



# WALKING ON THIN ICE

Will polar bears be able to survive a melting Arctic?

**SEARCHING FOR PREY**  
Polar bears rely on sea ice to find seals—their primary food source.

**ESSENTIAL QUESTION:**  
How might changes in the environment affect the animals that live in an ecosystem?

The helicopter's blades whirred in the frigid Arctic air as Anthony Pagano scanned the sea ice below. Finally, he spotted what he'd been looking for. A white bear was moving across the frozen landscape, more than 100 kilometers (62 miles) off the northern coast of Alaska. The helicopter swooped closer, and Pagano aimed a tranquilizer dart at the bear. The shot hit its mark.

Ten minutes later, the helicopter touched down on some ice near the bear. Pagano, a wildlife biologist with the U.S. Geological Survey,

cautiously approached the furry mound lying in the snow. He got to work fitting a tracking collar around the sedated animal's massive neck. The collar contained an *accelerometer*. The device detects changes in velocity, allowing Pagano to collect information about the bear's movements.

Polar bears roam the floating sheets of ice that cover the Arctic Ocean searching for holes where seals might surface to take a breath. Once a bear finds a good spot, it lies in wait on the *ice floe*, sometimes for hours, to ambush its next meal. But in recent years, warming temperatures linked to *climate change* have

## SHRINKING SEA ICE

Floating sea ice blankets the Arctic Ocean year round. Some of this ice naturally melts during the summer. But in recent years, warmer temperatures have caused more ice to melt than ever before. In fact, there's only half as much summer sea ice nowadays as there was 30 years ago.

KEY ● Ice ● Liquid Water



SEPTEMBER 1986



SEPTEMBER 2017

caused a major meltdown in the Arctic. Sea ice has been steadily shrinking—and so has the number of polar bears (see *Shrinking Sea Ice*, above). “We’re trying to get a better understanding of how these changes in sea ice are actually impacting them,” says Pagano.

### MEASURING ENERGY

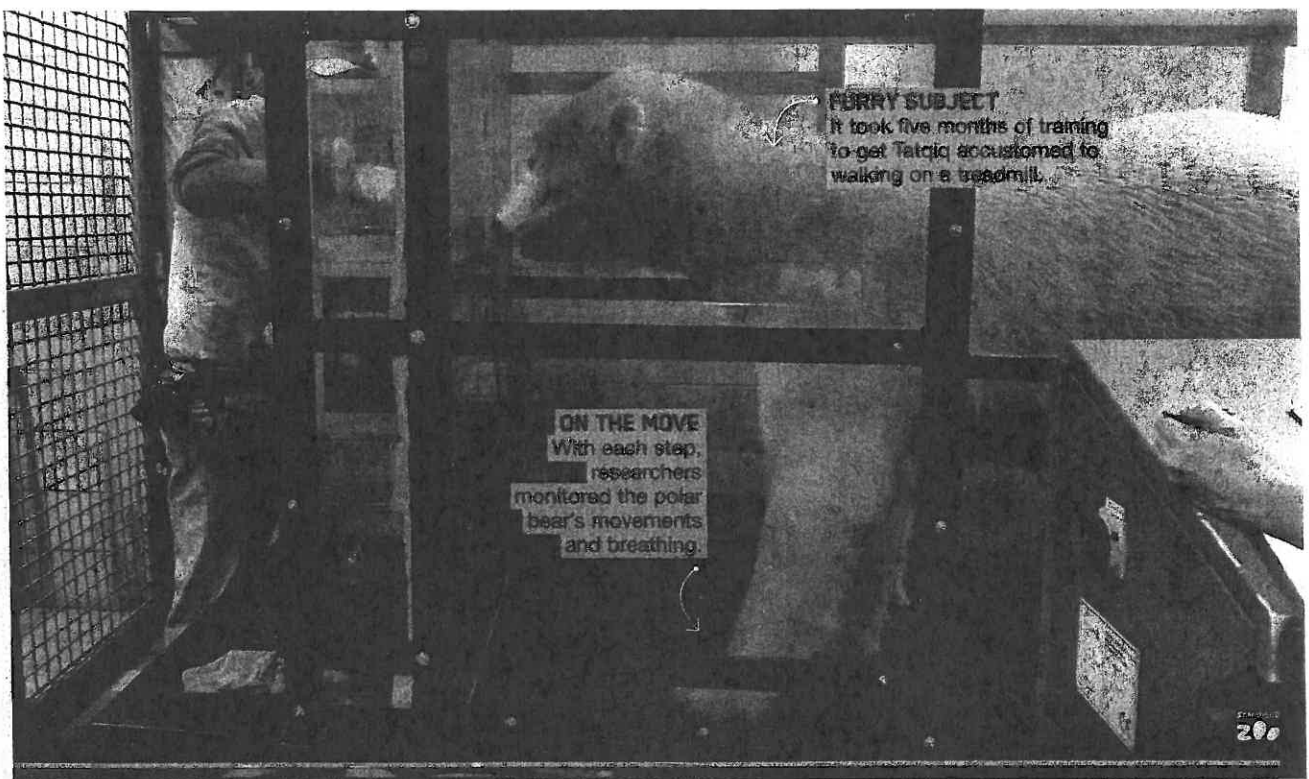
Scientists fear that as sea ice disappears, polar bears will have to work harder to find food. If hunting becomes too exhausting or the bears fail to find enough to eat, they could starve. Pagano wants to determine how much

