Winter 2008-09

MONTANA Naturalist

Follow Their Noses

Conservation in Action

Unique Complexity

Talkin' Turkey

see Get Outside Guide, page 9

Montana Natural History Center
Your Base Camp for Discovery

TO PROMOTE AND CULTIVATE THE APPRECIATION, UNDERSTANDING AND STEWARDSHIP OF NATURE THROUGH EDUCATION

MONTANA Naturalist

Features

Departments

Special Pull-Out Section

Cover photo – Tom turkey in full regalia, taken by Donald M. Jones in early April during a late season snowstorm just north of Troy, Montana. For more images, visit www.donaldmjones.com.

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Your Base Camp for Discovery

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tidings

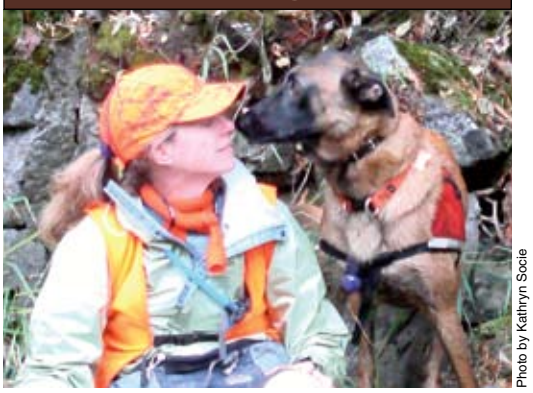


Photo by Kathryn Socie

Megan Parker and Peppin illustrate the love between dog and handler amid the rough going of field work.

In this season of thanksgiving we are reminded of all the wonderful things the world offers us – the relationship of dogs, the marvel of DNA, the overwhelming intricacy of a snowflake. Instead of wishing for something more or something else, we can open our eyes and partake of the banquet before us.

A Field Notes contributor recently wrote about discovering a giant puffball mushroom at the peak of its edible appeal. She described her find in detail, especially admiring the fungus' role as a decomposer in the forest ecosystem. She debates leaving the mushroom alone to fulfill its ecological destiny, but instead, she writes, "I bring the puffball home, where it fulfills a sustaining role in my kitchen. I cook it with reverence, its wild flavor of earth deeply respected at the table where I share its nourishment with friends."

Nature abounds with beauty and opportunities for us to feel a part of something greater than ourselves. As recipients of such abundance, we should be inspired to share that joy with others. Perhaps this winter you, too, will encounter something outside to share with friends. Let's give thanks and be thankful givers. *Happy holidays,*

Caroline Kurtz

Caroline Kurtz
Editor

Letter to the editor:

"I always enjoy the Montana Naturalist and immediately sit down and thumb through it when it arrives in my mailbox. In the most recent issue, however, I noticed an error on the last page, in the "Reflections" section. The skull identified as that of a wolf is actually a coyote skull. The description provided for carnivores is correct for both coyotes and wolves, but wolves have a proportionately broader, shorter skull, a prominent sagittal crest and sloping forehead, and more massive canines. This particularly caught my attention as the very day I received this magazine I was presenting a laboratory on this canid group to my university mammalogy class."
– Kerry R. Foresman

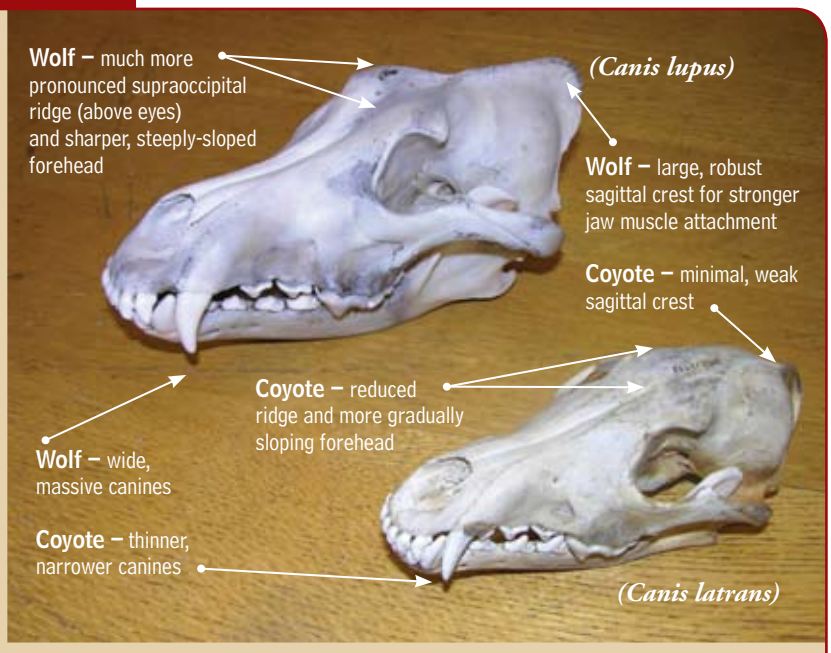


Photo by Kerry Foresman

Going to the Dogs

By Kathryn Socie

Conservation research's new best friend

Parked at the top of a long, winding, logging road, Aimee Hurt assesses her field gear before heading out for a day of data collection. Map. Check. GPS. Check. Data sheets. Check. Dog. Check.

Wicket, a specially trained scat detection dog, and a cadre of dogs with this unique skill set, are fast becoming an important tool available to scientists and wildlife managers in Montana and around the globe.

Employed to sniff out fisher scat on this particular field outing, Wicket and Hurt, co-founder of Working Dogs for Conservation (WDC), are helping biologist Michael Schwartz of the Rocky Mountain Research Station better understand why fishers, a relative of the weasel, are so rare in the Rocky Mountains. Fishers have been found only in north-central Idaho and west-central Montana, and Wicket's specially developed ability is among several survey methods being used to help shed light on this mystery.

Whether it's a lost hiker, drugs, bombs or even certain types of cancer, humans have made use of the hundreds of millions of scent-sensitive cells unique to the dog nose to sniff out a wealth of information. Recently, dogs have been tested and confirmed highly capable not only in distinguishing odors of different species of animals, but also different individuals within a species through their scat, allowing scientists to infer habitat use, range size and relative abundance. When combined with technologies available for the analysis of DNA extracted from scat, scientists can verify species, sex, and potentially determine population size, home range, paternity and kinship. Analysis of hormones extracted from scat also can determine the reproductive status of individuals.

From bears to butterflies, dogs are making huge contributions to conservation efforts, assisting researchers and helping a diverse array of species.

When Jon Beckmann, a scientist with The Wildlife Conservation Society, wanted to determine the habitat selection and movement patterns of black bear, grizzly bear, cougar and wolf in the Centennial Mountain range, he turned to dogs for assistance.

The Centennials, along the Idaho-Montana border, are one of the few east-west oriented mountain ranges in the area, providing an important migratory corridor for these four critical carnivore species between the Greater Yellowstone area and central Idaho's Frank Church River of No Return Wilderness. Safe corridors linking core habitats are essential to the survival and maintenance of healthy, genetically diverse populations of many species, but this is true especially for large carnivores.

Using WDC dogs to locate the scat of these target species, Beckmann was able to extract DNA from the samples found by the dogs, and determine relative densities, use of areas and movement patterns of carnivores. Moreover, he was able to identify potential bottlenecks for carnivores within the Centennials using these data as well.

