habitat when big game animals had all but disappeared from places like the Rocky Mountain Front,” said Graetz. “It seems now Montanans are viewing not just wildlife conservation as important, but also the value of wild lands and open space for their quality of life and economic wellbeing.”

Troy Carter is a Montana native and writes for the Bozeman Daily Chronicle.

*A statewide survey of 500 registered voters in Montana was conducted June 17-19, 2014. To ensure a balanced and accurate result, two teams, one Republican and the other Democrat, conducted the poll, whose purpose was to assess the paradigm Montanans from all walks of life wanted for their public lands.



In every walk with nature
one receives
far more than he seeks. *John Muir*

Keelie Revisky celebrates hiking to Ousel Falls. Rick and Susie Graetz



Will Klaczynski

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Thanks very much!

The editors—Rick Graetz, Susie Graetz, and Jerry Fetz

POLEBRIDGE MERCANTILE



CROWN of the CONTINENT and the GREATER YELLOWSTONE

MAGAZINE

University of Montana field course class on mountain geography taking a break at the Polebridge Mercantile in the North Fork of the Flathead. Rick and Susie Graetz