energy the animals use while searching for prey. The data could help him predict how polar bears might fare as their habitat continues to warm.

Researchers study people’s energy use while walking by having subjects stroll along on a treadmill. But that wasn’t an option for polar bears . . . at least not in the wild. If someone could teach polar bears in zoos to walk on a treadmill, thought Pagano, he could take the measurements he needed. Paired with his accelerometer data, he could determine the amount of energy wild polar bears typically expend

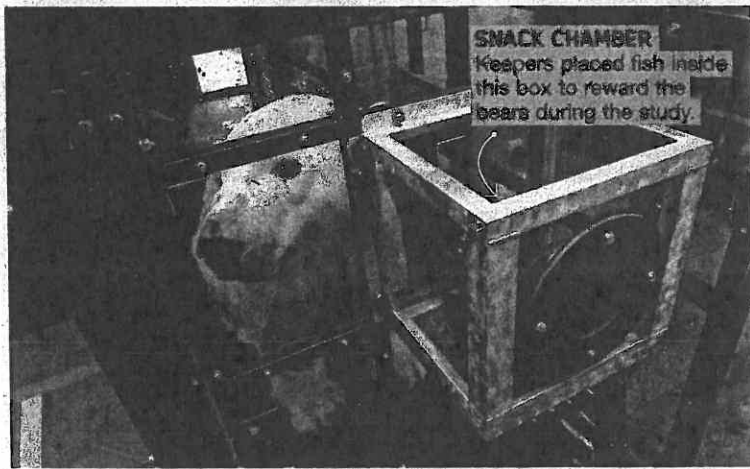
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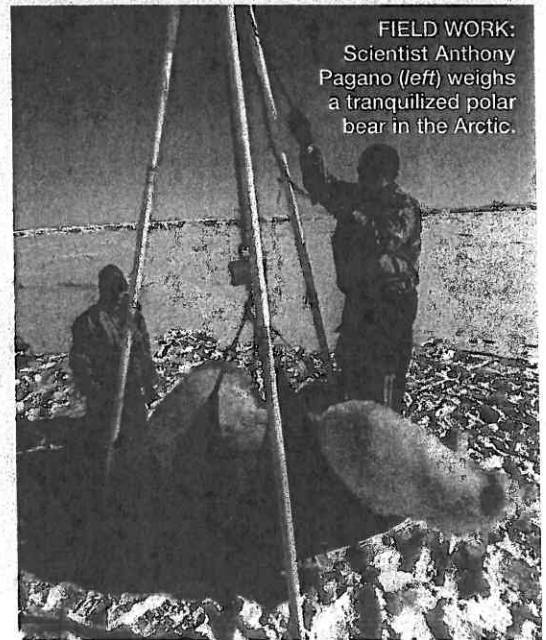


**FERRY SUBJECT**  
It took five months of training to get Tatqiq accustomed to walking on a treadmill.

**ON THE MOVE**  
With each step, researchers monitored the polar bear's movements and breathing.



**SNACK CHAMBER**  
Keepers placed fish inside this box to reward the bears during the study.



**FIELD WORK:**  
Scientist Anthony Pagano (left) weighs a tranquilized polar bear in the Arctic.

while hunting. He'd just need to convince captive bears to go along with the plan.

