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The creatures that can survive without water for years

The average person would struggle to survive for more than a few days without water, but some animals can go years without a drink



By Jane Palmer

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The heat is on across much of the northern hemisphere right now. 2016 is on track to be the planet's hottest year on record, **according to Nasa**. And with hot temperatures come droughts: the eastern Mediterranean has been experiencing **the worst drought in 900 years**.

Water scarcity takes a toll on humans and other animals. We typically lose **four to nine cups** of water per day, through breathing, sweating, peeing and pooping. If we do not drink enough to quench our thirst, the costs can be high. The symptoms of dehydration range from tiredness, headaches and muscle weakness to rapid heartbeat and ultimately loss of consciousness.

Many animals also struggle. But some critters, especially those living in seasonally dry environments, can be pretty ingenious when it comes to coping with drought.



A desert tortoise (*Gopherus agassizii*) (Credit: Daniel Heuclin/naturepl.com)

Saving for a dusty day

No desert house would be complete without a water storage tank, but for certain species that tank is internal.

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Tiwi Aboriginals dig out the frogs and squeeze them, squirting copious amounts of bladder water into their mouths

Tortoises, including desert tortoises and the giant tortoises of the Galápagos Islands, **store water in their bladders**. When it rains, or when these tortoises get access to leafy greens, they fill up their bladders with water. In drier times, the tortoises can then extract water through the permeable bladder walls.

You have to handle these distended tortoises with care, says **Glenn Walsberg** of Arizona State University in Phoenix. "If you pick up a tortoise and bother it enough, eventually you'll have a puddle

on the ground," he says. "You've effectively just poured their canteen out."

The **Australian water-holding frog** stores water in its gills, its tissues and the ultimate water storage device: **its bladder**. This bloated amphibian can store enough water to double its weight. Once totally full, it can live for up to five years without drinking.

Other desert inhabitants use external water storage tanks – in the form of the water-holding frogs. Snakes, birds, larger frogs, crocodiles and wild dogs all enjoy these watery treats. During the dry season, Tiwi Aboriginals dig out the frogs and squeeze them, squirting copious amounts of bladder water into their mouths.



A waxy monkey tree frog (*Phyllomedusa sauvagii*) (Credit: Michael D. Kern/naturepl.com)

Donning a coat of slime

Other drought-afflicted creatures have found ways to wrap their bodies up, preventing water from escaping.

In the deserts of North America, the aptly-named desert spadefoot toads use their claw-like feet to dig deep underground. There they hide for three-quarters of the year. Safe in their burrows, the toads shrink-wrap themselves in a mucus membrane to conserve water. "10 months later they emerge when they sense the drumming of a very heavy rain on the surface," says Walsberg.



When the water dries up, these water-dwelling creatures transform into land-dwellers that breathe air

Some tree frogs also **decrease water loss by secreting an impermeable waxy material** onto their skin. In South and Central America, **waxy monkey tree frogs** find a safe place then press their throats and abdominal walls down, while their legs wipe lipid secretions over their entire body.

As part of an experiment, Walsberg once kept a tree frog in a shoebox for several months. "When I opened the box, there was this thing that just looked like a mummified frog," he says. "Then I added water, the frog rehydrated, shed its skin and was just fine."

African lungfish take this approach even further. They are eel-like fish that generally live in the shallow waters of swamps and marshes.

When the water dries up, these water-dwelling creatures transform into land-dwellers that breathe air and hear through the atmosphere, rather than through water. Each lungfish has a bladder that has developed into a "lung", and a highly-developed ear similar to the ears of terrestrial animals.

During the dry season, lungfish burrow deep into dried mud using their pelvic fins, then excrete a coating of slime to minimise water loss. Encased in this gooey garb, African lungfish can "sleep" in a state of **suspended animation** for three to five years, without needing to eat or drink. The fish slow down their body clocks and only wake up when fresh water becomes available.



A hispid pocket mouse (*Perognathus hispidus*) (Credit: Rob Tilley/naturepl.com)

Forget drinking, just eat

For desert animals, food is often one of the best sources of water, and it can be stored when water cannot.

