POLAR BEARS INTERNATIONAL

Annual Newsmagazine

POLAR BEARS INTERNATIONAL

2021–2022

PROTECT THEIR FUTURE and SAVE OURS

As I write this, polar bears have gathered on the shores of Hudson Bay to wait for the sea ice to form. After months of fasting onshore, the bears are anxious to resume hunting on the frozen bay, feeding on blubber-rich seals and replenishing their fat reserves.

Watching them wait for the bay to freeze, I can't help but wonder if they sense their world is changing.

Already, the ice-free period on Hudson Bay is three to four weeks longer than it was in the 1980s. For the polar bears of western Hudson Bay, this means shorter hunting seasons and longer fasting periods, making this population one of the most endangered.

But it's not just about polar bears and retreating sea ice. This year's IPCC Sixth Assessment report lays out, in the starkest terms, the perils we all face should we fail to take swift, bold action to curb carbon emissions.

The U.N. report, approved by 195 governments and based on over 14,000 peer-reviewed studies, states unequivocally that climate warming is real, is serious, and is caused by us. The one glimmer of hope is that a short window of time remains to avoid the worst impacts. And that's why, at Polar Bears International, we continue to do all that we can to press for climate solutions—to protect the polar bear's future and save our own.

Through our Tundra Connections® webcasts, media outreach, a newly revamped website, live cams, and other channels, we connect with people around the globe, inspiring them to care about polar bears and join us in working for a renewable future. We also engage in climate policy and enlist the help of others—underscoring the urgency and building broad-based support. Because, to solve a problem this big, we need all hands on deck and global cooperation.

Thank you for your commitment to polar bears and your dedication to this cause. The polar bear's fate, and the fate of the planet, is in our hands. Let's write a more hopeful future together.

Sincerely,

Krista Wright

Krista Wright
Executive Director

Polar Bears International's mission is to conserve polar bears and the sea ice they depend on. We also work to inspire people to care about the Arctic and its connection to our global climate.

INSIDE THIS EDITION

Editor: Barbara Nielsen
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WORLD RANGER DAY AWARD 2021

Every year on World Ranger Day, we present an award to the dedicated men and women working on the frontlines to reduce conflict between polar bears and people—a growing problem as the sea ice melts in a warming Arctic, forcing more polar bears ashore and for longer periods.

This year, we were pleased to honor the achievements of two individuals in Arviat, Nunavut: Leo Ikakhik and Joe Savikataaq Jr.

Set on the coast of Canada's northern Hudson Bay, Arviat has experienced an increase in the number of polar bears that visit the town during the ice-free season.

"Keeping the bears away requires 24-hour monitoring from mid-September until the bay freezes," said Geoff York, Polar Bears International's senior director of conservation. "No matter what the weather or how late the hour, Leo and Joe are committed to keeping their community safe and preventing negative encounters."

Leo Ikakhik has been a polar bear monitor in Arviat since 2011 and is part of the community's five-person Wildlife Guardian team. Joe Savikataaq Jr. is a local conservation officer with Environment Nunavut who also serves as Arviat's mayor.

"Joe and Leo patrol the perimeters of the town during the ice-free seasons, watching for bears," said York. "They also respond to any sightings reported via Arviat's 24-hour hotline."

Often, the sound of an approaching vehicle is enough to scare off a polar bear that has ventured too close to town. Other tactics include loud noises like cracker shells, the use of rubber batons, and, with persistent bears, culvert trapping and relocation. The team also keeps watch for nearby attractants, such as a whale carcass that washed up on shore last fall, drawing the interest of a polar bear mom and cub.

We're grateful to Leo and Joe for their extraordinary efforts and for their role in keeping people and polar bears safe.

Past recipients of Polar Bears International's World Ranger Day Award include the late Vladelin Kavry of Russia's Umky Patrollers; Churchill, Canada's Polar Bear Alert team; Wildlife Officer Erling Madsen of Ittoqqortoormiit, Greenland; the North Slope Borough's Polar Bear Patrols in Alaska; and the rangers of Russia's Wrangel Island Nature Reserve.

