

The Superstarvers

During scarcity, drought or winter, hunger becomes part of an animal's life. But there are many ways to survive famine, and certain species have learned to soldier on without food

Eastern Pygmy Possum

Gets fat, then dormant

Australia's Eastern pygmy possum [below] survives an unpredictable climate and irregular food supply by having the longest known period of body-fat-fueled hibernation among mammals—up to 310 days on average. Biologists think a related species, the little pygmy possum [right], hibernates for up to six months. Both species eat insects, pollen and nectar. When food is readily available they eat until they're fat, accumulating reserves to get them through lean times.



FAST LENGTH:
310 DAYS



The little pygmy possum may fast for up to six months in its dormant state.



For most animals, life is a balance between periods in which food exists in surplus and periods of scarcity. The better a species is at dealing with the hungry times, the better its chances of survival. Some animals are hunger artists, so superbly adapted that they can last months or even years without food. Others are at risk of death after just a few days without eating.

Efficient energy conservation is the key to surviving long periods of hunger. In order to preserve vital energy, some animals reduce their body temperature. Many of them also cut back on the blood supply to their organs and put their digestive tract and immune system on standby.

The tiny Arctic ground squirrel takes energy savings especially seriously. It allows its body temperature to fall to about 27°F during its 8- to 10-month-long hibernation. The black bear, on the other hand, enters a so-called dormant state, in which its body temperature remains at an almost normal level, and shivers to keep warm. And the Australian striped burrowing frog can live in its arid environment without food or water by remaining dormant for periods of four or five years. It survives the fasting period by bur-

rowing underground and changing its metabolism so that it uses its energy reserves more efficiently.

Consuming the Body's Stores

Most animals have a predictable cycle of starving and eating and plan accordingly. Storm petrel chicks accumulate large stores of fat, for example. It is thought that these reserves provide energy during the intervals between feeding, which can last for several days.

A TYPICAL HUMAN ADULT can survive without food for as long as 70 days, after which the body will have exhausted its energy stores.

HOW LONG WE CAN SURVIVE WITHOUT:

OXYGEN:	2–4 minutes
SLEEP:	Unknown
WATER:	1–10 days
FOOD:	70 days

Many migratory birds subject themselves to extreme physical exertion when they make nonstop journeys over deserts or oceans, where there are limited opportunities to eat or drink. On the way, these birds almost entirely consume the stored resources in their bodies. When a garden warbler migrates from Tanzania to Ethiopia over the Sahara, for instance, its liver, spleen, kidneys and digestive system shrink to just half their normal