Pagano contacted the San Diego Zoo in California, where senior keeper Nate Wagner didn't think the idea of a polar bear walking on a treadmill sounded strange at all. These intelligent, curious bears were always up for a new experience. Wagner chose Tatqiq (taht-KEEK), a 17-year-old female, for the job. "She's incredibly inquisitive, and she's very happy to participate in just about any kind of activity that she's presented with," says Wagner.

Tatqiq and her twin brother were born in the Alaskan wilderness, but their mother died two months later. The cubs would have starved to death, except that their mother was wearing a tracking collar. Its unchanging signal clued

researchers in that something was wrong. They found the orphaned cubs and relocated them to the San Diego Zoo. Now Tatqiq, along with another polar bear at the Oregon Zoo that was recruited for Pagano's study, would have a chance to help bears in the wild.

### TREADMILL TRAINING

The first challenge for the researchers was finding a treadmill sturdy enough for a 263 kilogram (580 pound) polar bear. Pagano's team bought one designed for racehorses. Next, they

needed to find a way to measure the bears' oxygen intake as they walked on the machine.

An animal's body uses oxygen to create energy to power its muscles. Based on the amount of oxygen bears breathed in, Pagano could determine their energy use. To take this measurement, a subject would normally breathe through a mask. But, says Pagano, "you can't put a mask on a polar bear, because it would just swipe it off instantly." Instead, the researchers placed the treadmill inside a plastic and steel enclosure. The chamber was airtight, allowing Pagano to monitor oxygen levels inside.

The final step was persuading Tatqiq to walk into the unfamiliar contraption. Luckily, "true to her personality, she walked right inside with no problem," says Wagner. With the treadmill turned off, trainers measured Tatqiq's oxygen consumption when she wasn't moving.

The next time Tatqiq approached the treadmill, though, she found it slowly moving. Wagner offered her fish through an opening at the far end of the chamber. Over and over, Tatqiq ambled forward to snag the snack but then slid backward. Her patient trainers kept working until she figured out she had to keep moving to stay on the device. Eventually, Tatqiq became comfortable enough on the treadmill for Pagano to measure her oxygen intake at different walking speeds.

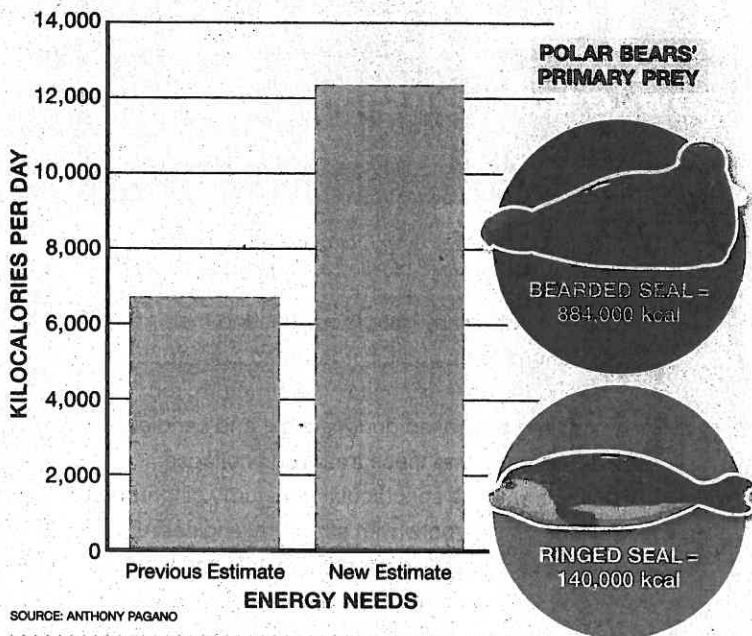
## UNCERTAIN FUTURE

Pagano analyzed the treadmill data and found that per pound of body weight, polar bears use about the same amount of energy as other large, meat-eating *carnivores*, like wolves and mountain lions, at routine walking speeds. The bears' energy use doubled when they walked a little faster.

