Ripple Marks

The Story Behind the Story

BY CHERYL LYN DYBAS

Collision Course: Climate Change, Bears, and Humans in the Land of 10,000 Lakes

"*Bears are made of the same dust as we; they breathe the same winds, and drink of the same waters.*"

—naturalist John Muir

Dust, winds, and waters. Bears and humans. All swirl together on this late summer afternoon in 2008 in Bear Head Lake State Park, Minnesota. A dry spell has turned dirt roads into arid trackways. Hints of winter's cool breezes blow from the north. Stealing beneath jackets, they run chill fingers up spines.

Bear Head Lake State Park is a dozen miles from the Canadian border, as the black bear, *Ursus americanus*, roams. The park's ursine residents are almost too numerous to count. Minnesota is home to the most black bears of any US state but Alaska—more than 30,000.

The availability of water in the Land of Ten Thousand Lakes, as Minnesota is known, is crucial for black bears. "The bears use wetland and riparian habitats for cooling and as dependable places for seasonal foods like berries," says Lynn Rogers, director of the North American Bear Center and the Wildlife Research Institute in Ely, Minnesota. His work is the subject of a BBC documentary released this fall, *Bearwalker of the Northwoods*. "To date," writes Rogers in a paper on the role of habitat quality in the natural regulation of black bear populations, published in the *Proceedings of the 4th Western Black Bear Workshop*, "precipitation exceeds evaporation over most of the range of Minnesota's black bears, making water readily available." For bears—and for us.

Global warming is arriving, however, even in northern Minnesota. Lakes once frozen solid by December are now ice-free. Drought, increasing with a changing climate, is a significant cause of berry crop failures in northern forests, especially in places like Minnesota where soils are shallow and easily dry out.

"If the North Woods becomes parched, fruits will be smaller and less abundant," says Dave Garshelis, a bear biologist at the Minnesota Department of Natural Resources. "A reduction in those plants would be bad news for bears." Today's Minnesota sand plain coniferous-deciduous forests would turn into oak savanna, brush, and grasslands, a process Lee Frelich of the University of Minnesota calls "savannification."

For now, however, black bears—and their human berry-loving neighbors—still feast on the abundant juneberries, raspberries, and chokecherries that grow near northern lakes and ponds.

In Minnesota, late summer and early autumn are known to bear researchers as hyperphagia season, a time, says Garshelis, when bears go into an overeating frenzy to build up their fat reserves before hibernating for the winter. Bear treats are at their peak in the northern forest then. Farther south, hyperphagia season happens well into fall.

"Bears need to gain a tremendous amount of weight just to make it through the winter," says Rogers. "They're fast asleep by December. But before they hibernate, their biological clocks shift into 'eat-eat-eat mode.' They may spend 20 hours a day foraging, consuming 15,000 to 20,000 kilocalories every single day." The weight a bear gains is regulated by the amount of fat reserves it accumulates—once those reserves reach an adequate level, a biofeedback mechanism returns the bear's appetite to normal.

Hyperphagia season ushers in encounters of the closest kind between bears and humans. Rogers believes that bears, however, have squatter's rights over forest and lake, river and stream. "As we expand our territory, we're moving smack onto land they already 'owned.' It's no wonder we're on a collision course, but it's one that can be easily avoided. Humans can learn to coexist—and happily so—with bears." How global warming will change the equation, however, he says, is a wild card.

Future savannification aside, finding one particular bear is today's goal for Rogers. He pulls his white van, loaded with tracking equipment for locating his 15 radio-collared research bears, onto the edge of a path linking Skeleton Lake and Bear Head Lake. Between lies Star Lake, jewel of Bear Head Lake Park. The park is more water than land; on a map it looks like a sea dotted with islands.

Near Star Lake, Rogers' best-studied bear, an eight-year-old female named June, is out there somewhere. "Out there somewhere" in Rogers-speak translates as: "anywhere within miles." The trek is not for the faint of heart. Miles of mud-bottom wetlands surround Star Lake like a moat, the tips of their reedy grasses glowing golden in the fading sun. But Rogers moves fast, his telemetry instrument crackling.

His long stride soon meets Star Lake's challenge, however: a half-mile of throat-high raspberry brambles snag his shirt and ensnare the antenna. The bushes' trailers snake along the ground, the better to trip the unwary.

Scratched and torn, Rogers, known as "the man who walks with bears," emerges from the choke-hold. Only to watch his colleague face the next hurdle. "I'm sunk up to my hips in mud!" yelps Sue Mansfield, who conducts bear research with Rogers. At the brambles' edge lie murky water and tangled weeds as far as the eye can see. "We're getting closer to June," coaxes Rogers, his transmitter's clicks becoming louder. "She must be on the hillside next to Star Lake."

