n the early 1990s, researchers trying to save endangered monk seals in the Northwestern Hawaiian Islands watched puzzled as a growing number of the animals suffered and died. First, a tiny islet the seals had depended on to haul out, give birth, and nurse pups washed away, forcing the group to move to a less protected spot where sharks attacked. The researchers found pups with bite wounds and back flippers torn off, dead pups, and pieces of pups—when the sharks left anything at all.

Then, surviving pups who had formerly been plump and extraordinarily healthy started losing more and more of their fat, says Tim Ragen, who helped conduct the research and now heads the federal Marine Mammal Commission. “As pups lost weight, they lost girth. Bones protruded. They had less energy,” says Ragen. “Eventually, they got to the point where they could no longer forage. We saw them lying on the beach wasting away—and then they died.”

Scientists tried to save the seals by hand-feeding them, fattening them up, and moving them to better locations—with mixed success. Starting at a place called French Frigate Shoals, first-year survival rates for juveniles dropped from 90 percent or better to no more than 30.

Part of the reason, Ragen and others now believe, may have been climate change. Global warming could be to blame for the sea level rise and the disappearance of the islet underwater. And it could have hurt the seals in another way: Recent studies in the Central Pacific Ocean have revealed a dramatic drop in productivity—the food available to creatures in the ecosystem. Over a relatively short period, climate change may well have joined with other human-caused threats to alter the monk seals’ habitat and food supply in ways to which the animals could not adjust.

“To survive, an animal must maintain a positive energy balance—take in at least enough energy to support itself and its growth and reproduction,” says Ragen. If they cannot, he adds, “they lose their energy reserves, their ability to forage, and their ability to maintain their health and condition. Eventually, they cannot support life itself and they die.”

The U.N.’s Intergovernmental Panel on Climate Change estimates that 20 to 30 percent of species are at risk of extinction due to global warming. As alarming as those projections are, they mask the individual plights of animals in radically changed environments. For many of these animals, a man-made problem has become a natural disaster. On the level of individual creatures, gut-wrenching dramas are playing out. Unlike Hollywood scenarios of apocalyptic climate change, the devastation is taking place off-screen, out of view of most of the world’s people. Animals are struggling and, often, failing to survive. And the losses aren’t in some future time. They’re happening now.
Global warming is striking polar regions—and animals—first and hardest, as snow and ice melt earlier and reappear later, reflecting less of the sun’s light and uncovering expanses of darker land and ocean that absorb more heat. In the Arctic, temperatures have risen at almost twice the rate as elsewhere on Earth. Polar bears have become the poster child for animals threatened by climate change.

Recent TV commercials featuring the plight of polar bears have made it look as if they are in danger of drowning. Actually, it’s more complex. Sea ice is melting sooner, leaving bears fewer and smaller platforms from which to hunt ringed seals, their primary prey; they need to kill an average of 45 a year to survive, according to a study by polar bear expert Ian Stirling and researcher Nils Are Øritsland. With shrinking opportunities to hunt and fewer ringed seals to prey on (see “Meltdown” on page 19), polar bears are going hungry—sometimes even turning up in towns looking for food. Fewer females are in good enough condition to reproduce and fewer young bears are surviving into adulthood. Adding to the stress on the species is unrelenting pressure from trophy hunters, who shoot hundreds of bears each year for rugs and other home décor. For individuals, it’s a story of weight loss, increasingly rare pregnancies, and malnourished young who often don’t survive. In a word: Starvation.

Wildlife photographer Daniel J. Cox has witnessed the gruesome results of starvation firsthand. Filming in Canada last year, he came upon an emaciated polar bear mother and her two malnourished cubs huddled in a snow bank against the wind. The mother barely had enough energy to drive off another bear who approached, presumably to eat her young. Then, as Cox filmed, one cub rose up and went into convulsions. The mother lay listless, helpless, as her cub was dying.

This sad scene is being replayed across other Arctic species. Walruses, for example. Until now, these big, bulky creatures have conserved energy by riding pieces of ice to scattered shallow water feeding grounds where they forage on clams, crabs, and other invertebrates. Diminished ice forces walruses to swim farther out to find food, depleting their energy and fat reserves.

During the summer of 2004, the sea ice retreated particularly fast from the Western Arctic, and researchers spotted calves swimming in deep waters by themselves or in pairs, apparently unable to keep up with their mothers and the rapidly receding ice. Usually, marine mammals approach research vessels out of curiosity and then swim away again, says Carin Ashjian, an associate scientist at Woods Hole Oceanographic Institution. But these calves stayed beside the ship, barking, for hours.

