

# TERROR

## ON TINY FEET

Insects, earthworms, and grubs beware: Shrews are hungry—all the time.

BY KERRY R. FORESMAN  
PHOTOS BY THE AUTHOR,  
ALEXANDER BADYAEV, AND DONALD RUBBELKE

To gain a sense of what a pygmy shrew weighs, hold a penny in your hand. The coin tips the scales at 2.5 grams ( $\frac{1}{10}$ <sup>th</sup> of an ounce), while the pygmy shrew, one of the world's smallest mammals, weighs even less—not even 2 grams. In my laboratory, I have watched a 3-gram masked shrew attack a nightcrawler. The shrew is so small the worm can actually flip it over, like a man wrestling a 20-foot python. Tiny as they are, shrews are all the more incredible because they are true mammals, bearing live young and providing nourishment for their offspring with milk from mammary glands. They do everything humans do to survive—obtain food and water and care for their young—only on a much smaller scale, at a much faster pace, and with far more ferocity. »

**EASY PICKINGS** A dusky (montane) shrew prepares to eat a frozen dragonfly in a laboratory terrarium. In the wild, shrews also hunt and eat earthworms, spiders, and grubs captured on the forest floor.

ALEX BADYAEV



# IMAGINE YOURSELF EATING 50 POUNDS OF MEAT AT BREAKFAST, AT LUNCH, AND ONCE AGAIN AT DINNER.



If I took a survey asking which Montana mammal was the most ferocious, I suspect a majority would say the grizzly bear. They'd be wrong. Pound-for-pound (or in this case, gram-for-gram), shrews make grizzlies look like pet llamas. A shrew is almost always hunting. And each day it kills its entire weight in prey. That would be like a grizzly killing and eating a cow elk or two mule deer bucks every 24 hours.

Despite its remarkable predatory ability, the odds seem stacked against this ravenous, hyperactive carnivore. A shrew's small size makes it prey for owls, weasels, and snakes; it somehow has to survive winter without hibernating; it must eat every hour or risk dying of starvation; and the female has child-rearing responsibilities that nearly defy belief. "Like a street punk from a B movie, shrews grow up fast, live hard, and die young." I'm not sure who originally wrote this, but it is one of my favorite descriptions of shrews, because it's so true. For the past 30 years, I have been studying the ecology and reproductive biology of these species. I continue to be amazed at how interesting and unique they are, and yet how little any of us knows of these smallest of Montana mammals.

## VORACIOUS APPETITE

Shrews are tiny animals with pointed snouts, small eyes and ears; long, hairy tails; and short, velvetlike fur. They are primarily insectivores, hunting and eating insects, earthworms, and snails.

Of the 33 shrew species in the United States and Canada, 29 belong to a group known as "long-tailed" shrews (genus *Sorex*).

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Ten of these shrews live in Montana, each with its own particular habitat requirements. The northern water shrew lives in fast-rushing mountain streams primarily in western Montana, while the light-colored Merriam's shrew prefers the arid sagebrush communities of the state's central and eastern regions. The dwarf shrew is found in high-altitude environments such as the Beartooth Plateau. Preble's shrews range from semiarid grass-sagebrush habitats to openings in subalpine coniferous forests.

Shrews have a voracious appetite. An adult kills and consumes, on average, its entire body weight in insects or other small animals such as salamanders every day. (Imagine yourself, if you are an average-sized person, eating 50 pounds of meat at breakfast, at lunch, and once again at dinner—and remember, you have to catch this food yourself.)

Though shrews lack the canines associated with carnivores such as wolves or mountain lions, they have unique teeth that function nearly as well. Two huge incisors, which protrude forward like buck teeth, allow the shrew to catch and hold prey. Behind the incisors are teeth called unicuspid teeth that lack the elaborate cusp patterns seen in the teeth of other mammals. Farther back in the jaw is a full complement of crushing premolars and molars. These teeth have an unusual tritubercular (three-cusped) structure unchanged for more than 60 million years. It's one of several anatomical characteristics that make today's

**GLOBAL RANGE** Ten shrew species live in forests and grasslands across Montana. The tiny mammals are also found worldwide, from the Arctic to the Middle East. Shown here: a bronze statue of an extinct shrew species found in an Egyptian tomb.



shrew nearly identical to those that walked beneath the feet of dinosaurs.

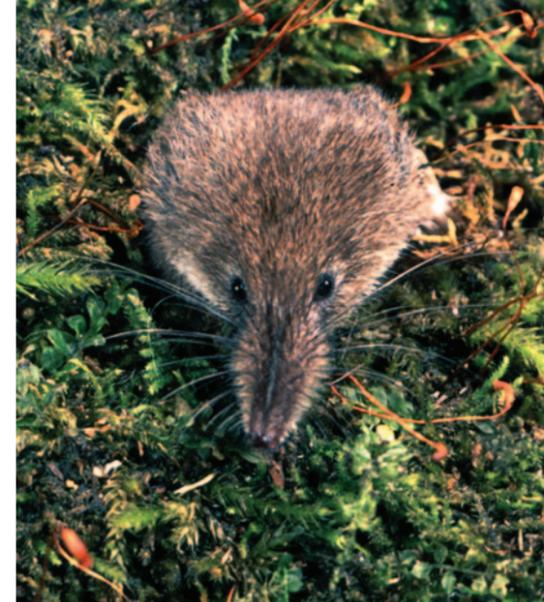
## CRAZY CARDIO

You'd think such a tiny animal wouldn't need much food. But with mammals, the smaller the specimen, the more calories it needs in proportion to its body weight to survive. Shrews have a phenomenally high metabolic rate because the surface area of their body is extremely large relative to their body mass, or volume. This causes them to lose a greater proportion of heat than is lost by larger mammals such as humans or even mice. As a result, shrews must ingest an enormous number of calories to offset their enormous energy loss.