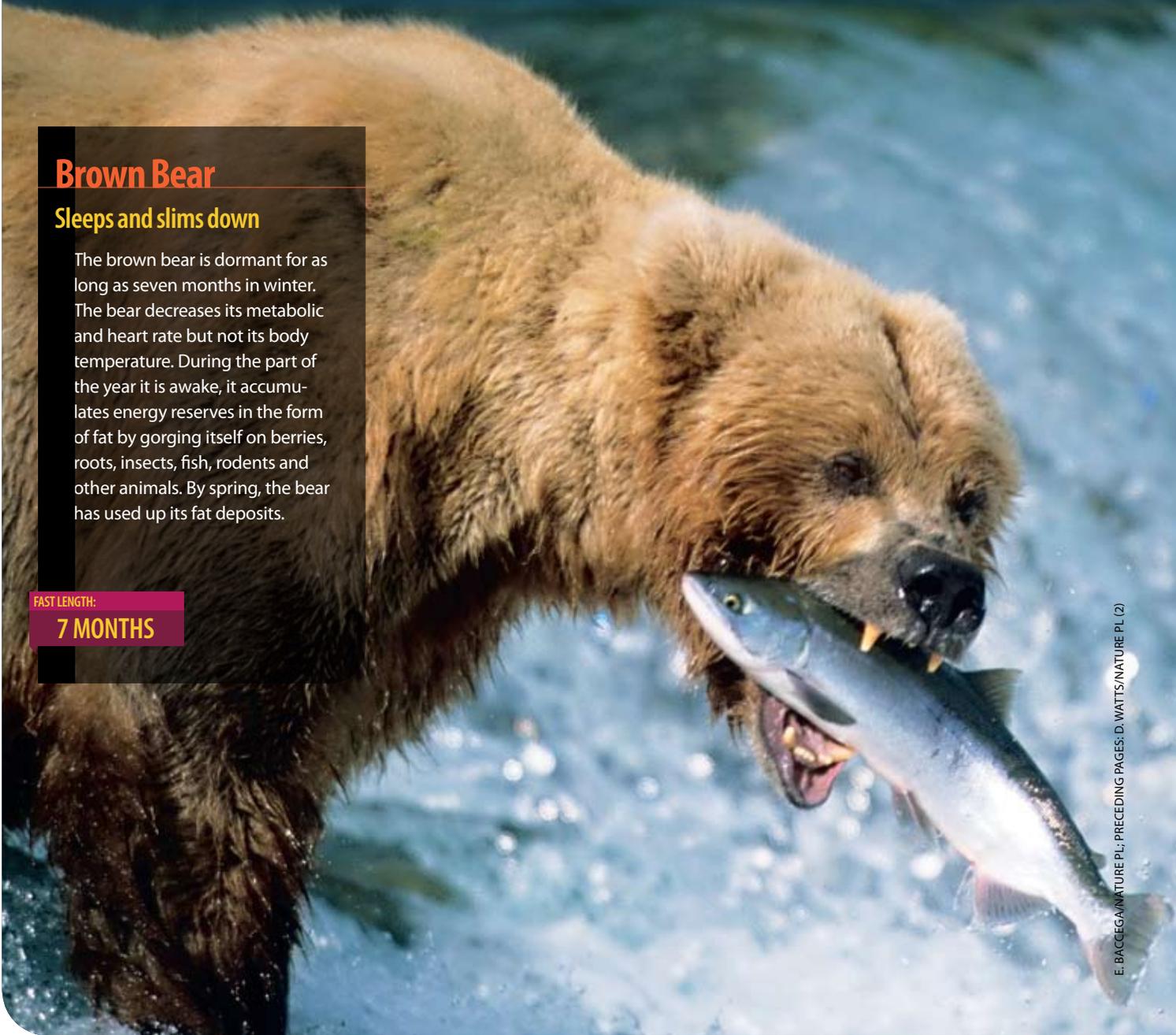
Brown Bear

Sleeps and slims down

The brown bear is dormant for as long as seven months in winter. The bear decreases its metabolic and heart rate but not its body temperature. During the part of the year it is awake, it accumulates energy reserves in the form of fat by gorging itself on berries, roots, insects, fish, rodents and other animals. By spring, the bear has used up its fat deposits.

FAST LENGTH:

7 MONTHS



E. BACCEGA/NATURE PL; PRECEDING PAGES: D. WATTS/NATURE PL (2)

FAST LENGTH:

7 MONTHS



Fat-Tailed Dwarf Lemur

Acts reptilian

This native of Madagascar becomes dormant every winter for up to seven months. It curls up in holes in trees, surviving on fat deposits in its body and tail. The lemur saves energy by letting its body assume the ambient temperature, like a reptile. In a poorly insulated tree hole, its body temperature fluctuates with the weather, but in a well-insulated hole, the temperature stays relatively constant.



FAST LENGTH:

3 WEEKS

Atlas Moth

Never eats at all

Although caterpillars eat a great deal, once they become adult moths they may never feed again. The mouthparts of many adult moths, including the Atlas, do not develop completely. These adults have to rely entirely on fat deposits accumulated in the larval stage. But these energy reserves don't have to last long: Atlas moths die within two or three weeks.

FAST LENGTH:

5 YEARS



Australian Burrowing Frog

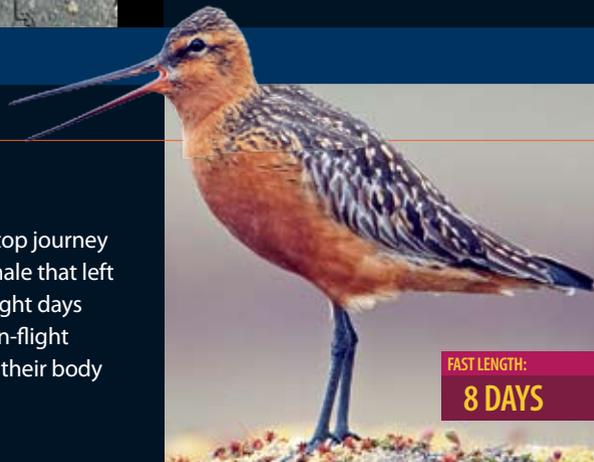
Goes underground

The Australian burrowing frog buries itself to survive long droughts and can live for about five years on its fat reserves. It lies cocooned in a layer of shed skin. When the rains return, the frogs quickly surface to reproduce and to feed. They then begin a feeding frenzy, consuming animals up to half their body size.

Bar-Tailed Godwit

Flies 7,000 miles on one tank

The Alaskan variety of these waterfowl undertakes an amazing nonstop journey every year and eats nothing along the way. One study followed a female that left her nesting grounds in western Alaska and landed in New Zealand eight days later, after a migratory flight covering 7,257 miles—without a single in-flight snack. Before godwits take off, their digestive organs shrink, and half their body weight consists of fat for energy storage.



FAST LENGTH:

8 DAYS

FAST LENGTH:
MANY WEEKS

Land Snail

Locks itself inside

During periods of prolonged drought or cold weather, Europe's land snails can shut themselves in for days or weeks. They withdraw into their shells and secrete a mucus membrane that closes the opening. This slows the loss of water by evaporation, and the snails also conserve energy by reducing their metabolic rates. When water is available again or the temperature increases, the snails wake up and come out of their shells.

Python

Lets its gut shrivel

Pythons can go more than a year without a meal, but when they do eat, they can consume animals of more than one and a half times their size. Unlike humans and other animals, a python's digestive system doesn't operate between feedings. It restarts once a python eats, and within 24 hours of eating large prey, the snake's intestines can double in size.