The dogs have proven their worth. On one of her first field outings, Wicket located several areas where bears had been particularly busy, sniffing out 47 bear scats in a single day, and Camas, a German shepherd, located 40 scats. As a result of their efforts, 40 miles of BLM roads have closed and a 1,200-unit housing development and golf course was halted. The dogs uncovered enough evidence of grizzly bear use in the area to convince agencies and developers that this was a hot spot for an endangered species.

Photo by Aimee Hurt

Photo by Julie Larsen Maher, courtesy of WCS

OPPOSITE PAGE, TOP: **Wicket poses with the results of a day's labor during a survey for large carnivores in the Centennial Mountains.**

OPPOSITE PAGE, BOTTOM: **Tsavo at work in the Centennial Mountains, with Jon Beckman (WCS) and handler Alice Whitelaw (WDC).**

As new uses for the amazing dog nose are discovered, the importance of our centuries-long relationship with canines deepens and appreciation for our "best friend" grows.

Photo by Julie Larsen Maher, courtesy of WCS

After learning about the Beagle Brigade, a group of border patrol dogs used to identify organic materials carrying diseases and pests that could infect U.S. agriculture, Kim Goodwin, a conservation biologist working with the Invasive Weed Prevention Program at Montana State University in Bozeman, began to wonder: "Can dogs do the same thing on the landscape? Can a dog find a living plant among other living plants in a community?"

A specific plant species is an entirely different and complicated scent to detect than the scat of a specific animal. In order to detect a weed in the field, a dog has to work in a landscape dominated by plants, with many different species occurring in a small area. The dog must be able to recognize the volatile chemicals produced by a single species in a sea of plant scents. A tough task considering all plants produce these chemicals, known as vapor constituents, but in different ratios.

Goodwin worked with WDC to train dogs to locate spotted knapweed, testing their success at locating these plants against experienced human surveyors. The dogs used in her research performed better than people, and when using dogs as a team she found them to have 100 percent accuracy, whereas people only came as close as 75 percent. "We [humans] are inherently limited in what we can find," says Goodwin.

In fact, one of the advantages dogs have, she discovered, is the ability to locate juvenile and small plants people can't see, particularly plant parts that are still underground.

So valuable were the dogs in locating exotic plant species, they were recently recruited in Oregon to detect the threatened Kincaid's lupine, a host plant for the critically endangered Fender's blue butterfly. The native lupine and butterfly currently exist on only one-tenth of one percent of the habitat that was once available. Current research and conservation efforts are focused on understanding the specific habitat needs of the plant, and locating new populations of both the lupine and the butterfly. The detection abilities of the dogs will soon be tested against experienced botanists in locating plants. The aim is to develop efficient search protocols, and continue to measure dogs' accuracy and efficiency.

As new uses for the amazing dog nose are discovered, the importance of our centuries-long relationship with canines deepens and appreciation for our "best friend" grows. At the rate dogs are successfully being used by scientists and managers to protect wildlife and better understand their ecology, it may soon be said that conservation truly has gone to the dogs.

Kathryn Socie freelance writes and edits in the sciences while helping non-profits like the Montana Natural History Center and Working Dogs for Conservation to grow. She can be reached at kathryn@socie.com

ABOVE, LEFT: **Wicket gets a reward for job well done.**
BELOW: **WDC co-founder Megan Parker and Peppin ford the Swift River during a survey for fishers in the Selway-Bitterroot Wilderness.**

Photo by Kathryn Socie

About Working Dogs for Conservation:

Working with detection dogs to benefit science and conservation, Working Dogs for Conservation promotes on-going research into the abilities and applications of conservation detection dogs, and provides the unique method of surveying with detection dogs to wildlife researchers, conservationists and associated institutions. WDC has partnered on numerous projects around the globe, targeting many different threatened or endangered species.

Conservation dogs are selected for their extremely high play drive, ability to concentrate and their agility, often making them very difficult pets. Many of the dogs on staff are rescued shelter dogs or those relinquished by overwhelmed owners. WDC is committed to providing a positive, fulfilling life for working, retired and candidate conservation detection dogs.

To learn more about WDC online, go to www.workingdogsforconservation.org.

Photo courtesy of Working Dogs for Conservation

WILDLIFE CSI

Solving nature's mysteries with DNA analysis

By Camille Barr

Since our days as early hominids, we have gathered information from the natural environment for our survival, enjoyment and to increase our understanding of the world. We have generally relied on our senses of sight, sound and touch to gather these clues. In the last 20 years, however, we have added a new and powerful tool to our arsenal – DNA.

We are familiar with DNA's great value for genetic engineering, disease testing and forensics, but the uniqueness of every individual's DNA also is useful for understanding our natural world.

Tucked inside cells, DNA is the genetic blueprint that directs all the development and functioning of living organisms. It consists of strings of four molecules, analogous to letters in an alphabet, that are repeated in varying arrangements. When combined into groups akin to words in a paragraph, these code for proteins and other molecules that perform all of an organism's functions. Through the process of mutation, in which letters change from one to another, and recombination, in which genes move around and change their associations with other genes (e.g. blue eyes with brown hair, or blue eyes with blonde hair), all individuals carry an unique genetic code.

The uniqueness of every individual's DNA is useful for understanding our natural world.

DNA is found in most parts of living organisms – a plant leaf, a salamander tail, a blood sample – and biologists can use a wide variety of sources. The questions this information can answer are just as varied. For example, DNA collected from hair traps in the wild can tell us about the sizes of animal populations (as did the highly publicized recent grizzly bear study in Montana). DNA can also tell us about the history of organisms, such as when an invasive species first came here and where it came from. We can use it to understand how organisms are related to each other. And understanding DNA markers can give us insight into how organisms adapt to a myriad of conditions, including super hot environments as in thermal hot springs, or drought, or human population growth.

In Montana, DNA tools are used extensively in biological research. In Yellowstone National Park, mass DNA collected from thermal mats (which contain hundreds of microscopic bacterial and other species), has revealed several previously unknown microorganisms that are untapped reservoirs of genetic potential. In the National Bison Range, DNA tools have helped reveal the parasite species infecting hoofed mammals like bison and elk, and how these parasites move from one species to the other. And DNA markers from monkeyflowers are telling us what genes are responsible for the earliest divergence between populations that eventually become new species.

While the source material for DNA is varied, the methods to obtain these data are essentially the same. Once a sample is collected, DNA is extracted from that sample. This process involves the use of various solutions and centrifugation (high-speed spinning) to remove everything but DNA. What scientists end up with is a tube of DNA suspended in liquid.

Then a key step happens. In order to study pieces of DNA, large quantities of this tiny molecule must be generated. Prior to 1983, the only way this could be done was through the collection of large amounts of source material, which proved impossible for

continued on page 8

Photo by Al Mebane, YNP

Grand Prismatic Spring; Yellowstone National Park

AN UNLIKELY SUPERHERO

Thermus aquaticus. An odd name that sounds like something out of a science fiction novel. Or perhaps a superhero that rescues people who have fallen to Davy Jones' locker. It turns out that the name does belong to a superhero, but for reasons that will surprise you.

Thermus aquaticus is the scientific name for a bacterium that grows in hot springs. This bacterium was first discovered in 1969 in Yellowstone National Park. If you've ever been there, you might remember the vibrant colors you can see at the hot springs. Those colors are actually the result of microorganisms like *T. aquaticus*. This single-celled organism lives best at 160 degrees Farenheit, which is 30 degrees hotter than what people thought at the time was the limit for life. *T. aquaticus* not only thrives at extremely high temperatures, it is also very ancient – in fact, its preference for extreme temperatures may be a holdover from when its ancestors lived in the hot and steamy environment of early earth.