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You can keep a pocket mouse and a gallon of seed and nothing else in a jar, and come back in a year... and the mouse will be perfectly happy

North American **kangaroo rats** and **pocket mice** all collect seeds when conditions are moist and plants are reproducing. Then they live off these seeds for the rest of the year.

"The kangaroo rats and pocket mice are basically sedentary grocery shop keepers," says **Mary Price** of the University of California Riverside. "They'll stock the shelves and then defend that, and then live off the food that they've gathered and stored until the next amount of food is available."

These rodents spend the hot dry days holed up in their dens chomping on their bounty, coming out only at night. They eat these high-carbohydrate seeds to yield energy and "metabolic water",

bypassing the need to drink at all.



We all get thirsty (Credit: Anup Shah/naturepl.com)

"You can keep a pocket mouse and a gallon of seed and nothing else in a jar, and come back in a year, and it will be 50% faecal pellets and 50% seed, and the mouse will be perfectly happy," Walsburg says.

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I added water, the frog rehydrated, shed its skin and was just fine

Whereas these rodents rely on carbohydrate metabolism to supply water, larger mammals like camels and **oryx** tend to **rely more on fat metabolism**.

For every gram of fat an animal breaks down, it gets back 1.12 milliliters of water. So rather than store water in their humps, camels store fat: up to 80lb (36kg) of it. For an Arabian oryx, storing its fat in a mild hunchback, this metabolised water can provide up to a quarter of its daily needs.

If fat is such a good source of water, you might wonder why the desert is not a mass of obese animals rolling around in their own lard. However, animals with evenly-dispersed fat would struggle to keep cool, because fat is also a good insulator that traps body heat.

This means the best trade-off is to tuck fat deposits away in one or two discrete locations. For example, the **Gila monster** stores its food and water supply in its large and bulbous tail, which is one-fifth the size of its entire body.



A banner-tailed kangaroo rat (*Dipodomys spectabilis*) (Credit: Visuals Unlimited/naturepl.com)

Stopping the leak

While insects and cacti might provide a meagre supply of water, most desert animals survive by being what Price calls "water misers". These thrifty creatures have developed ingenious ways to stop the slow leak of moisture caused by sweating, panting, breathing, urinating and excreting.

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When they do make urine, it is kind of pasty and they make very little of it

Kangaroo rats have fur-lined cheek pouches, which completely lack salivary glands. These dry "grocery bags" lie in folds separate from the rest of the mouth, so the rodents do not waste a drop of saliva while they transport their seeds.

Kangaroo rats also have a tremendous ability to salvage the water from their urine before they pass it. To perform this feat, they have evolved **specialised kidneys with extra microscopic tubules for extracting water from urine.**

"This means they can extract more water and pump it back into the body, so it doesn't go into the urine," Price says. "When they do make urine, it is kind of pasty and they make very little of it."

These animals are also experts at drying out their faeces. Kangaroo rat poop is less than half water, much drier than normal.



A camel caravan in Morocco (Credit: Room the Agency/Alamy)

While sweating and panting can help over-heated animals stay cool, both activities also lead to costly water losses. To get around this, camels do not pant and have fewer sweat glands. They allow their body temperature **to vary by as much as 6C** in a single day.

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The thorny devil lives in the Australian Outback and possesses the ability to drink with its skin

"As humans, we spend a lot of energy keeping our body temperature close to 38C," Walsberg says. "One of the keys for camels is relaxing the limits of their body temperature regulation. It's a great method to reduce your reliance on water."

Taking it one step further, camels, ostriches and kangaroo rats all have **specialised respiratory systems** that help them breathe out less air.

The air in the lungs of a kangaroo rat is warm and saturated with water, but the tip of its nose is cold. In between is a long and convoluted air passage. As the air makes its way from the lungs to the atmosphere, the water vapour cools and condenses on the mucus membrane of the rat's nose. Once condensed, the water gets pulled back in rather than breathed out.