But because polar bears' bodies are so massive, they need to consume a tremendous total amount of calories to survive (see *Polar Bear Energy Needs*, upper right). That's why seals, which

## POLAR BEAR ENERGY NEEDS

Pagano found that polar bears burn a lot more energy than scientists previously believed. That's why the animals need access to high-energy food sources like seals, which are easily found on sea ice, to get enough calories to survive.



SOURCE: ANTHONY PAGANO

are rich in fat, make up the bulk of their diet. As sea ice declines, polar bears will have fewer opportunities to ambush seals by waiting for them to surface at their breathing holes. Melting ice may force the bears to chase prey on land, which uses a lot more energy.

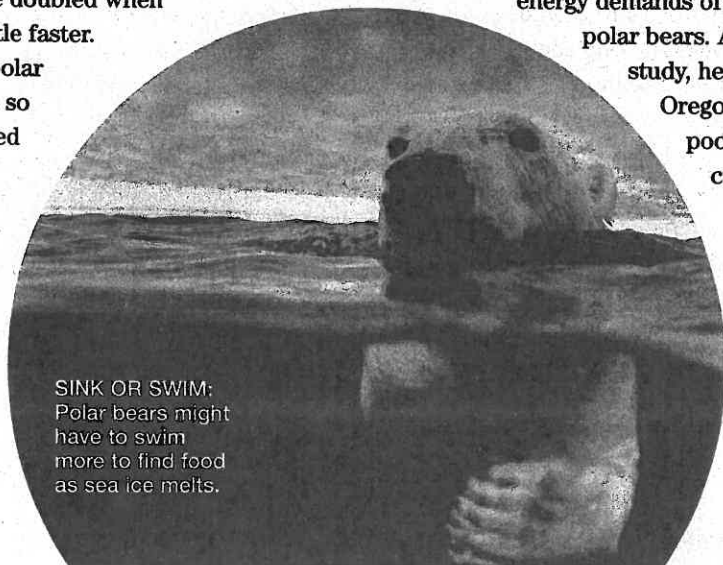
With fewer ice floes, polar bears may also find themselves swimming more often in their search for food. Paddling for miles in the open ocean is even more physically taxing than walking. Pagano became curious about the energy demands of swimming on

polar bears. After his treadmill study, he worked with the Oregon Zoo to set up a pool with an endless current. They've already begun to collect some data—after training a polar bear to swim in it! ❄️

—Jacqueline Adams

## CORE QUESTION

Cite evidence from the text to explain why Pagano turned to captive animals to learn about their wild counterparts.



**SINK OR SWIM:** Polar bears might have to swim more to find food as sea ice melts.

**Name:** \_\_\_\_\_

# BUILT FOR THE COLD

Use evidence from the table on the first page to fill in the graphic organizer below. Construct a claim, evidence, and reasoning explanation about how polar bears' adaptations allow them to live in the Arctic.

<p><b>CLAIM</b> (a statement that answers your question):</p>          	
<p><b>EVIDENCE</b> (relevant data that supports your claim):</p>          	<p><b>REASONING</b> (your explanation for how and why your evidence supports your claim):</p>          

**ANALYZE IT:**

Critically read over your answers. Did you include sufficient evidence? Did you include only evidence that supports your claim? Have you clearly explained how the evidence supports your claim? Revise your answers if needed.

Name: \_\_\_\_\_

# BUILT FOR THE COLD

In “Walking on Thin Ice” (p. 8), you learned that polar bears may suffer because of changes to their Arctic habitat. The table below describes some of the physical and behavioral adaptations of polar bears. Use the information to construct an evidence-based explanation on the next page about how these traits help the bears survive in the Arctic.