When most organisms go above 130 degrees, the proteins in their cells change structure so that they become non-functional – just like the protein in egg white changes when you cook it. Because proteins do almost everything that gets done in our cells, high temperatures are usually fatal. It was clear, though, that *T. aquaticus* defied this destructive effect of heat, and this set off a rush to discover what these proteins were. One of them turned out to be very useful indeed.

Turn back the clock to 1953. This was the year we learned the structure of DNA, which lit the fire for intense interest in the genetic blueprint of all organisms. What are genes? How do they differ between species? How do they differ between people? But because DNA is so small, to start studying it in depth we needed to have more than we could get out of little cells. And this was a huge stumbling block for researchers. But in 1983, 30 years after the structure of DNA was discovered, a scientist named Kary Mullis discovered a method called Polymerase Chain Reaction, or PCR, that did just that – it made millions of copies of the DNA that we can get out of cells. This was revolutionary, but there was a catch: this method required the DNA to be heated up to high temperatures, which destroyed all the proteins that are needed to copy the DNA.

And this is where *Thermus aquaticus* saved the day. *T. aquaticus*' proteins are heat-stable. One of them, called Taq DNA polymerase, can keep copying DNA even after being heated up. This allowed for the production of large quantities of DNA, which started a landslide into the study of our genes.

And the rest is history in the making. All because of this tiny organism we have the human genome project. Because of this bacterium we have forensic DNA technology and apparently endless television CSI spinoffs. Because of this bacterium we can grow rice that prevents blindness. And it is also because of this organism that we can determine whether or not we carry a gene for breast cancer, or a gene that makes us hate broccoli.

All this from an organism 500 times smaller than a grain of sand, happily thriving in the steaming pools of Yellowstone National Park. – *Camille Barr*

continued from page 7

small organisms or small samples, such as hair in a hair trap.

But in 1983, a process was developed, called PCR (short for the Polymerase Chain Reaction) that revolutionized the way we use DNA. This process uses a naturally-found protein that copies DNA as cells divide. Because artificially making large numbers of DNA copies requires the samples to be heated to temperatures higher than almost all organisms call tolerate, using the naturally occurring copying protein found in most organisms was impossible. But in 1983, a researcher tried out the protein from a bacterium adapted to thermal hot springs in Yellowstone National Park. When you take some of this protein, add a short "starter" piece of DNA for whatever gene or piece of DNA you are interested in, and add an organism's DNA, what you end up with is a tube chock full of copies of a single piece of DNA.

From here, a researcher can characterize the DNA in a number of different ways: for example, the DNA can be "sequenced," in which each letter is identified, or the size of the DNA fragments can be measured. Different sequences of letters, or different sizes, can indicate different individuals, populations or species. Shared letters or fragment sizes can indicate genetic relatedness. And patterns of sequence evolution can indicate whether that gene was under natural selection, is of ancient or recent origin, or is now defunct.

The level of detail afforded by DNA analysis is unprecedented, and work using this tool is only just beginning. With advances in technology, we are now able to sequence entire genomes, such as those of humans, corn, fruit flies and monkeyflowers, and genome sequencing of organisms other than these model systems will become routine. Indeed, while our ancestors couldn't look forward to see what their descendants would become, with DNA analysis we can look back and see their legacy in us.

Camille Barr currently is a postdoctoral researcher at the University of Montana. She studies plant evolutionary genetics.

Photo by Bruce MacQueen, istockphoto.com

Terrific Turkeys

The common name for this familiar bird comes from a long-ago misconception that turkeys came from the country of Turkey. In fact, turkeys are native only to the western hemisphere, and were imported into Spain from the New World by Hernando Cortez after his invasion of Mexico. Wild turkeys were quickly domesticated and used for food throughout Europe, and perhaps were carried back to America by English colonists who didn't realize they were bringing a native species back home.

Today you might think of a turkey, first and foremost as the delicious centerpiece of a Thanksgiving or Christmas meal. In fact, turkey was not the main dish at the first gathering at Plymouth Colony in 1621. Records indicate that a few turkeys were eaten during that celebration, but more prominent were cod and sea bass, clams and other shellfish, venison and duck. Turkeys were plentiful along the shores of Cape Cod Bay, but having a holiday menu centered around one did not become popular until the early 1800s.

Photo Hulton Archive

In the late-17th and 18th centuries, hunters reported seeing a thousand turkeys in a day. Yet from an estimated population of 10 million wild turkeys, their numbers shrank as hunting increased and native woodland habitat was cut down and plowed under for farmland. Disease spread from domesticated poultry also played a role. By the 1940s there were perhaps as few as 30,000 wild turkeys left, and only a fraction of their former range.

Turkeys were never native to Montana. They were introduced here in the 1950s in a national conservation effort to save the species that Benjamin Franklin once thought would make a better emblem of the United States than the bald eagle. These conservation efforts were largely successful and the total turkey population now stands at more than three million. However, in Montana where conditions are harsh enough to keep wild turkey populations in check, they tend to stay close to human habitation where grain and other food is readily available.

Did you know...

Male turkeys, called **toms**, have no feathers on their head and upper neck, and their skin turns a vivid red and blue during mating season. They have a fleshy growth, called a **snood** or **dewbill**, on the front of their heads. A tuft of bristles, called a **beard,** grows from the center of their breasts. A pouch-like area at the front of the throat is called a **wattle**. Their legs have **spurs**, which start to grow after the first year.

Photo by Linda Haugen, USDA Forest Service, Bugwood.org

Turkeys build their **nests** on the ground, in large, messy piles of leaves. Their **eggs** are about twice as large as a chicken's and are a creamy tan color speckled with brown. Hens **incubate** eggs for about 28 days before they hatch.

Turkeys are strong short-distance fliers and **roost** in trees at night. Come day, they descend to the ground where they scratch and **forage** for plant material, small invertebrates and cold-blooded vertebrates. Turkeys are **gregarious** and live in flocks. They prefer to inhabit mature forests with a variety of trees and vegetation. In summer they venture into open spaces, like pastures.

Special Pull-Out Section: pull out and post these pages for handy reference.

get outside calendar

December 3 Evening Lecture Series. Biomimicry, 7:00 p.m. Biomimicry Insitute K-12 Education Director Sam Stier discusses design from nature. Suggested donation $3.

December 6 Saturday Kids Activity. Camouflaged Critters, 2:00 p.m.

December 13 Saturday Discovery Day. Winter Ecology on Snowshoes, 9:00 a.m.-3:00 p.m. Free.

January 6 Volunteer Naturalist Training, 4:00-5:00 p.m. **Winter Adaptations.** Volunteer training for Visiting Naturalist in the Schools January class visits.

January 10 Saturday Kids Activity. Snow, Ice and Everything Nice, 2:00 p.m.

January 21 Evening Lecture Series. Bears of the World, 7:00 p.m. Presented by Chris Servheen. Suggested donation $3.

January 24 Saturday Kids Activity. Cold Weather Creatures, 2:00 p.m.

January 27 Volunteer Naturalist Training, 4:00-5:00 p.m. **Skulls.** Volunteer training for Visiting Naturalist in the Schools February class visits.

January 31 Saturday Discovery Day. Winter Tracking, time TBA. Tom Parker from Northwest Connections leads this field trip. Call 327-0405 to register.

February 7 Saturday Kids Activity. Super Stars, 2:00 p.m.

February 12 Evening Lecture Series. Blackfeet Skies, 7:00 p.m. Presented by Leo Bird. Suggested donation $3.

