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DISCOVERY

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SMALL THINGS, LARGE WONDERS

Yellowstone's first BioBlitz inventoried many of the park's lesser known species. Photo: Beth Pratt

By Beth Pratt
Yellowstone Association

"We're coming to realize how terribly important the great population diversity of small organisms are that are the foundation of the ecosystems, and these are the little things that run the earth."

EDWARD O. WILSON

Introduction

Visitors flock to the western national parks to experience grandeur and bigness—the towering granite peaks and cascading waterfalls of Yosemite or the almost infinite expansiveness of the mile-deep Grand Canyon. Yellowstone proves no exception to this rule—people delight in what has been deemed the “charismatic-mega fauna,” the large mammals who

wander the park in numbers seen nowhere else in America. Grizzly bears, wolves, bison, and elk indisputably inhabit the starring roles in Yellowstone.

Yet to simply view Yellowstone as a habitat for bigness is to miss an array

of wonderful life overshadowed by a preference for the showier bison or bear. “Such is nature; it doesn't have to be large or dangerous to be interesting,” said biologist Donald Streubel. And hidden among Yellowstone's waters and trees, or under its rocks and snow, live some astonishing creatures with life stories just as fascinating as their larger cousins.

This past summer, the Yellowstone Association—along with the National Park Service, Montana State University, and several other organizations—sponsored the first-ever BioBlitz of Yellowstone National Park. This was a 24-hour biological inventory focused on the lesser-known species in the park. Hundreds of visitors young and old gathered around the BioBlitz tent eagerly peering into microscopes at red water mites or watching a display of

What's Inside...

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- WINTER LODGING DISCOUNTS

carnivorous aquatic beetles. Volunteer scientists from across the country, all of whom had just spent an exhausting day counting the flora and fauna in the Mammoth Hot Springs area, enthusiastically related stories of their discoveries.

At the insect table, a microscope revealed dozens of tiny creatures wiggling among leaf litter. Beetle expert Michael Ivie proudly displayed the tiny featherwing beetle, the smallest beetle in Yellowstone and one of the smallest in the world. The size of a pinhead, the beetle had to be viewed through a hand lens. James Halfpenny, a scientist based in Yellowstone, shared photographs of his group's exciting find. While searching for pika, his team encountered a marten scurrying among the rocks. "We must have taken over 400 photos of the marten between us," he said and laughed.

On your next visit to Yellowstone, take the time to peer under rocks, wander in riverbanks, or examine the delicate crystals of snow—explore the world

of smallness. You might discover algae that bring color to winter's monotonous white with a pink bloom that protects the plant against the sun. Or hear the marvelous symphony of a frog that almost doubles his body size in order to sing. Or catch the flash of a river rainbow from a fish with ancestors who swam across the continental divide after the last ice age.

The rewards of curiosity toward the more modest inhabitants of the park are high. As the naturalist and artist Jack Laws notes: "Studying natural history is a way of opening up to the world. The closer you look, the more you slow down and start to carefully observe, the more delighted and full of wonder you become. The lives of some of the smallest creatures hold some of the most astonishing secrets."

In tribute to the small world of Yellowstone, here are six fascinating stories of the more diminutive—but no less important—creatures that inhabit the park.

Don't Eat the Red Snow: *Chlamydomonas nivalis*

"Travelers in mountainous districts and polar regions have often described what is known as red snow, but as yet no very satisfactory account has been given of the plant itself."

JOSEPHINE TILDEN, *The Algae and Their Life Relations*, 1935

The phenomenon of red snow—also referred to as watermelon or pink—has piqued the interest of observers for thousands of years, with the earliest account attributed to Aristotle in his *Meteorologica* in 300 BC. Charles Darwin encountered the startling display when traveling through the mountains of South America and provided the first accurate description for the anomaly, for which explanations have ranged over time from the fantastic (iron-bearing meteorites), to the gruesome (blood stains) to the ordinary (pollen). Recent studies of the red snow—which occurs on every continent in the world—attribute the crimson blooms to a surprising source: sunscreen.

Although snow may appear inhospitable to life, the micro-alga *Chlamydomonas nivalis* (the most common organism responsible for the phenomena) thrives in this extreme habitat. E. Kol, a scientist who extensively studied the snow-loving organisms, inventoried as many as 354 algae species living in a snow environment. The unicellular algae live in a "unique microhabitat, namely the water between snow crystals," writes scientist Daniel Remias. Optimum conditions for the algae include temperatures just above the freezing point accompanied with melt water scattered throughout the snow.