To maintain its high metabolism, a shrew needs faster respiratory and heart rates to acquire oxygen and circulate it through the body. A resting shrew breathes approximately 800 times a minute and has a heart rate of 1,000 beats per minute. By comparison, humans breathe about 18 times a minute and have a resting heart rate of 60 beats per minute. I have listened to a shrew's heartbeat through a stethoscope, and it is a blur of patters, each beat nearly inseparable from the previous one.

Since the shrew's motto could be "Eat or die," it cannot afford to miss a meal or even a snack. Shrews must remain constantly active and vigilant for unsuspecting quarry, so they are always running from place to place. Just watching the frenetic creatures can be exhausting. Shrews don't even get a break in winter, because they are too small, and thus too hyperactive, to accumulate enough fat to hibernate, as a chipmunk or bear does.

I've long been interested in how shrews survive a typical Montana winter. I assumed they entered a state of torpor to reduce their caloric requirements. After all, how else could a warm-blooded animal that cannot hibernate, eats every hour, and requires an insect diet possibly live through the winter? Yet after extensive behavioral and physiolog-



**POINTY-SNOUDED PREDATORS** Shrews are one of Montana's most common mammals, found throughout the state from moist meadows to alpine bogs to dry coniferous forests. Among Montana's ten species are the masked or common (above), pygmy (above right), and northern water (right). All species have tiny eyes and ears, a long hairy tail, and a pointy snout covered with long whiskers (below). Bottom: Red pigmentation is caused by iron deposits that harden teeth used to break through insect exoskeletons. Below right: The pygmy shrew, shown here actual size, is one of the world's smallest mammals. Its body is 2 inches long and it weighs only  $\frac{7}{100}$ th of an ounce—less than a penny.



CLOCKWISE FROM TOP LEFT: DONALD RUBBELKE; ALEX BADYAEV; DONALD RUBBELKE; KERRY FORESMAN; DONALD RUBBELKE

# THE FEMALE SHREW'S FEAT OF REARING ITS YOUNG CONTINUES TO AMAZE ME.



ical studies on shrews during the cold months, my graduate students and I have been unable to find evidence that shrews ever slow down. We now suspect that one way they survive Montana's -30 degree temperatures is by staying in the small, relatively warm space between the ground and the snowpack. They search for food in this insulated environment, which rarely gets colder than 35 degrees regardless of the air temperature above. Shrews also stay warm—and conserve precious calories—by growing a winter coat of dense hair. How they stay fed that time of year is still a mystery. Seeds and other plant material don't have enough protein, so shrews must continue to live on insects during the cold months. We suspect that overwintering grubs provide them with a rich source of fat and protein.

## AMAZING REPRODUCTION

If a shrew survives the winter, its breeding activity begins in March and peaks in April or May. Most shrew species typically produce four to seven young after a 20-day gestation period. Young shrews grow extremely fast. The newborn masked (common) and vagrant shrews we rear in our laboratory grow to nearly adult size in roughly three weeks. The poor mother must produce milk for babies each growing to over 3 grams before they are weaned. That's 12 to 21 grams of babies fed by a female who herself weighs only 4 grams. As a longtime mammalogist, I know that animals can do some remarkable things, but the female shrew's feat of rearing its young continues to amaze me. What's more, females may even produce an additional litter during their second summer. Both males and females age rapidly and die in the fall. At just 16 to 18 months long, shrews have one of the shortest life spans of any mammal.

Though shrews are found throughout Montana, they are so small and well camouflaged by their gray or brown fur that people rarely see them. Those interested in watching shrew behavior should look under logs on moist forest floors dense with decaying wood and leaves. This habitat provides shrews with a rich source of insect



DONALD RUBBEN

**READY TO EAT, AGAIN** Due to a high metabolism that burns their entire body weight in calories each day, shrews must constantly feed on spiders and other insects. If they go for more than one hour without food, they risk starving.



ALEX BOWNEY

food and ideal protective cover.

All shrew species have poor eyesight, but they compensate with keen senses of smell and hearing. They have long nasal passages, a flexible nose that constantly moves in different directions, and highly developed whiskers sensitive to vibrations in the soil. A shrew uses its snout to probe leaf litter or loose soil for worms or insects.

Some species, such as the vagrant shrew, may also find prey using a primitive form of echolocation. Like bats, these shrews emit high-frequency squeaks. We suspect that they can judge distance by hearing their ultrasounds echoing back from objects ahead of them.

I find all shrews fascinating but the northern water shrew particularly so. Common throughout western Montana, it is the largest shrew in North America. The species prefers watery habitat, especially cascading mountain streams. Northern water shrews forage underwater on aquatic insects and often build their nests on moss-covered rocks in midstream. Scientists suspect that this shrew has evolved to be larger than others to survive in cold water. (The larger a mammal's size, the less surface area it has relative to body mass, meaning less heat loss.) Unlike other shrews, the northern water shrew has long, coarse hairs growing between its toes. The hairs intertwine to create a weblike surface that powers the shrew's swimming strokes.

It's no surprise that northern water shrews have adapted to survive in their unique environments. That's true of all shrews. These tenacious little warriors evolved millions of years ago and have survived everything nature could throw at them, from ice ages to floods to supervolcanic eruptions. Yet here they remain, dashing back and forth across the forest floor at breakneck speed, hunting, always hunting. 🐭