February 21 Saturday Kids Activity. Tricky Trackers, 2:00 p.m.

February 23 Montana Master Naturalist Class, 4:00-7:00 p.m. Mondays through May 11. Become a certified Montana Master Naturalist. This course, open to students and the general community, will give participants the tools and skills of a naturalist through hands-on exploration of natural areas and discussion of the natural history of Montana plants and animals. Two Saturday field trips included. Cost is $295, which includes $50 non-refundable deposit required to register. Class available for 3 credits through UM for an extra fee. Space is limited; call 327-0405 for more information or to register.

February 24 Volunteer Naturalist Training, 4:00-5:00 p.m. **Wing Lift.** Volunteer training for Visiting Naturalist in the Schools March class visits.

February 25 Evening Lecture Series. Surviving Severe Wildfire, 7:00 p.m. Presented by Dick Hutto. Suggested donation $3.

December

MNHC Hours: Tuesday-Friday, noon - 5 p.m. and Saturday noon - 4 p.m.
Beginning January 1, 2009
New Admission Fees: $2/adults, **$1**/children 4-12, **free**/children 3 and under and MNHC members.

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			Evening Lecture Series. Biomimicry, 7:00 p.m. 3	4	5	**Saturday Kids Activity. Camouflaged Critters,** 2:00 p.m. 6
7	8	9	10	11	12	**Saturday Discovery Day. Winter Ecology on Snowshoes,** 9:00 a.m.-3:00 p.m. 13
14	 Photo courtesy of YNP		*Small mammals stay busy under snow* 17	18	19	20
21			24	25	26	27
28	29	30	 Photo by Miller, YNP			**January** 3
Moose forage for willow twigs 4	5	**Volunteer Naturalist Training,** 4:00-5:00 p.m. **Winter Adaptations.** 6			9	**Saturday Kids Activity. Snow, Ice and Everything Nice,** 2:00 p.m. 10
 Photo by Douglas Faulkner, YNP			14	*Deer and elk begin to shed antlers* 15	16	17
			Evening Lecture Series. Bears of the World, 7:00 p.m. 21	22	23	**Saturday Kids Activity. Cold Weather Creatures,** 2:00 p.m. 24
25	26	**Volunteer Naturalist Training,** 4:00-5:00 p.m. **Skulls.** 27	28	29	30	**Saturday Discovery Day. Winter Tracking,** time TBA. 31

Programs and events held at MNHC's new home - 120 Hickory Street - unless otherwise noted.

February

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2	3	4	5	6	7 **Saturday Kids Activity.** Super Stars, 2:00 p.m.
8	9 *Snowshoe hares nibble conifer buds and shrub bark*	10	11	12 **Evening Lecture Series.** Blackfeet Skies, 7:00 p.m.	13	14
15	16	17	18 *Look for snowshoe hare and lynx tracks in high conifer forests*	 Photo by Roger Anderson, YNP		21 **Saturday Kids Activity.** Tricky Trackers, 2:00 p.m.
22	23 **Montana Master Naturalist Class,** 4:00-7:00 p.m. *Mondays through May 11.*	24 **Volunteer Naturalist Training,** 4:00-5:00 p.m. **Wing Lift.**	25 **Evening Lecture Series.** **Surviving Severe Wildfire,** 7:00 p.m.			28

March

1	2	3	4	5	6	7
 Photo by Willis Peterson, YNP		10	11 **Evening Lecture Series.** Orchids and Other Rare Plants of Montana, 7:00 p.m.	12	13	14 **Saturday Kids Activity.** Sneaky Snakes, 2:00 p.m.
		17	18	19	20 **Saturday Discovery Day.** Snow Geese Migration.	21 **Saturday Kids Activity.** Endangered Species Treasure Hunt, 2:00 p.m.
22 *Western screech owls begin breeding*	23	24 **Volunteer Naturalist Training,** 4:00-5:00 p.m. **Bird Bills.**	25	26	27	28
29	30 **Nature Detectives Spring Break Camp,** 9:00 a.m.-4:00 p.m *March 30 - April 3*	31	1 **April**	2	3 **Volunteer Naturalist Training,** 10:00 a.m. to 3:00 p.m. **Spring Field Trip.**	4 18

get outside calendar

March 11 Evening Lecture Series. **Orchids and Other Rare Plants of Montana,** 7:00 p.m. Presented by Steve Shelley. Suggested donation $3.

March 14 Saturday Kids Activity. **Sneaky Snakes,** 2:00 p.m.

March 21 Saturday Discovery Day. **Snow Geese Migration at Freezeout Lake.** Call 327-0405 to register.

March 21 Saturday Kids Activity. **Endangered Species Treasure Hunt,** 2:00 p.m.

March 24 Volunteer Naturalist Training, 4:00-5:00 p.m. **Bird Bills.** Volunteer training for Visiting Naturalist tin the Schools April class visits.

March 30-April 3 Nature Detectives Spring Break Camp, 9:00 a.m.-4:00 p.m; early drop-off begins at 8:00 a.m. and late pickup lasts until 5:00 p.m. For students in the 2nd through 5th grade, this week-long camp engages children in the study of the natural world through field trips, science explorations, stories, and arts and crafts projects. Students learn about plants and animals native to our region, and explore local natural areas under the guidance of our Visiting Naturalist in the Schools instructors. $175/MNHC members; $220 non-members. Space is limited. Call 327-0405 to register, or learn more at www.MontanaNaturalist.org. A $50 non-refundable deposit is required upon registration to reserve your child's space. Full payment is expected one week prior to start of camp unless other arrangements have been made. Camp fee is refundable (minus the $50 deposit) ONLY if a cancellation is made by March 24. Withdrawals after this time are NOT refundable. Membership fees also are non-refundable and must be paid at registration to get the discount.

April 18 Volunteer Naturalist Training, 10:00 a.m. to 3:00 p.m. **Spring Field Trip.** Learn about riparian ecosystems, explore spring happenings and learn how to teach children in the field. This training will prepare volunteers for leading educational stations during school field trips in May. Free, location TBA. Call 327-0405 to register.

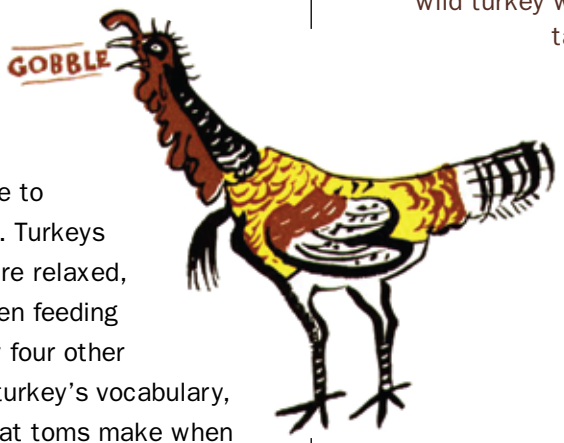
Look for these program symbols in *Montana Naturalist* and on our website at www.MontanaNaturalist.org.

- **Adult Program**
- **Youth Program**
- **Volunteer Opportunity**

Visit www.MontanaNaturalist.org for directions. To register or to learn more, call MNHC at 327-0405.