The red algae begin their life as green cells with whip-like tails utilized for swimming to the surface to seek light for photosynthesis. Once near the surface, the cells transform into red spheres that decorate the snow with a reddish-hued color. When the snow melts, the spores dry on the rocks and soil until their revitalization under the next winter's snowfall begins the cycle anew.

The red pigmentation the cells produce acts as a sunscreen that protects the algae from ultra-violet radiation. Even more amazingly, the tiny organisms

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YELLOWSTONE
ASSOCIATION

THE MISSION OF THE YELLOWSTONE ASSOCIATION

The Yellowstone Association, in partnership with the National Park Service, fosters the public's understanding, appreciation and enjoyment of Yellowstone National Park and its surrounding ecosystem by funding and providing educational products and services.

P.O. Box 117 • Yellowstone National Park, WY 82190
www.YellowstoneAssociation.org
ya@yellowstoneassociation.org
406-848-2400

Monday - Friday • 8 a.m. - 4:30 p.m. Mountain Time



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also manufacture a strong antioxidant that works to counter damage done by ultraviolet rays. Because of these unique traits, red snow is currently being studied as a source of powerful new medicines that may assist with cancer and other disease.

Look for the red snow in open alpine areas—a distinctive watermelon scent usually accompanies it. And even though it's not yellow, be sure to still heed the advice of the age-old saying, as consuming the colorful red algae would bring extreme digestive discomfort.



Boreal chorus frog. Photo: Beth Pratt

It's Not Easy Being Green: Yellowstone's Frogs

"Kermit!" shouted a high childish voice and we knew the roadside wetland we were scouting held at least one frog. A distant moose was instantly forgotten as the young tourist's family gathered around to share her delight in observing the tiny creature with the fearless wide-eyed gaze and mysterious powers of transformation."

DEBRA PATLA AND CHUCK PETERSON, *Yellowstone Science*

It truly isn't easy being green in Yellowstone. The winters of the Northern Rockies with temperatures hovering near zero Fahrenheit during the day and often dropping below zero at night, don't provide the most amphibian-friendly habitat. Lacking the ability to generate their own body heat, amphibians utilize the temperature of their environment for internal climate control. Perhaps not surprisingly given the challenges, within Yellowstone's borders live only four species of amphibians. These include two species of frogs: the Columbia spotted and the boreal chorus frogs (for comparison,

Yosemite National Park, with its less severe winters, boasts triple the amphibian population).

Yet the intrepid frogs of Yellowstone persevere despite the environment. Making the most of the wintry spring and taking advantage of the small doses of summer sunshine, the boreal chorus frog and Columbia spotted frog hop through numerous wetlands and meadows even at the higher elevations in the park. Indeed, the winters may have produced a hardier breed of frogs in Yellowstone than their more temperate cousins. A study reported in *Yellowstone Science* concluded: "For spotted frogs, Yellowstone winters translate into long lives." Spotted frogs in the park can live up to 10 years as compared with a 3-year average life span of those studied in coastal British Columbia.

Park visitors flock to Yellowstone for the elk, bison, and bighorn sheep ruts, yet the park's annual frog "rut" is an overlooked spectacle not to be missed. After emerging from hibernation in springtime (likely spending the winter in cozy burrows abandoned by other animals) thousands of frogs travel large distances to their breeding grounds. Spotted frogs have been observed traveling 600 to 1400 feet in a few days even over snow to breeding grounds—that's akin to a person traveling almost 6 miles! Park naturalist M.P. Skinner in 1927 described a mass migration he witnessed at Pelican Creek "The whole length of the...causeway was live with

them, every square foot having from one to three tiny frogs on it, and more continually coming up from the marsh."

Once situated at the breeding grounds, the musical courtship of the frog rut resounds at many locations around the park. Instead of locking antlers or ramming horns, the frogs choose a more peaceful method of competing for females: singing.

The frog symphony in Yellowstone is quite an experience to behold, with the music of a gathering of boreal chorus frogs continuing day and night as the animals call for female companions. For such a small animal (adults are usually less than two inches) to serenade so loudly is remarkable. Even more incredible is the singing frog's body almost doubles in size with the expansion of its throat, and in a single minute the frog may give up to 20 calls.

Spotted frogs lack the loud, distinctive call of the boreal chorus frog and instead take a softer approach to courtship with a faint croaking.

Lord of the Flies: Ephydrid Fly

"I have always thought that one of winter's strongest points was its lack of 'bugs'... and yet it was the 'bugless' winter that first introduced me to insects."