FAST LENGTH:
1.5 YEARS

FAST LENGTH:
2 YEARS



Lungfish

Slows down to survive

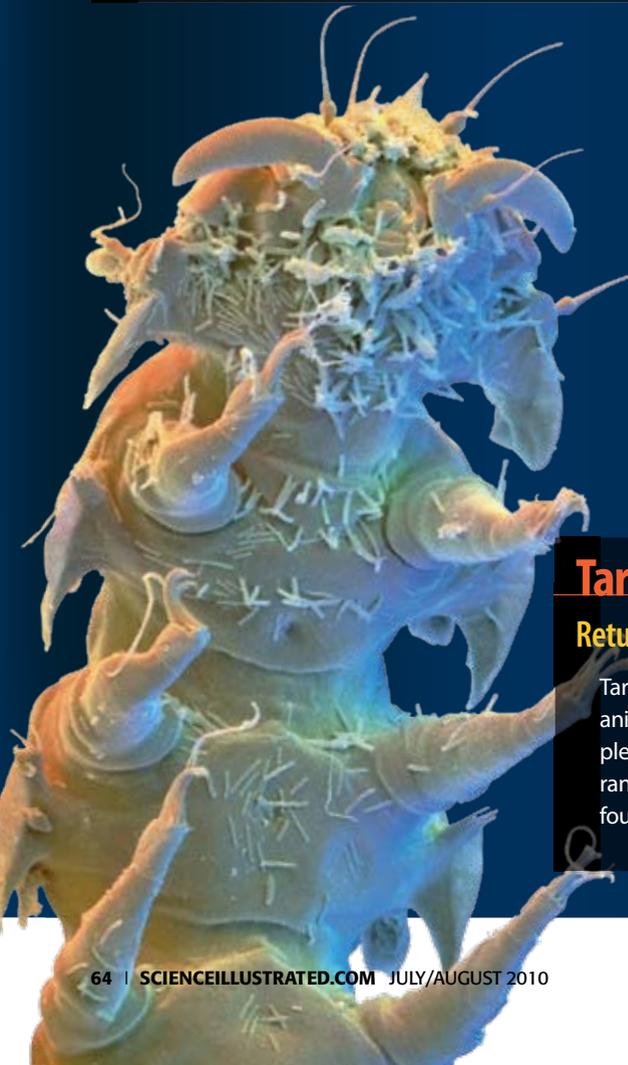
The African lungfish, so named because it has both gills and air-breathing lungs, burrows into the floor of a river or lake and secretes a mucus coating that protects it when water levels fall. The fish slows down its metabolism to save energy.

Tardigrade

Returns from the dead

Tardigrades can survive without eating for almost a decade. These microscopic animals go into a dormant state called cryptobiosis. With their metabolism completely arrested, they can withstand extreme conditions, including temperatures ranging from near absolute zero (-459.67°F) to around 200°. They have also been found to survive pressure of up to 6,000 atmospheres.

FAST LENGTH:
8 YEARS



CLOCKWISE FROM TOP LEFT: R. MAIER/ANIMALS ANIMALS; W. BOLLMANN/PHOTOLIBRARY; PHILLIP COLLA/SEAPICCS.COM; SPL/FOCI

STORY CONTINUES ►►

weight—and even the birds' heart and flight muscles lose part of their mass.

Learning from Superstarvers

Lack of food is dangerous, but lack of water is the real killer. Although energy from food is the body's fuel, think of water as its motor oil—a necessity for the body to function. Water enables countless chemical reactions and transports nutrients around the body, while helping dispose of harmful waste products. Humans begin to suffer detrimental effects after losing just 2 percent of their body weight from fluid loss, and losing more brings on even more serious symptoms. But for

microscopic terrestrial animals called tardigrades, losing almost all their water is no big deal. Found virtually everywhere on Earth, these unusual creatures can survive for around a decade in the most extreme dormancy in the animal kingdom—cryptobiosis, in which metabolic activity appears to come to a standstill. This allows them to handle extreme atmospheric pressures and temperatures ranging from close to absolute zero to around 200°. They resume their metabolic activities upon rehydration.

Biologists and physicians are eager to understand how such superstarvers survive. Humans cannot withstand a

shutdown of metabolic activity, and after long-term starvation, people often suffer from gastrointestinal problems when they eat again. Not so with burrowing frogs, which are able to successfully switch from starvation to consumption as soon as food or water becomes available. By studying how superstarvers regulate their metabolism to get through long periods of dormancy under extreme conditions, we might someday create therapies that could allow us to turn our metabolism up and down like thermostats, control weight gain and loss, and survive extremes of temperature. ■

Emperor Penguin

Starves for love

FAST LENGTH:

4 MONTHS

Emperor penguins breed during the Antarctic winter, and their chicks are welcomed into the world by temperatures that can reach as low as -76° , accompanied by fierce winds. After laying her egg, the female abandons incubation to her mate and goes off to the ocean to feed and refresh her fat deposits. The dutiful male fasts while incubating the egg under a fold in his skin for about four months. When the female returns, she relieves him of his duties.