“We realized we were witnessing something that wasn’t normal,” Ashjian says. “... They should have been with their mothers—they were nursing. We all felt bad. But there wasn’t anything that we could do.”

Increasingly, when exhausted walruses look for a place to
rest, they must turn to land because there’s no sea ice to be found. Tens of thousands now crowd together on narrow beaches along the coasts of Alaska and Russia. If the animals are spooked, they stampede toward the water in a killer rush that leaves the smallest crushed, suffocated, or crippled with broken bones. The U.S. Fish and Wildlife Service and U.S. Geological Survey have documented hundreds dead. Reports from Russia tell of thousands.

South of the Arctic, scientists are starting to see evidence that global warming will hurt many bird species. In Europe, 75 percent of common bird species studied by scientists are declining in numbers because of climate change, according to a 2009 report published in the journal Public Library of Science ONE. Exactly why isn’t clear. Presumably, climate change is causing them to lose habitat. Some scientists expect that global warming will also throw off the delicate timing of bird migrations. Birds will continue to fly north at their usual time, while their food supply—swarms of newly hatched insects, say—peaks even earlier. In such a scenario, by the time birds arrive or their young hatch, the mainstays of their diet are long gone.

Animals who depend on small and specific food supplies and habitats—often already threatened or partially destroyed by human activities—will have the smallest safety net. In North America, researchers are worried about “specialist” birds with particular diets or habitat requirements: The common nighthawk, for example, has already disappeared from much of the northeastern United States; scientists suspect this ground-nester’s absence in the region can be blamed on a drop in the number of gravel roofs that once served as nesting sites. The birds are still found in Southwest grasslands, but researchers fear that a combination of increased drought and fire will disrupt populations of insects that sustain them.

Until recently, animals have generally adapted as the Earth’s climate turned warmer or cooler, dryer or wetter. But change is coming too fast now. In the mountains, global warming is shrinking the already meager ranges of animals who live on the slopes. As temperatures rise, shifting habitats uphill, animals can’t always move with them. Wolverines adapted to deep snow packs and cool year-round temperatures may find they have nowhere to go as the air warms and snow melts entirely from peaks such as those in Montana’s Glacier National Park (see “Spirit of the Wolverine,” page 22). Pikas, little round-eared rabbit-like creatures who live on rocky slopes called taluses, may not find the right terrain farther up the mountainside.

To give such animals a way out, people will have to provide natural corridors allowing them to move between increasingly isolated fragments of habitat and, when necessary, travel long distances to new hunting or feeding or breeding grounds, says Michael Soulé, who is known as the father of conservation biology and serves as the Wildlands Network’s vice president of conservation science. “Maintaining the capacity for creatures to move is going to be essential if we’re going to save much of nature on this planet.” With climate change, he says, “things will become less predictable and more extreme. Some places there’ll be floods and hurricanes. Other places there’ll be more drought. A lot more animals will suffer. A lot more will go extinct.”

At this point, global warming can’t be immediately stopped. But its pace can be slowed. And both the size of future temperature increases as well as the number of years before the world reaches a new equilibrium can be reduced. This is what must happen in order for species to be able to adapt and endure, according to a 2009 report from the International Union for Conservation of Nature. Polar bears, for example, could survive across most of their current range if greenhouse gas emissions peak by 2020, then drop substantially, says a December report in the journal Nature. The bears’ survival will also require an end to trophy hunting. “We still have the physical ability to achieve these targets … if only we have the political and social will,” says Steven Amstrup, lead author of the study and a senior scientist at Polar Bears International. “If polar bears are written off, much of life on Earth as we know it is also written off.”

Already, Ragen says, scientists are regularly confronting exactly the wrong kind of surprise: evidence that climate change is causing even greater environmental devastation than expected. The human species needs to bring its population growth and CO₂ output in check, and do so quickly, he says, or the planet will suffer a terrible and irreversible loss.

“Eventually, we are going to be sustainable,” he says, explaining that human beings will be forced to adjust their lifestyles so they and the planet can survive. “The question is: ‘What will be left when we get there?’”
The day-to-day threats to koalas in Australia are not hard to spot: drought; bush fires; habitat loss because of human encroachments on the forest. Post-mortem exams of 700 koalas in Queensland, where populations are falling, concluded that most of the animals had wasted away, presumably because they couldn’t find enough eucalyptus trees to feed on.