Slogging onward, Rogers and Mansfield navigate across the wetland. With each step comes a sucking sound as they break free of the bog's firm grasp.

Unfazed, the biologists continue, wet to the waist, up a rise lined with low cedars. There, one tree's branches crisscross another's. Keep Out, the cedars seem to say. "They're sheltering June," believes Mansfield. "It'd be nearly impossible for a casual hiker, or in winter, a cross-country skier, to find his or her way in here."

A rustling in the cedars, and indeed a fattening June saunters into view, her black coat sun-dappled in the woods. "June-bear," says Rogers softly. She walks straight to him, her nose touching his hand.

"We've obtained detailed health and behavioral information about bears by earning their trust," says Rogers. "They go about their business while giving us close-range observations." Results of Rogers' studies are leading to an understanding of the extent of bears' home ranges, and of when and how they forage for food just before hibernation. The knowledge has

LEFT: Black bear mother and cubs. RIGHT TOP. Lynn Rogers visits one of the bears. RIGHT MIDDLE. "Ted," the world's largest black bear, emerges from his den during a mid-winter thaw…a very rare look at a black bear in winter. RIGHT BOTTOM. Sue Mansfield and Lynn Rogers track bears using telemetry. BACKGROUND. Black bear near a Minnesota lake. *Photos courtesy of Ilya Raskin*

Climate Change, Bears, and Humans, continued…

shed light on a once-dark corner of black bear life.

With black bears common wherever there is a water source in US Western and Midwestern woodlands, and becoming more so in those in the East, and people moving farther into the forest, "that translates into a lot of chance autumnal meetings," says Rogers.

During hyperphagia time, bears often venture closer to towns than usual, especially when natural foods are scarce. "Residents need to dispose of their trash in bear-proof containers, and delay putting up bird feeders until at least December, when bears are in dens," Mansfield says. For problem bears necessitating calls to wildlife divisions, biologists can use nonlethal methods of deterring the bears, such as rubber bullets or pepper spray.

If people would watch bears quietly for a while, the researchers believe, they'd find that through the eyes of a bear, they could walk into the forest for a time, and into another world.

At the North American Bear Center in the winter of 2008, that walk is a short one. Except during hibernation, three black bears dwell in plain sight of the center's main windows: Ted, a 12-year-old male who weighs almost 1,000 pounds, the largest black bear on record; Honey, a year older than Ted, named for her cinnamon-colored coat; and Lucky, a two-year-old taken from his den in Wisconsin as a cub by someone hoping to make him a pet. The Wisconsin Department of Natural Resources found Lucky and transported him to the North American Bear Center.

"Like us," says Rogers, "every bear is different. Honey is standoffish, but Ted makes friendly clicking noises and grunts around people he likes."

On a February afternoon, Ted awakens from a nap. The boundary between species melts in the midwinter sun. The largest living bear takes a step forward. A visitor takes the next. Hazelnut *Homo sapiens* eyes meet hazelnut *Ursus americanus* eyes, seconds before human and ursine noses touch.

Bears and people are made of the same dust, breathe the same winds, drink of the same waters.

Lynn Rogers with Ted at the North American Bear Center in Ely, Minnesota.
Photo courtesy of Ilya Raskin

Russian Roulette: To Catch a Fish-Owl

The spotted owl of Russia, it's been called. Like the spotted owl, the endangered Blakiston's fish owl, *Ketupa blakistoni*, endemic to northeast Asia and the world's largest owl, relies on old-growth tree cavities for nesting and is threatened by logging operations.

But while the fish owl requires ancient forests, it also needs rivers with open water in winter, the better to snatch salmon and other fish. "In fish owl range in the Russian Far East," says Sergei Surmach of the Russian Academy of Sciences in Vladivostok, "ice-free water in winter is found only where the current is fast, or where there's an upwelling of warm springwater."

Streams are as important to Blakiston's fish owls as main river channels, Surmach discovered. "If there's enough prey, openings as small as a few square meters are enough to sustain a pair of fish owls throughout the winter."

Those ice-free openings may expand with global warming, making Blakiston's fish owls the winners in the Russian roulette of climate change.

For now, researchers like Surmach and Jonathan Slaght of the University of Minnesota brave deep winter snows, and villages in remote parts of Russia where the only running water is in snowbank-lined rivers, to monitor fish owls. Their surveys, supported by the Wildlife Conservation Society-Russia, Amur-Ussuri Center for Avian Diversity in Vladivostok, and other organizations, show that the fish owl population in the southern Russian Far East in an area just inland of the Sea of Japan is made up of about 130 pairs. The region encompasses Primorsky Krai and Khabarovsky Krai south of the Amur River.