Talkin' Turkey

Wild turkeys make a wide variety of sounds, each with its own meaning. The **"gobble"** may be the best-known sound – males use it to attract a hen for mating. The **"yelp"** is a long sound made to locate other turkeys. Turkeys **"cluck"** when they are relaxed, and **"purr"** softly when feeding and content. Twenty four other sounds round out a turkey's vocabulary, including a sound that toms make when they are in the **"strut"** – or displaying for females. This has been described as a **"chump"** or hum – a nonvocal sound the source of which is not well understood. What might turkeys be communicating with some of their other sounds?



Make Your Own Turkey Call

Hunters in North America have been trying to fool turkeys for thousands of years. As far back as 4,000 years (and possibly earlier), people used leaves, slate, wooden strikers and even wild turkey wingbones to make turkey calls. To try your skill at talking to turkeys, you'll need:

- An empty plastic film canister
- A hollow, round coffee stirrer or cocktail straw

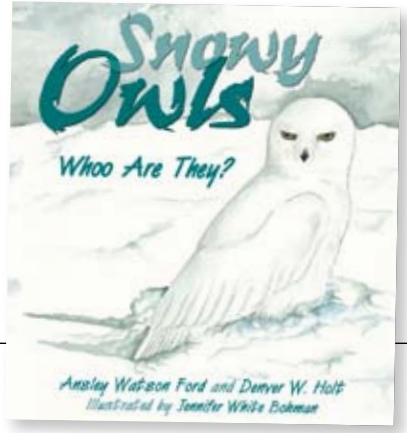
- Remove the cap and punch a hole in the bottom of the film canister using an ice pick or drill with a small bit. Make the hole just big enough to insert the straw or stirrer.
- To make the "cluck" sound, place the straw up to your lips and cup your hands around the canister. Suck in air through the straw, pursing your lips as if for a kiss.
- Move your hands around the bottom of the canister to experiment with different sounds until you make a sound like a turkey "cluck."
- Once you make a cluck sound, try the more difficult "yelp."

To hear what wild turkeys sound like, go to the National Wild Turkey Federation's website at www.nwtf.org and click on Newsroom, then Audio.

Winter white

Photo Montana FWP

Many animals, predator and prey alike, are out and about all winter. How do they cope with a changed landscape? One way is to put on a new coat – literally. Snowshoe hares, weasels and ptarmigan are three animals that change their summer coloration for winter white, as a way to blend in with their surroundings and avoid detection. The process of shedding and growing in of different coats is triggered by the shortening and lengthening of daylight hours. In the case of the ptarmigan, like all birds, they molt their feathers a certain number of days after the end of nesting season. The white feathers grow in time to match the winter snow.



BOOK CORNER

Snowy Owls

For owl aficionados everywhere, *Snowy Owls, Whoo Are They?* is a wonderful introduction to the history and habits of Ukpik, as the Inupiat people of the Arctic Circle call them. The book by Ansley Watson Ford and Denver Holt, and illustrated by Jennifer White Bohman, provides a wealth of information about these birds of prey, such as how they are adapted for life on the arctic tundra, strategies for hunting and their mysterious migration patterns. A number of games and activities are included to provide youngsters ways to learn more about how snowy owls find food, raise chicks and hide from predators. A comprehensive list of Web resources encourages readers to go online to see more photographs, listen to a snowy owl call or see how scientists track snowy owls and other migratory animals by satellite. *Snowy Owls, Whoo Are They?* is available for $12 from local booksellers, online retailers or from Mountain Press Publishing at (800) 234-5308.

One of The Teller's many spring-fed wetlands on a chilly winter morning.

Riparian Recovery

One step at a time

By Sam Lawry

Photos courtesy Teller Wildlife Refuge

The cottonwood galleries of the Bitterroot floodplain here provide a ribbon of beauty and tranquility within an increasingly densely populated valley. Deer flag their departure with a flash of brilliant white tails. A pair of pileated woodpeckers search for insects on a nearby snag. It's easy for an observer to be enchanted by the overall brilliance of this natural place.

This place is The Teller Wildlife Refuge, a 1,200-acre, nonprofit, private conservation property north of Corvallis, Montana, whose mission is "to inspire, educate and demonstrate conservation in action." Consisting of floodplain habitats, wetlands and agricultural lands, The Teller is testing many habitat restoration and enhancement projects to improve habitat diversity for a host of fish and wildlife species.

One of these projects consists of enhancing and restoring native riparian habitats to appear as they may have at the time Lewis and Clark navigated this wild and scenic place. Two hundred years ago, floods left sand bars and sediment deposits that native tree and shrub species quickly colonized. The system was ever-changing, with new soil deposits and gravel bars offering a mosaic of vegetated and non-vegetated areas. Fires played a role as well, stimulating new growth and creating plant communities of diverse size and age. Since that time, impacts from grazing, fire suppression, flood control and the spread of noxious weeds have changed the look of the riparian habitat here. Heavy browsing by wild ungulates, predominantly white-tailed deer, also is taking a toll.

We estimate that 150 white-tailed deer call The Teller their home. Occupying a relatively small home range, these deer are preventing the establishment of native shrub and tree species. A walk through any of the riparian systems on The Teller and other areas along the Bitterroot River, offer a glimpse of these impacts. In the spring and early summer, black cottonwoods and aspen attempt to send up new runners, only to be nipped off by browsing deer. When nearby crops are no longer available, winter browsing by white-tailed deer heavily impacts other shrub species, such as chokecherry, serviceberry and dogwood.

Before fence

After fence

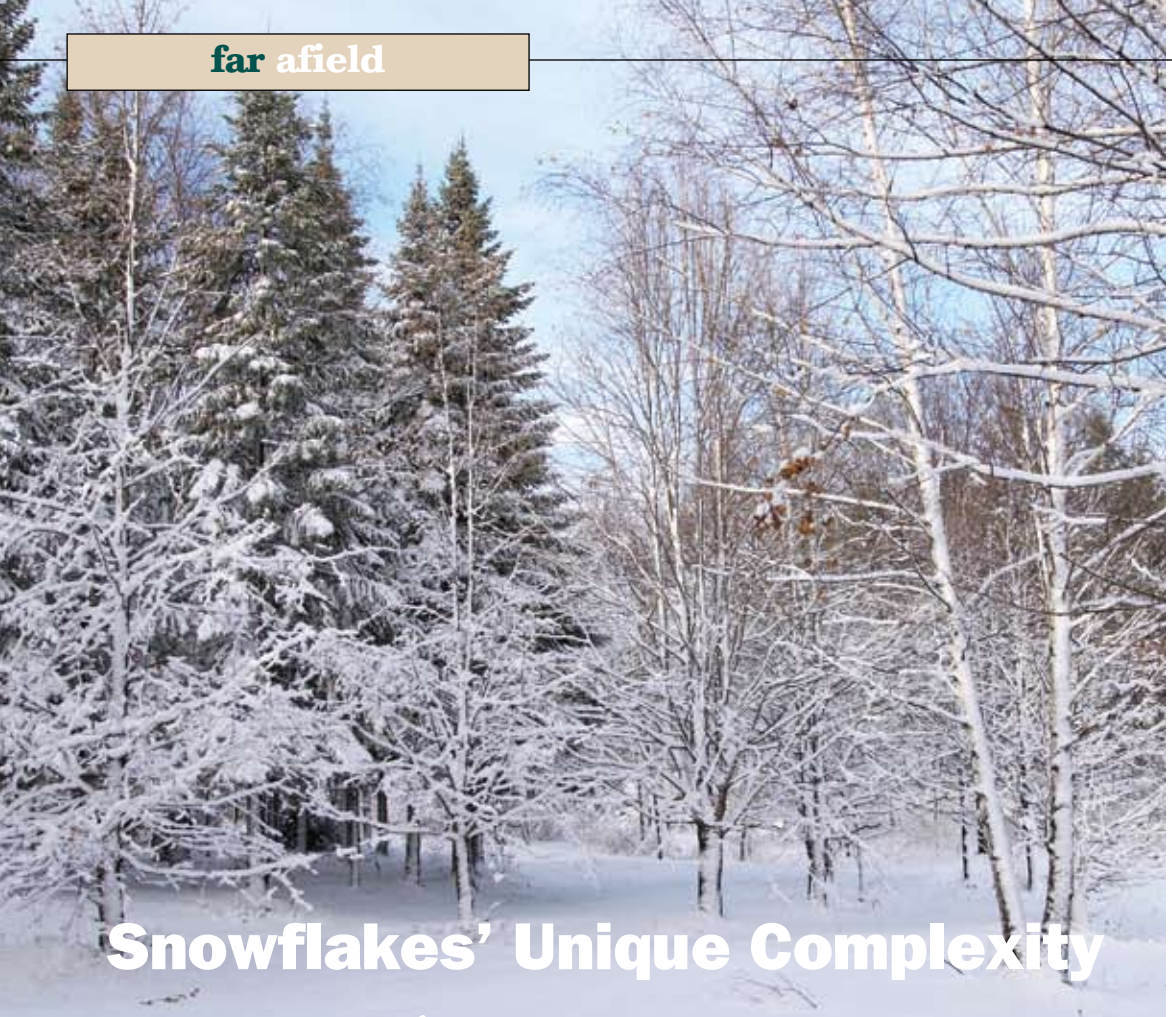
In an attempt to minimize the impacts of deer, The Teller erected a state-of-the-art electric fence on approximately five acres within the riparian gallery in July 2007. The solar powered, 11-strand portable fence is designed to withstand occasional blow downs of dead trees. When a fallen tree is cut away from the fence, the elastic strands bounce back into place, supported by fiberglass rods. The intent of the project is to exclude deer from the area for a period of five years, allowing trees and shrubs within to become established prior to moving the fence to a new location. So far, the results are promising.