But behind these obvious threats lies an invisible but devastating one: greenhouse gases. As CO₂ levels in the atmosphere rise, scientists expect the chemical composition of eucalyptus leaves to change and the protein available to koalas to drop. Laboratory studies have shown that the leaves of plants exposed to higher CO₂ levels have a third less nitrogen and far more tannins—the substances that make unripe fruit taste astringent. Tannins bind to proteins, making them impossible to digest. Koalas will get less nutrition from CO₂-altered leaves, and scientists predict that the poorly nourished animals won’t be able to reproduce.

“Effectively, what the tannins do is turn the proteins into leather, which is not exactly a good food source,” says William Foley, a professor at Australian National University in Canberra.

It’s challenging to observe an invisible gas and the altered molecular makeup of leaves, but over time both of these will have profound effects, says Ian Hume, professor emeritus at the University of Sydney: Researchers will return to areas of forest that once contained koalas and find them gone because they have not been able to harvest enough energy to reproduce.

What ordinary people will likely see first, Hume says, is more dead koalas on roads, as animals travel longer distances to get enough to eat and increase their vulnerability to car accidents. Then people might notice they no longer spot koalas with young on their backs, because the animals are not reproducing some years, or have stopped reproducing at all. Most individual animals will survive, just not in the best condition.

If greenhouse gas emissions are not cut, Hume says that within 50 years, koalas won’t just be disappearing from areas of human sprawl. They’re going to vanish from remote forests.

To protect koalas, Foley and other scientists have proposed replanting corridors of eucalyptus trees on the country’s most fertile land, which was long ago cleared for agriculture. Trees grown on good soil will have more protein in their leaves—and the increases could outweigh the protein losses from rising CO₂ levels, Foley says. A network of small 10-hectare patches of forest on Australia’s best land could be enough to save the species.
The ringed seal is one of the smallest Arctic marine mammals—barely known outside research journals. But upon this spotted creature rests an ecosystem that supports the iconic polar bear. For the last five years, as sea ice has formed late in the season or not at all, Kit Kovacs has observed populations of this keystone species heading toward disaster in Norway’s Svalbard archipelago.

“We haven’t had significant reproduction since 2005—2006, 7, 8, 9, [and] 10 have basically been nothing,” says the senior scientist with the Norwegian Polar Institute. “… Right now we have [no young]. … The pups that were born are all dead—polar bears were eating them like M&Ms.” A day or two after seals were born, Kovacs returned to find only blood smears.

For pups to survive the breeding season, the animals need a set of conditions that have always occurred for millions of years, but now can no longer be relied on: an ice platform that remains stable for at least a month and a half during the Arctic spring, and enough snow for seals to dig and maintain caves. These dens allow their young to hide from predators, dry off, and warm up, while they grow and accumulate the body fat that will eventually allow them to tolerate wet and cold.

In recent years, even when there’s ice, snow doesn’t accumulate. Or it melts early, and snow caves collapse and wash away, leaving pups exposed to both the elements and hungry bears. The radical change in the climate seems to have disrupted breeding, which takes place after pups are born, Kovacs says. In 2010, the female seals she saw were fat and healthy—but not pregnant.

Estimates place ringed seals’ global population at 2 to 7 million. But no one really knows how many of the animals still exist, says Kovacs. It’s difficult if not impossible to count them without ice. Their future depends on whether they can adapt and start building caves on land. But these would lack the floor holes afforded by sea ice, which allow animals to safely enter and exit the water. Realistically, Kovacs says, even if the world starts seriously cutting its greenhouse gas emissions, “I don’t know if it will save ringed seals.” One type of ringed seal is already considered endangered. The U.S. National Marine Fisheries Service is considering listing the four other subspecies as threatened.

If the ringed seals go, so too will the polar bear, write experts Ian Stirling, formerly with the Canadian Wildlife Service, and Andrew Derocher, of the University of Alberta: “Polar bears are large animals and they got that way by eating seals, not berries. … Large numbers of polar bears require enormous numbers of ringed seals.”
Cause and Effect: **WHAT YOU CAN DO**

**Our way of life**, including heavy consumption of meat, eggs, and dairy products, is a major contributor to global warming. Just as cars and power plants release greenhouse gases into the atmosphere, so does animal agriculture. CO₂ emissions are produced by the clearing of forests for farmland, and by the burning of fossil fuels to power machinery and produce fertilizer to grow grain for animals. Nitrous oxide is generated by these same fertilizers, used to boost nitrogen in soils. Methane is released by farm animals and their manure. According to a U.N. estimate, one-fifth of human-caused greenhouse gases worldwide—9 percent of carbon dioxide, 37 percent of methane, and 65 percent of nitrous oxide—come from livestock production. Methane has more than 20 times the global warming potential of CO₂ over 100 years; nitrous oxide has about 300.