The best information on fish owl populations comes from capturing and banding individual birds and placing GPS transmitters on them. "GPS gives us the most accurate picture of the lives of these

secretive owls," says Slaght. "The only time we see them is when we have them in hand, so GPS data are critical for finding out how they use their habitat, and where they're going, for how long, and during what seasons of the year."

The results, he says, will guide the development of a conservation plan for the species.

How best to trap a fish owl, especially on an ice-covered, fast-moving river? Slaght, Surmach, and Sergei Avdeyuk of the Amur-Ussuri Center for Avian Diversity devised an ingenious method.

"Fish owl capture is best attempted in winter," says Slaght. "However, owl foraging areas can consist of multiple ice openings in rivers, spread across several square kilometers. Identification of appropriate trap sites can be very difficult. There's no sure-fire method of predicting which of the possible foraging areas will be visited by owls, or when they will be visited."

Russian roulette at its finest.

Fish owls were historically trapped by the indigenous Udege people of the southern Russian Far East. They considered the owls a food source and captured them with leg-hold traps set on stumps that were suspected fish owl hunting perches.

From that information, the scientists improvised.

The researchers set out in search of fish owls at two sites on the eastern slope of the central Sikhote-Alin Mountains in Primorye (the southern Tunsha and Serebryanka River valleys, near the village Terney), and the Amgu River valley near the village Amgu. This past winter, Terney made international news as the "epicenter" of a record snowfall. Nearly two meters of snow fell in less than three days, isolating the village for days if not weeks.

To find owls there, the researchers followed tracks in the snow: claw-marks left behind as the owls "ran" along river-banks searching for open water.

To catch an owl, the scientists constructed square prey (fish) enclosures using hardware cloth, a metal material similar to chicken wire, Slaght and colleagues write in a paper in the September 2009 issue of *The Journal of Raptor Research*. They then collected "live lures" by becoming fish owls themselves, however briefly: they went fishing in almost-frozen river pools. When they couldn't catch fish, they snared Far Eastern frogs. "Fish owls often do the same thing," says Slaght. "We learned it from them."

Once a trap was fashioned of hardware cloth and loaded with lure fish, the researchers set VHF monitors on the traps to alert them to the presence of owls.

In the midst of an early March blizzard, Slaght and an assistant set up an infrared camera to "spy" on a trap. They recorded a male fish owl as he spent almost six hours there, slowly eating all 20 lure fish. "Even after he had cleaned out the trap," says Slaght, "he sat on the bank watching intently, as if wondering when the magic fish box would again produce snacks."

A week later, on the final day of fieldwork for the winter of 2009, Slaght and his assistant hiked into the forest to check on a fish owl's breeding site. "The wind was wild, and the snow was falling heavy and wet, adding stress to one of my already-cracked skis," says Slaght. "It snapped about halfway across the river valley. But we continued—only to find the nest tree unused."

After slogging their way back through waist-high snowdrifts, the scientists drove to the nearest town in white-out blizzard conditions.

"We'll try again, though," says Slaght, "and hope for better luck."

Same time, same place, next year? Only Russia's fish owls know the answer.

Photos from top to bottom. | Jon walking out of the Tunsha River valley in a blizzard. *Photo courtesy of A. Mukhachova* | Filya, the resident male of the Serebryanka territory. *Courtesy of J. Slaght* | Map of Primorye, Russia. Inset map shows Primorye. Dark shading is global Blakiston's fish owl distribution. *Courtesy of J. Slaght* | Olga, the resident female of the Leonokva territory, prior to release. *Courtesy of J. Slaght* | Young Masu (or Cherry) salmon are an important prey species for the owls. *Courtesy of J. Slaght*

Polar Bears' Habitat—and Polar Bears—Shrinking

North-northwest to Greenland, a bear faces a more immediate threat. *Ursus maritimus*, the "maritime bear" best known as the polar bear, is melting.

Along with the ice floes on which it depends to find its seal prey, the polar bear itself is shrinking, says Cino Pertoldi of Aarhus University in Denmark and the Polish Academy of Sciences in Bialowieza. Pertoldi and colleagues examined 282 polar bear skulls collected in East Greenland during two time periods: 1892 to 1939, and 1961 to 2002. Skulls from the later period are between 2 and 9% smaller than those from the earlier time, the scientists report in a 2009 paper in the *Journal of Zoology*.