What's more, when they are in their burrows and they do breathe out water vapour, the vapour becomes trapped in the burrow – and then they breathe it back in. "So they are also recycling," says Price.



A thorny devil (*Moloch horridus*) (Credit: Patricio Robles Gil/naturepl.com)

Catch it if you can

While desert animals have adapted to conserve water, some have also found cool ways to catch every drop of water they can.

For example, the **thorny devil** lives in the Australian Outback and possesses the **ability to drink with its skin**. Its scientific name *Moloch horridus* was inspired by the Caananite god Moloch in John Milton's poem *Paradise Lost*. It is covered with spikes, and between these spikes water-collecting grooves run all over its body.



Kangaroo rat poop is less than half water, much drier than normal

The moisture-attracting grooves can absorb water like blotter paper, and collect night-time dew that settles on plants or on the animal's back. All the grooves run directly to the lizard's mouth, which sucks water droplets from all over its body.

Sand grouse can also soak up small quantities of water and store it in their feathers. That is essential, because they often nest up to 30 miles (50km) from water.

When a male sand grouse spies a pond or puddle, he sits in it, allowing his spiral-shaped abdominal feathers to soak up the water like a sponge. "They then fly back to the nest, and the young will wring the water out of its feathers," Price says.

In deserts close to the sea, like Africa's Namib Desert, the morning fog can provide relief. Fogstand beetles, such as the **desert toktokkie**, **wait each day like sentries** and allow the fog to condense on their bodies. The water droplets then supply their daily needs.



A Gila monster (*Heloderma suspectum*) (Credit: Michael D. Kern/naturepl.com)

But what if it gets even drier?

Just because desert creatures have adapted to dry conditions, it does not mean that they will survive, or even thrive, when climate change makes some areas of the world even drier, Price says.

"It really depends on how things dry out," Price says.

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When I do fieldwork in that time, the desert gets distinctly quieter

When the rain comes, it stimulates the production of plants. If there is enough rain, then desert mice and rats will still have a supply of food.

"But if the intervals of food production are too far and few between, then they won't be able to do very well," Price says. "They'll die out just like everything else will."

Walsberg has already witnessed changes in the populations of certain species, such as frogs, during his career. He believes that it is difficult to predict how drought will affect animals already adapted to water scarcity.

Each year he works in the field in the Sonoran Desert, the hottest desert in North America. It is home to at least 60 species of mammals, 350 birds, 20 amphibians and about 100 reptiles. In July he will sometimes encounter a real hot streak where the temperatures reach the high forties, even hitting 49C for hours at a time.

"When I do fieldwork in that time, the desert gets distinctly quieter," Walsberg says, "And I wonder, did all the animals just suppress all of their behaviour for the rest of the summer, or are they just dead?"