DONALD STOKES, *A Guide to Nature in Winter*

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Ephydrid flies on hot spring algae. Photo: NPS



The Clark's nutcracker may possess one of the most extensive memories in the animal world. Photo: NPS

Yellowstone's geothermal activity acts as a formidable nemesis to its sub-arctic winters—at least on a small scale. As Thomas and Louis Brock observe in their article *Life in a Hot Water Basin*: “Each hot spring—the spring itself and its immediate area—constitutes a little island where life is not dormant even though it is closely surrounded by the cold and snow of a Rocky Mountain winter.” Even on a frigid, subzero day in Yellowstone, small flies gather around the microbial mats formed by a hot spring, like campers huddled around a campfire to ward off the cold. Unlike the campers, however, a step away from the heat source would result in death for the tiny insects.

The most common insect that inhabits this micro-tropical environment is the ephydrid fly, a hardy species found in hot springs around the globe that have been observed in the Himalayas as high as 15,000 feet. The fly feeds on the algae and bacteria gathered in microbial mats produced by the effluent channels of water flowing from the hot springs. The species of ephydrid vary by the conditions found at each spring, such as alkalinity or rate of water flow, which in turn influence the type of microbial mat formed.

To feed on this algae and bacteria, the fly descends into the scalding water with its own version of a submarine: a tiny air bubble that surrounds the insect and provides insulation against the water temperature. Even without this protection, the ephydrid fly can tolerate temperatures up to 109°F, and it deftly balances the cooler air above the hot spring with the hotter air below in order to endure the heat. Additionally,

the fly's choice of an extreme home doesn't diminish its abundance: 500 flies per square yard inhabit a typical hot spring, and researchers once counted an amazing 100,000 ephydrid larvae per square yard at one site.

The Einstein of the Aves: Clark's Nutcracker

“Habitually seeking the top of a tall pine tree or fir, often at the very top of a mountain, or searching out some other country for miles in every direction, he was always a most conspicuous bird.”

M.P. SKINNER, *Birds of Yellowstone National Park*, 1925

The Clark's nutcracker caught the attention and admiration of one of Yellowstone's early park naturalists, M.P. Skinner, from his first encounter with the boisterous bird in the Gardner Canyon in the early 1920s. He describes the bird as a “striking fellow dressed in black, white and grey,” and later writes: “His ready adaptability to conditions should win our respect.” Skinner's regard for the Clark's nutcracker was well warranted, yet at the time he was unaware of the bird's immense capabilities and tremendous memory that later study would reveal.

An elephant may never forget, but the Clark's nutcracker may possess one of the most extensive memories in the animal world. The bird has evolved his specialized skills and advanced cognitive functioning in order to achieve the maximum benefit from his primary food source: tiny pine seeds.

The term “nutcracker” is a bit misleading, as the bird first pries the seeds from the cone and then breaks them open to consume. He gathers his food in a small pouch under his tongue, which can hold up to 90 seeds. Once his pouch fills, he digs a small cache with his bill on an exposed slope and then buries his treasure. In the course of storing his food, the Clark's nutcracker can deposit up to 9,000 caches with 33,000 seeds over 12 square miles. Using landmarks the bird can relocate the thousands of caches by memory up to nine months later—and even under snow.

This inquisitive bird's namesake is Captain William Clark, which seems particularly appropriate given the superior mapping and navigation abilities that enabled the Lewis and Clark expedition to successfully complete their remarkable journey. Captain Clark first viewed the bird in the Rocky Mountains in 1805: “I saw to day [a] Bird of the woodpecker kind which fed on Pine burs its Bill and tale white the wings black every other part...” Clark observed that the bird resided year-round in the mountains and “in many parts is the only bird to be found.”—the result of its ability to store and locate the enormous amount of food required to survive winter at the higher elevations.

Part of the bird's strategy in burying so many caches is to store a surplus of food to allow for the inevitable loss from other animals such as ground squirrels. This overkill strategy has a significant impact on the surrounding ecosystem, as John Fraley observes in *Montana*

Outdoors: “A Clark’s nutcracker will plant an entire forest in its lifetime. The high-elevation whitebark pine stands of Montana and the entire Rocky Mountain west would not exist were it not for this cone-cracking, seed-caching bird.”

Across the Great Divide: Cutthroat Trout

“Very few people ever give a thought to appreciating fish in any way but catching and eating them, but fish, like other wildlife, are worth watching.”