While it is nearly impossible to find an unbrowsed cottonwood outside the fence, approximately 200 young trees are nearing three feet tall within the enclosure. Volunteers also planted 600 individual native trees and shrubs inside the fence to speed up the recovery process. A walk through the enclosure now reveals young ponderosa pine, rocky mountain juniper, red osier dogwood, willow, skunk sumac, black hawthorn and others that will soon add to the structural diversity of the riparian habitat. One unexpected result: spotted knapweed plants inside the enclosure have much greater vigor than those outside, demonstrating that deer have been having an impact on this noxious invader, as well as on the more desirable native plants.

The project was made possible with assistance from the Natural Resource Conservation Service, which provided cost-share funds through a special initiative to improve avian habitat. Teller volunteers are conducting quarterly bird surveys to detect any change in species abundance and numbers of birds using the habitat inside versus outside the enclosure. By promoting the recovery of structural diversity within the riparian community, a host of bird species, including neo-tropical migrants, will again find necessary foraging, nesting and hiding cover.

While we know this project cannot be duplicated throughout vast acreages of riparian systems, we hope it will demonstrate to other landowners and managers what can be done on a small scale to benefit many wildlife and plant species.

Sam Lawry is director of conservation programs at The Teller. The Teller offers educational opportunities for school groups and the general public. Go online to www.tellerwildlife.org, or call (406) 961-3507.



Snowflakes' Unique Complexity

As I move up the snow packed trail, tiny clouds of breath like frosty ghosts escape from my mouth. My thoughts are focused inwardly and my eyes on the trail until I hear a distinct sound: snow. Falling snow! Ice crystals tap on my hood as if to wake me up to this world of magic, as if I were inside one of those water-filled paper weights that you shake to make plastic snowflakes fall.

It almost makes you dizzy, to look straight up into falling snow. People seem to love watching things fall through the air: autumn leaves twirling down, fireworks sizzling through a July sky, even parachuters plummeting. But what seems to me most extraordinary about snowflakes is that their very descent shapes what they look like by the time they make it to my mitten for a closer examination. On this winter day, I began to wonder if the old saying was really true.

– From a Field Note by Marianne Wanek, 1998

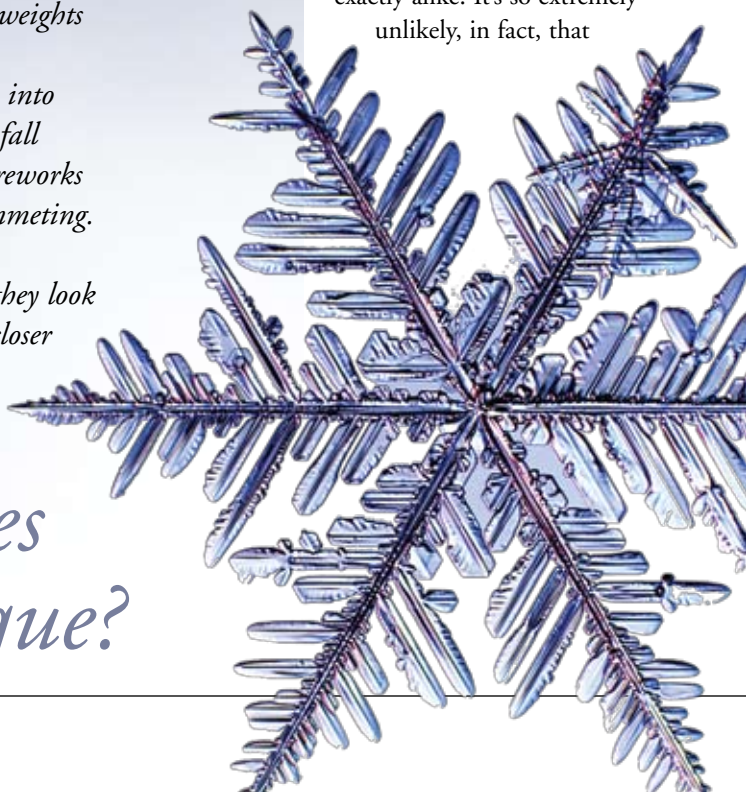
Are all snowflakes truly unique?

The answer to this age-old question comes from Kenneth G. Libbrecht, a professor and chairman of physics at the California Institute of Technology. His book, *The Snowflake: Winter's Secret Beauty*, with photographs by Patricia Rasmussen (Voyageur Press, 2003), is a beautiful, readable elucidation of the mysterious nature of snowflakes. You can read about snowflake individuality and much, much more online at www.snowcrystals.com.

Is it really true that no two snowflakes are alike? Now there's a question I hear a lot. It's a funny question, almost like a Zen *koan* – if two identical snowflakes fell, my inquisitive friend, who would know? And can you ever be sure that no two are alike, since you cannot check them all to find out?

Although there is indeed a certain level of unknowability to the question of snowflake alikeness, as a physicist I find that I can address this issue with some confidence. As I will demonstrate, the answer depends to a large degree on what you mean by the question.

The short answer is yes – it is indeed extremely unlikely that two *complex* snowflakes will look exactly alike. It's so extremely unlikely, in fact, that



even if you looked at every one ever made you would not find any exact duplicates.

The long answer is a bit more involved – it depends on just what you mean by "alike," and on just what you mean by "snowflake." Let's look at the possibilities....