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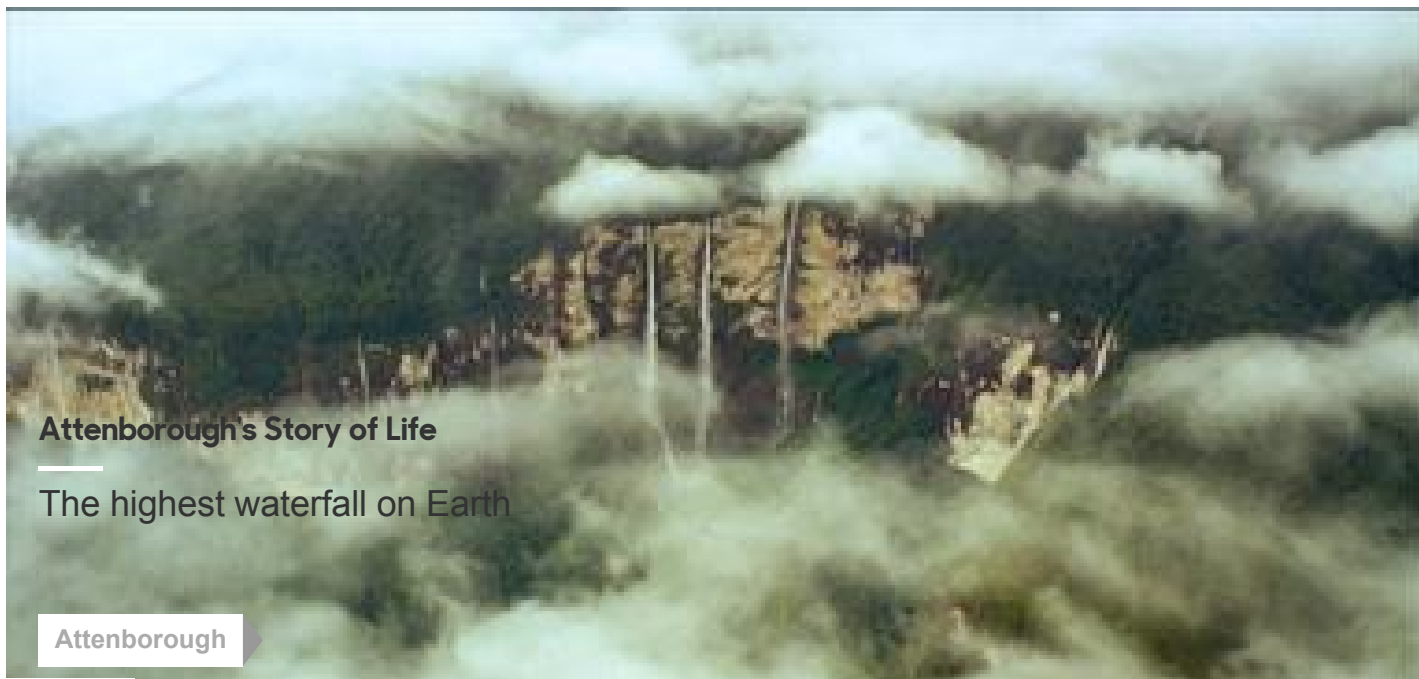
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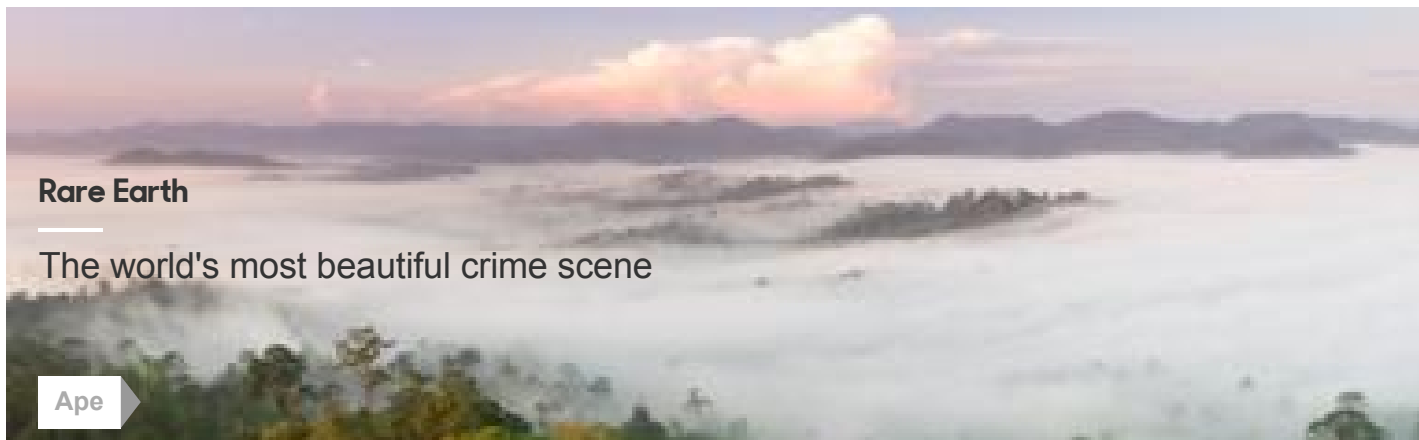


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