JOHN VARLEY AND PAUL
SCHULLERY, *Yellowstone Fishes*

According to some theories, thousands of years ago at the end of the last ice age, a small fish struggled against forceful currents, swimming mightily upstream, ascending like a determined mountaineer until it reached the headwaters of the Yellowstone River and crossed the Continental Divide. Yellowstone’s waters—fishless during

the time of the glaciers—began to resound with aquatic life. Since the intrepid cutthroat trout first swam into Yellowstone more than 8000 years ago, the fish has been an integral part of its new home. Historically, the cutthroat trout inhabited more than 17,000 stream miles. Today it controls directly or indirectly the fortunes of 42 species of animals in the park.

Some inhabitants of the pastoral Hayden Valley depend upon the cutthroat as a food source. The fish’s abundance in the Yellowstone River caused author John Varley to deem it “a trout river of awesome capacity, both ecologically and for the human spirit.” The Yellowstone River meanders through the valley’s velvety meadowlands, which are guarded by distant snow-covered peaks. Wildlife is abundant. While in the valley many visitors catch a glimpse of a grizzly bear ambling on the banks of the river, a white-chested osprey soaring overhead, or a playful otter splashing in the water. These animals—along with bald

eagles, pelicans, weasels, and dozens of others—may owe a debt to that fish that conquered the Continental Divide with his monumental swim thousands of years ago.

Aside from providing a vital food source, the cutthroat also afford park visitors with spectacular wildlife viewing, especially during spawning season. The colorful cutthroat trout decorate the waters of Yellowstone, flashing like a rainbow in motion their distinctive bright orange, pink, or reddish striped gills, and their golden to copper hued and black dotted torso, as they migrate en masse upstream to spawning beds. Anglers in the park also take advantage of the superb fishing opportunities the cutthroat—deemed “the park’s foremost sport fish”—provide in Yellowstone’s many rivers.

When a delighted angler today admires the glint of the golden hued fish in the sunshine as he pulls it from the river, he may not realize that his catch is significant to a healthy ecosystem.



The cutthroat trout has become an integral part of its new home. Photo: Tom Murphy



A grizzly bear digs for pocket gophers. Photo: NPS

As Hal Borland wrote in *This Hill, This Valley*, “Any river is really the summation of the whole valley. To think of it as nothing but water is to ignore the greater part.”

To ignore the significance of Yellowstone’s native cutthroat is to ignore the osprey soaring overhead, the grizzly bear roaming the riverbanks, or the bald eagle nesting in a lodgepole pine.

King of Yellowstone’s Underworld: Pocket Gopher

“Consider what it would be like to excavate about five tons of soil per year with two teaspoons—this will give you some idea of the incredible excavating abilities of these animals.”

DONALD STREUBEL, *Small Mammals of the Yellowstone Ecosystem*

Underneath the rolling hills, rocky meadows, or sweeping valleys of Yellowstone, small creatures weighing less than half a pound patiently carve miles of tunnels invisible to park

visitors. Deemed “nature’s plowshares” for their prodigious digging abilities, the Northern pocket gopher constructs extensive and elaborate burrows that would rival any Hollywood mansion with its relative size and splendor. A single animal’s tunnel system can extend to more than 500 feet in length and contain separate chambers for food storage, nesting sites, fecal deposits, and foraging access. And it achieves all of this remarkable burrowing with tiny front claws that measure only an inch in length.

In the winter months, the pocket gopher remains active and does not hibernate. The animal will often extend its tunnel system into the snow, allowing it to forage on the topsoil covered by the snowpack. To build its winter burrows, the gopher fills the snow tunnels with a layer of soil, creating long, dirt tubes called “gopher eskers” that remain after the spring snowmelt. Excavating all of this soil—an incredible five tons a year—is made possible by the gopher’s powerful shoulders, formidable claws, loose skin and hair (allowing it to reverse

direction easily), and a naked tail that acts as a navigation tool.

The importance of the pocket gopher doesn’t end with its laudable excavating abilities. The mammal is a keystone species in Yellowstone—one that plays a vital role in promoting biodiversity and the health of the ecosystem. The gopher often unwillingly surrenders its hard work in building food caches to a hungry grizzly bear, and an array of species also take up residence in its tunnel systems including mice, lizards, and snakes. Predators such as the occasional grizzly bear, owls, raptors, foxes, weasels, and coyotes often make a meal of the small gopher.

The tunnels themselves also provide beneficial irrigation and water distribution to the soils, which affects plant distribution and diversity. In *Rocky Mountain Natural History* Daniel Mathews notes that “gophers churn the soil in a big way, with big ecological effects.” He credits the tiny pocket gopher with helping to “speed plant recovery near Mount Saint Helens by bringing soil and seeds to the ash buried surface.”