Nano-snowflakes can be exactly alike. Some things in nature are exactly alike. For example, our understanding of elementary particles indicates that all electrons are *exactly, precisely* the same. This is one of the cornerstones of quantum physics, and if you think for a bit you will see that this is a profound statement. Electrons are true elementary particles, in that they have no component parts; thus they are all *exactly* alike.

A water molecule is considerably more complex than an electron, and not all water molecules are *exactly* alike. If we restrict ourselves to water molecules which contain two ordinary hydrogen atoms and one ordinary oxygen atom, then again physics tells us that all such water molecules are exactly alike. However about one out of every 5,000 naturally occurring water molecules will contain an atom of deuterium in place of one of the hydrogens, and about one in 500 will contain an atom of heavy oxygen (^{18}O) instead of the more common ^{16}O. These rogues are not exactly the same as their more common cousins.

Since a typical small snow crystal might contain 10^{18} (a million trillion) water molecules, we see that about 10^{15} of these molecules will be different from the rest. These unusual molecules will be randomly scattered throughout the snow crystal, giving it a unique design. The probability that two snow crystals would have exactly the same layout of these molecules is very, very, *very* small. Even with 10^{24} crystals per year, the odds of it happening within the lifetime of the universe is indistinguishable from zero.

Thus at some very pure level, no two snow crystals are exactly alike. An exception (why does there always have to be an exception?) would be a snow crystal with only a handful of molecules. If we assemble a crystal of only 10 molecules, for example, then it's not so unlikely that each of the 10 will contain two ordinary hydrogen atoms and one ordinary ^{16}O atom. Furthermore, a cluster of only 10 molecules will only have a few likely configurations. So there's a reasonable probability that two 10-molecule snow crystals would be *exactly* alike.

I might add that even if we restrict ourselves to isotopically pure water molecules, it's still very, very unlikely that two macroscopic snow crystals would be *exactly* alike. When a crystal grows, the molecules do not stack together with perfect regularity, so a typical snow crystal contains a huge number of crystal dislocations, which again are scattered throughout the crystal in a random fashion. One can then argue, like with the isotopes, that the probability of two crystals growing with exactly the same pattern of dislocations is vanishingly small. Again one has the exception of few-molecule crystals, which can easily be free of dislocations.

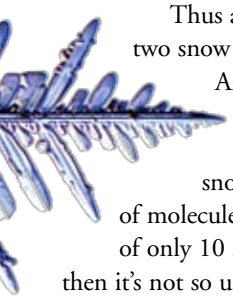
The number of possible ways of making a complex snowflake is staggeringly large.

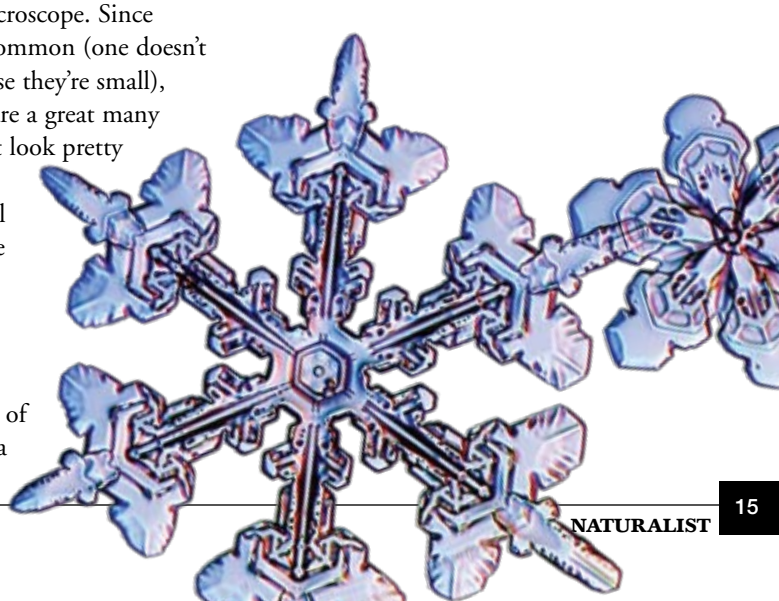
Small snow crystals can look alike. Now let's relax our definition of alikeness, and say that two snow crystals are alike if they just *look* alike in an optical microscope (the smallest features one can see in an optical microscope are about one micrometer in size, which is about 10,000 times larger than an atom). In this case things are very different. One can find simple hexagonal prisms falling from the sky, and one can certainly make such simple crystals in the lab.

Crystals with simple shapes often look similar to one another, and it's not hard to imagine that if you sifted through a reasonable number of Antarctic snow crystals you would find two that were essentially indistinguishable in a microscope. Since simple crystals are very common (one doesn't notice them much because they're small), it's fair to say that there are a great many natural snow crystals that look pretty much alike. But that's only for simple hexagonal prisms. What about more complex stellar crystals?

Larger, complex snowflakes are all different. The number of possible ways of making a complex snowflake is staggeringly large. To see just how much so, consider a simpler question – how many ways can you arrange 15 books on your bookshelf? Well, there are 15 choices for the first book, 14 for the second, 13 for the third, etc. Multiply it out and there are over a trillion ways to arrange just 15 books. With a hundred books, the number of possible arrangements goes up to just under 10^{158} (that's a 1 followed by 158 zeros). That number is about 10^{70} times larger than the total number of atoms in the entire universe!

Now when you look at a complex snow crystal, you can often pick out a hundred separate features if you look closely. Since all those features could have grown differently, or ended up in slightly different places, the math is similar to that with the books. Thus the number of ways to make a complex snow crystal is absolutely huge. And thus it's unlikely that any two complex snow crystals, out of all those made over the entire history of the planet, have ever looked completely alike. – *Kenneth G. Libbrecht*





Snowflake photos by Kenneth G. Libbrecht; scenic photo – istockphoto.com

Photo by Dawn McCloney/Dawn Alicia Photography

Children and Nature Summit

Spurred by the national movement to find ways to increase the amount of time children spend out of doors, experiencing nature, the state of Montana in September held a daylong Children and Nature Summit. The meeting brought together individuals and organizations for the purposes of raising awareness about the issue of "nature deficit disorder" and its implications for the mental and physical health and wellbeing of individuals, communities and society.

National headlines, health and wellness reports and Congressional investigations have suggested that today's children are no longer playfully exploring the natural world. The reasons for this disconnect are thought to range from the ubiquitous presence of electronic media in childrens' lives to overstructuring their "free" time to concerns about safety. But inactivity and a lack of contact with nature arguably do have a negative impact on children's cognitive and physical health and development.

The Montana Children and Nature Summit was a first step in developing cooperative strategies to reconnect youth to Montana's outdoors. MNHC was a summit partner and executive director Arnie Olsen was a member of the steering committee. Ideas discussed at the summit included creating a guide for parents and others to getting children outside and developing incentives, such as volunteer "nature clubs," for kids to spend time outside; helping schools tackle the issue; and working with communities to create and maintain safe, accessible natural areas.

For more information about what's happening in Montana, or to learn more about the topic of children and nature in general, go to the following websites:

For Montana-related info, www.mtrpa.info/summit.php
For national info, www.childrenandnature.org

With Gratitude...

We acknowledge the following sponsors and donors for their generous support of our annual dinner and auction fundraiser. This year you helped MNHC raise more than $35,000 for school and community education programs. Thank you!

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Thanks also to the auction committee and volunteers:
Marilyn Marler, Hank Fischer, April Christofferson, Susan Roy, Kathryn Socie, Mindy Goldberg, Steve Woodruff, Kathryn Holder, Leah Grunzke, Lauren Sullivan, Dave Todd, Brian Williams.