**Polar Bear Characteristics**

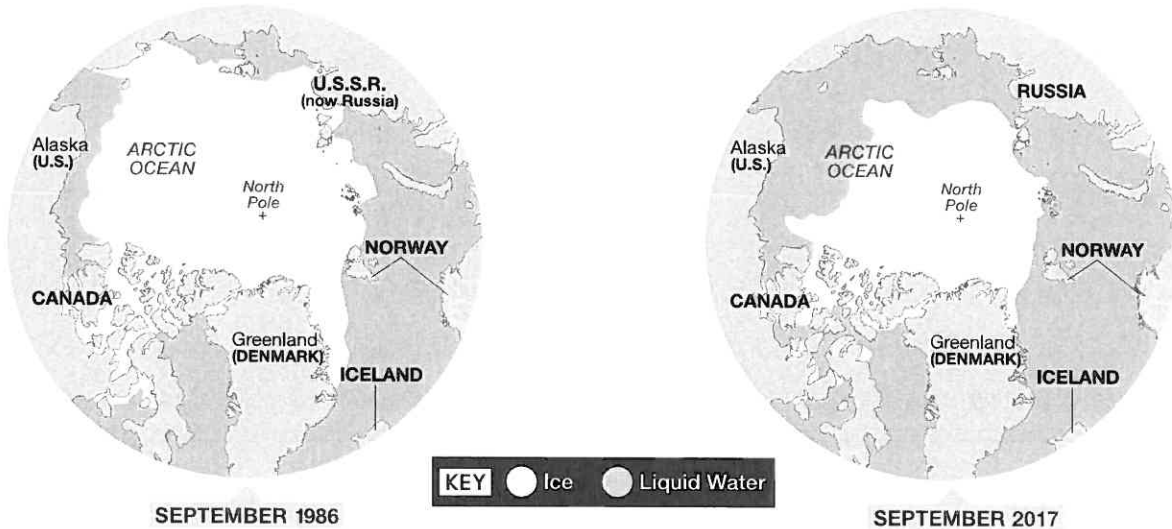
Physical Adaptations	Behavioral Adaptations
Adult male polar bears can weigh up to 600 kilograms. A large female may weigh 50 to 290 kg.	Polar bears are solitary animals that spend most of their lives alone. Cubs stay with their mothers for two-and-a-half years until they are ready to survive on their own.
Polar bears have a layer of fat up to 11.4 centimeters thick. The fat insulates their bodies, preventing heat from escaping.	Polar bears are strong swimmers. They use their wide paws like paddles in the water.
Thick fur covers polar bears' bodies. They have undercoats of very dense, short hairs surrounded by a layer of longer hairs. The fur is mostly clear but appears white because of the way it interacts with sunlight. The skin of a polar bear is black—which helps it to absorb heat from the sun's rays.	When walking on thin ice, polar bears often spread their legs wide—which helps to distribute their heavy weight over a larger area.
Polar bears' paws are very wide and have black pads that are covered in small bumps called <i>papillae</i> . These bumps help them grip the ice. Each paw has five claws that can extend more than 5 cm.	When temperatures plummet and winds blow, polar bears often dig small holes in the snow and curl into balls to stay warm. They also use their paws to cover their noses, which helps them maintain their body heat.
Polar bears have small tails and ears. The small surface area of these appendages helps prevent heat loss.	When a female bear becomes pregnant in the late fall, she builds a cave in the snow. She then births her cubs in the cave and feeds them milk until spring. Male bears and females that are not breeding do not hibernate during the winter.

Name: \_\_\_\_\_

# SHRINKING SEA ICE

In “Walking on Thin Ice” (p. 8), you learned that polar bears are at risk because warming temperatures are causing sea ice to melt. The maps below show the amount of ice in the Arctic Ocean in September 1986 and September 2017. Use the maps and the article to answer the questions that follow.

## FALL ARCTIC SEA ICE



SOURCE: NATIONAL SNOW AND ICE DATA CENTER

### ANALYZE IT

- Which countries that had sea ice along their coasts in September 1986 were bordered by open water in September 2017?
- Describe which area of the sea ice has melted most significantly over the past 30 years.
- Scientists usually use data from September to determine how the amount of sea ice has changed over the years. Why do you think they focus on that month?
- Polar bears live in the U.S., Canada, Greenland, Norway, and Russia. In which area would you expect to find the healthiest polar bear populations? Use evidence from the article to support your answer.
- Based on the maps and the article, what do you think will happen to polar bears in Russia as summer sea ice disappears?