The resulting changes in climate may affect every creature on the planet. Not just animals in exotic locales, but people, their pets, and backyard wildlife. Hurricanes, floods, mudslides, wildfires, and blizzards may strike more often and with greater severity, putting human and animal lives at risk. Ranges and migrations will shift. Habitat for many species will shrink.

While the issue of climate change has divided many lawmakers and members of the public, the consequences—and potential consequences—for wild animals are too great to ignore. Along with actions like re-
Hawaiian Birds:
BATTING MALARIA

The last century has seen the extinction of about half of Hawaii’s amazing array of honeycreepers—similar in biological significance to the multitude of endemic finches Darwin discovered on the Galapagos Islands. A leading culprit in the disappearance of one after another of these uniquely adapted forest birds—at least 17 out of 41 species and subspecies—is avian malaria.

Likely introduced during the early 1900s with birds imported from beyond the islands, the disease came to define where honeycreepers could live: Today’s surviving species mostly inhabit narrow high-elevation refuges, some as little as 300 meters wide, where the air is too cold for mosquitoes that transmit malaria but rainfall is plentiful enough to sustain a forest. Now, global warming is allowing mosquitoes to expand farther up mountainsides, threatening the remaining honeycreepers, especially a small cream-bellied, dusky-winged bird called the akikiki.

As akikiki ranges contract, the number of birds has dropped from 7,000 in 1973 to 1,500 or fewer, says U.S. Geological Survey researcher Carter T. Atkinson, stationed on the Big Island of Hawaii. Climate change is almost certainly involved, he says: On one plateau where mosquitoes have moved into the low-altitude limits of the birds’ range, the proportion of malaria-infected akikiki has nearly tripled. Recently, the akikiki was listed as endangered.

“Populations are starting to crash,” Atkinson says. “There’s a very real danger that these will be the next [honeycreeper species] to go extinct.”

The path toward zero is a painful one for individual birds. Within about a week of the parasite entering their blood through the bite of an infected mosquito, they become severely anemic, as the parasite ruptures most of their red cells. Their blood turns thin and watery. Their spleen and their liver swell as dead cells pile up in each.

Their energy drains away. Weakened to the point where they can no longer fly or eat, most starve or, unable to flee, are eaten by predators.

“They puff up their feathers [and] just sit there in the tree,” says Atkinson. “If they have enough resources—enough fat—they might be able to pull through after about two weeks.” The majority don’t.

Members of one other honeycreeper species are developing some tolerance to malaria. It’s not likely that will happen for the akikiki. The number of individual birds is already so low there probably aren’t any who have inherited or will develop a mutation that protects against the disease. During the next 10 to 20 years, Atkinson says, the akikiki will likely vanish.

A single bite from a malarial mosquito can kill the i'iwi. Nine of 10 birds who get the disease die. Global warming is allowing mosquitoes to live at higher elevations, shrinking the range of honeycreepers like the i'iwi and akikiki.

Producing automobile usage, here’s how you can make a difference.

► FIGHT FACTORY FARMING: Reduce the amount of animal products you eat. A shift to more plant-based foods can cut greenhouse gas emissions. Urge your members of Congress to move forward with meaningful legislation to curb global warming. Insist that they allow the Environmental Protection Agency to help address the crisis through actions like measuring the amount of greenhouse gases released by factory farms, says Mimi Brody, director of federal affairs for The HSUS.

► HELP WILDLIFE: Observe birds in your backyard. Researchers depend on data from citizen scientists to see what’s happening over large geographical areas, says Ben Zuckerberg of the Cornell Lab of Ornithology. Get involved by signing up to participate in projects such as Cornell’s Project FeederWatch and eBird and the National Audubon Society’s Christmas Bird Count. Also landscape with native trees, shrubs, and grasses, says John Hadidian, director of urban wildlife for The HSUS. Animals have already lost so much living space to expanding cities and suburbs, pollution, logging and mining, and the conversion of forests, grasslands, and wetlands into farms. “The more habitat that exists that is supportive of diversity, the more these species can take a hit,” says Hadidian.

► DEVELOP A DISASTER PLAN: Be prepared to take pets with you during evacuations or to care for them indoors if you take shelter at home. Create a pet emergency kit with enough food, water, and medication for three days. Take pictures of your pets and put collars on them so you can find them if they become lost.