And special thanks to Mayor John Engen for graciously playing Master of Ceremonies – again.

Our Solid Foundations

To date MNHC has received grants from 9 foundations and one major business sponsor in 2008. Not only do these funding partners play an essential role in enabling us to provide quality natural-history education in schools and informally in the community, but by "putting their money where our mouth is" they keep us focused on programs that serve the community in demonstrable ways, from microscopes to bus repair.

Cinnabar Foundation
general operations

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Visiting Naturalist in the Schools

PPL Montana Community Fund
bus repair, scholarship funds for Visiting Naturalist in the Schools and Summer Science Discovery Camps

Plum Creek Foundation
field equipment, outdoor classroom tent, storage barn

William H. and Margaret M. Wallace Foundation
Visiting Naturalist in the Schools, field microscopes

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GPS units, other field equipment

Northwestern Energy
fencing to protect osprey nest near the Missoula Osprey baseball field

Dennis and Phyllis Washington Foundation
Mining/Geology Discovery Trunk, upgrades to other educational resource trunks for schools.

M. J. Murdock Charitable Trust
Summer Science Discovery Camps and Visiting Naturalist in the Schools

Southgate Mall
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MNHC Photo

Montana Master Naturalist Class

Whether your interest is professional development or personal pleasure, you can deepen your knowledge and appreciation of Montana natural history through MNHC's Montana Master Naturalist Class, offered through the University of Montana. This course, the first step toward certification as a Montana Master Naturalist, is open to students and the general community. Participants will gain the tools and skills of a naturalist through hands-on exploration of natural areas and discussion of the natural history of Montana plants and animals led by local experts and MNHC staff. Two Saturday field trips are included. The class is held Mondays, February 23 through May 11, from 4:00-7:00 p.m. The cost is $295, which includes a $50 non-refundable deposit required to register. The class also is available for three credits through UM for an extra fee. Call 327-0405 for more information or to register.

MNHC Photo

2008 Award Winners

For excellence in the field of natural history education, **Maureen Froelich**, 4th grade teacher at Alberton Elementary School, was awarded this year's Natural History Educator Award at the October dinner and auction.

A teacher for 28 years, 25 at Alberton Elementary, Froelich has brought natural history education into her classroom in the most authentic way, says MNHC Education Director Lisa Bickell – by encouraging her students to become naturalists. Her classes have participated in the Visiting Naturalist in the Schools program since 2006.

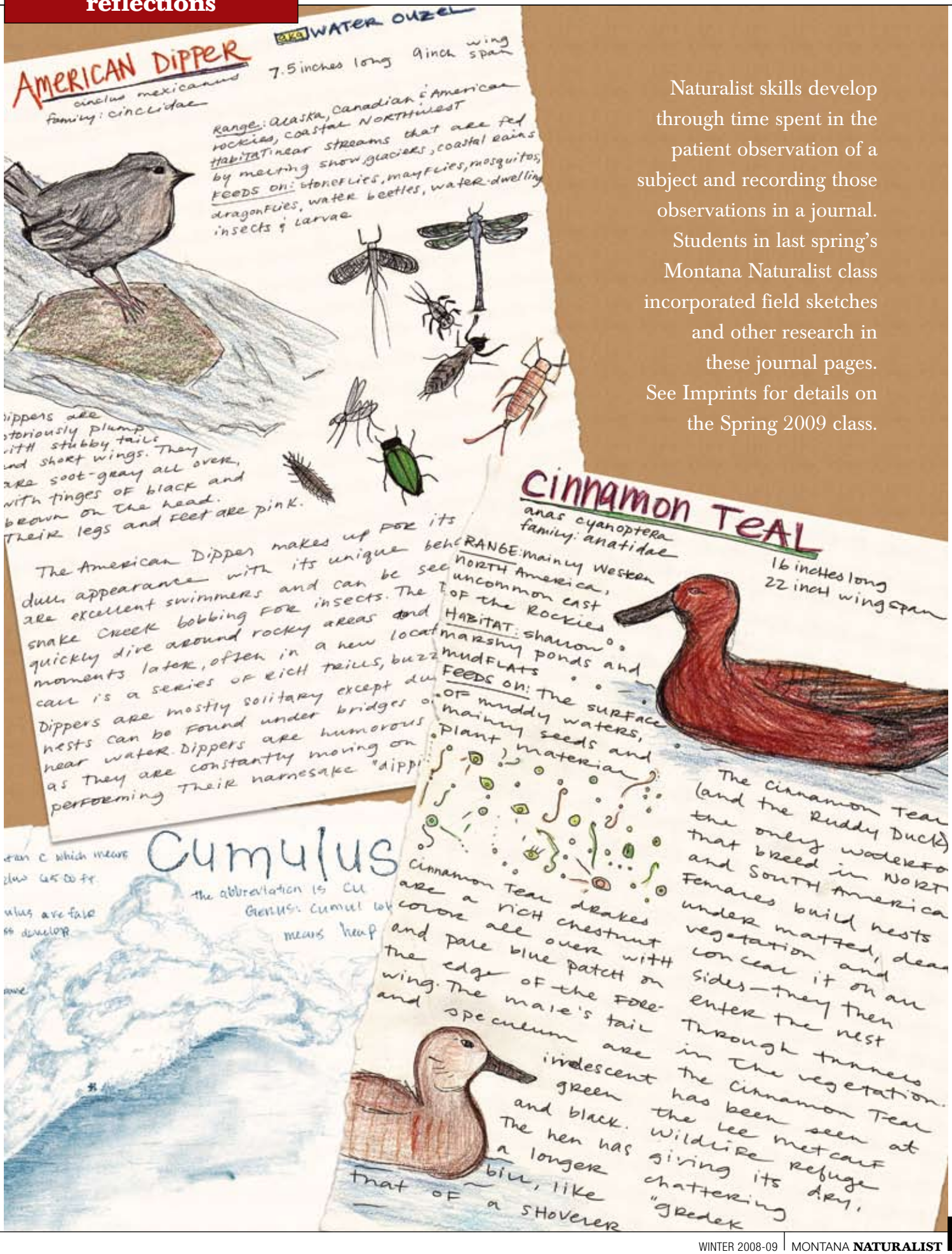
"Maureen encourages students to ask questions and share their observations," Bickell says. "Her students have been known to bring in mushrooms and other natural treasures to class and she takes the time to celebrate these discoveries and explore with the students."

"My favorite thing about bringing natural history into the classroom is how involved and immersed the students become when you start them thinking about the natural world," says Froelich. "My students take it from there; it's really that easy."

Photo courtesy Sue Reel

As one of the original founders of MNHC and for her achievements in natural history education, **Sue Reel** was chosen to receive the first ever Director's Award for her outstanding service, dedication and contributions to MNHC. Reel is a wildlife interpreter for Lolo National Forest. She developed and implemented the first Watchable Wildlife program in the national forest and has received numerous professional awards for her work in conservation and interpretation.

Reel served on the board of MNHC since its inception, in 1991, until 2007. She continues to support MNHC in many ways, including through cooperative projects such as a fire ecology exhibit at the center and on the Bitterroot Birding and Nature Trail. Her dedication and commitment to MNHC is an inspiration and deeply appreciated.



Naturalist skills develop through time spent in the patient observation of a subject and recording those observations in a journal. Students in last spring's Montana Naturalist class incorporated field sketches and other research in these journal pages. See Imprints for details on the Spring 2009 class.

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