The study's early period predates the manufacture of most organochlorines, including pesticides such as PCBs, introduced in 1939. Organochlorines were widely produced by the 1950s. A five-to-ten-year lag intervened before winds transported them north to Greenland. The years before 1939 also had higher sea levels with more ice along the Greenland coast. "In short, those years had better living conditions for polar bears," says Pertoldi.

He believes that the stress caused by reduced Arctic sea ice cover, and the increased effort it takes for polar bears to hunt for seals, has affected the bears' fitness—and led to smaller bears. "When a lot of energy has to be expended to find food, less energy can be devoted to growth," he says. "If you had two children, for example, and fed one of them well and one poorly, the starving child would be smaller because it wouldn't have enough energy for growth."

The size decrease in polar bear skulls, he says, "is a result of the double whammy of climate change and pollution weakening the bears' immune systems and reducing their reproductive success."

Lower reproductive success may have decreased the population and ultimately led to greater inbreeding.

"Polar bears have virtually no ecological overlap or potential competition that could otherwise affect their growth and body size," says Rune Dietz of Aarhus University, a member of the research team.

The Zoological Museum of Copenhagen provided 300 polar bear skulls for the study, according to Christopher Sonne of Aarhus University, also a collaborator. "The skulls gave us a window into the bears' development over an entire century," he says. "During that time, many pollutants in the Arctic have increased." Some of the compounds have been phased out, but others are still used in manufacturing and other processes. "Polar bears have very high levels of pollutants in their bodies," says Sonne. He believes they are among the most polluted animals on the planet.

"Everyone worries about the ice melting out from under polar bears," says Pertoldi. Now we also need to be concerned about the bears themselves gradually fading away.

ABOVE. The Zoological Museum of Copenhagen provided polar bear skulls for research. BELOW. A polar bear in the snow. *Photos courtesy of Rune Dietz*

Rain-on-Snow: New Arctic Killer Fingered

It was a storm even Rudolph the Red-nosed Reindeer couldn't find his way in.

Rain-on-snow, it's called, this freezing rain that pockmarks a solid snowpack—and leads, at least in the Far North, to the deaths of tens of thousands of ungulates like musk oxen, caribou, and reindeer.

In October, 2003, a severe rain-on-snow event killed more than 20,000 musk oxen on Banks Island, the westernmost of the Canadian Arctic islands, according to climatologist Jaakko Putkonen of the University of North Dakota in Grand Forks. "Rain-on-snow reduced this isolated herd by 25%, and significantly affected the native people dependent on hunting them for a winter food source."

With the few weather stations in the Arctic, the event's detection was largely based on reports from hunters in the area.

Such rain-on-snow, Putkonen and colleagues have found, can significantly alter a frozen ecosystem, with changes that remain for the rest of the winter. It creates layers of ice on the surface, as well as within and below the snowpack. "These water and ice layers," says Putkonen, "can support the growth of toxic fungi, warm the soil under the snowpack, and keep large grazing mammals from reaching their food beneath the snow."

The effects of rain-on-snow like that which fell on Banks Island in 2003 reverberate through Arctic and subarctic ecosystems. For example, says Putkonen, ptarmigans can't burrow into iced-over snow for cover.

A minor rain-on-snow event, he says, "may only wet the surface and create a thin icy layer on the snowpack surface." But in a major such rainfall, caribou, reindeer, and musk oxen can't paw through ice layers to reach nutrient-rich lichens and other bits of food. Pooling water from ice puddles also drowns lichens, making them inedible.

"The animals are then forced to increase their range to find sustenance, which imposes a cumulative energy penalty over the course of a winter," write Putkonen and colleagues Kevin Rennert, Gerard Roe and Cecilia Bitz of the University of Washington in a 2009 paper in the *Journal of Climate*. "This energy penalty can increase winter depletion of body fat and protein reserves, increase mortality, and decrease calf birth weights."

A subsequent population crash often happens several years after a rain-on-snow event: adults age without young to take their place. Icing such as rain-on-snow events is the best predictor of the variability of Svalbard reindeer population numbers, for example. The phenomenon has been implicated in the 70% decline in Peary caribou over the last three generations. The Peary caribou is a subspecies found in the high Arctic islands of Canada's Nunavut and Northwest territories.

Humans are also affected by rain-on-snow. If icy rain becomes more common in a warming climate, says Putkonen, "uncertain times lie ahead for the northern native populations whose commercial meat export, subsistence hunting, and cultural identity are tied to the fate of ungulates."

No one knows how many more rain-on-snow events may occur as global temperatures warm. If they increase, Rudolph may have a full-time job in the Arctic: guiding his fellow reindeer across a treacherous, ice-rimed landscape.

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