MATERNITY DENNING *at the* BASE *of* ICEBERGS

RESEARCHERS RECENTLY DISCOVERED A UNIQUE POLAR BEAR MATERNITY DENNING HABITAT IN NORTHEAST GREENLAND: SNOWDRIFTS AT THE BASE OF ICEBERGS FROZEN INTO LANDFAST ICE

By Dr. Kristin Laidre and Dr. Ian Stirling

Unlike other North American bears, most polar bears do not go into dens for the winter but continue to hunt seals from the sea ice. Pregnant adult female polar bears are the exception. They enter maternity dens by late October or early November and give birth to cubs by late December to early January. At birth, the cubs are too small to survive winter conditions so the maternity den functions as an external womb. Within the safety of the den, cubs can be nursed and sheltered for three to four months until they are large enough to follow their mothers onto the sea ice to hunt seals. Consequently, reliable locations of suitable snowdrifts for maternity denning, and the overwinter stability of the individual den sites chosen by pregnant females, are critical to the survival of cubs.

DEN LOCATION BASICS

In most areas around the circumpolar Arctic, females dig maternity dens into snowbanks on secure land areas adjacent to the sea, often showing great fidelity to denning locations. In particular, they choose sites that recur annually in snowdrifts. These drifts are formed by the wind blowing snow over the leeward slopes of coastal hillsides, valleys, barrier islands, and other landscape irregularities.

The snowdrifts selected for maternity dens are usually compacted and hardened on the surface by winds that continue through the winter. Observations of adult females sampling snowdrifts for denning suitability in the fall indicate they are quite selective about the ones they choose. However, other than sufficient

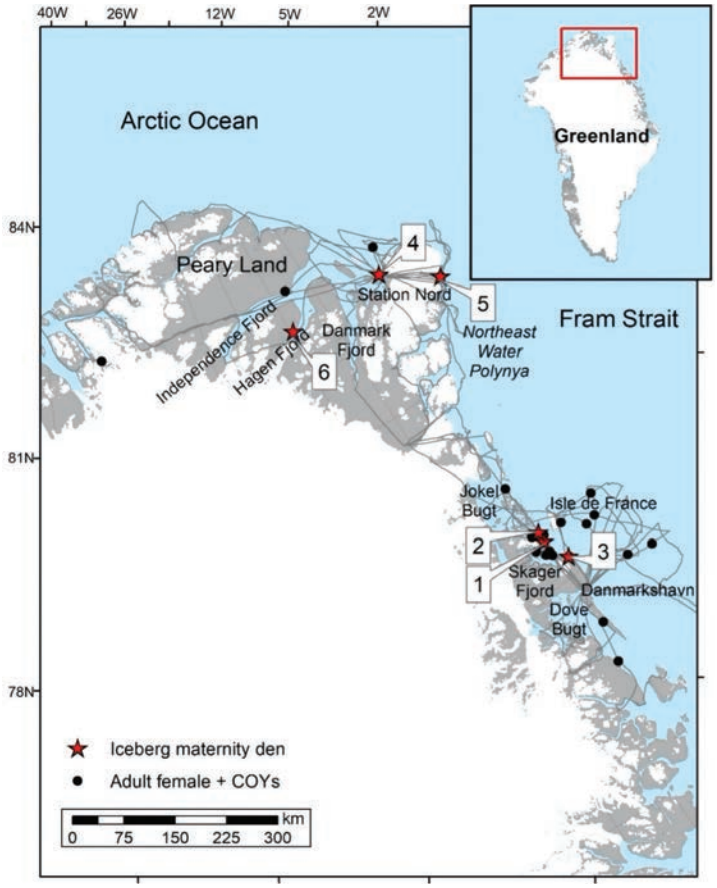

Figure 1. *Locations of polar bear maternity dens found in or around grounded icebergs in offshore north and northeast Greenland in April and May 2018 and 2019. Observations or physical captures of family groups (adult females with one or two cubs of the year) are also shown (black dots) with helicopter search tracks (gray lines) flown.*

depth, it is not obvious what specific factors may influence a female's selection of a particular snowdrift among many in a local area that might appear suitable to a human. Overall, polar bears

"A COMPLETELY NEW ASPECT OF POLAR BEAR DENNING WAS DISCOVERED, ALMOST BY ACCIDENT."

across the Arctic show a preference for denning on land rather than the sea ice. The overwinter stability of land-based snowdrifts is likely a significant factor, though a limited amount of maternity denning has also been documented in old stable multiyear ice well offshore from the less stable annual ice near shore.

UNUSUAL FINDINGS

During research on polar bears in northeast Greenland, conducted out of Danmarkshavn in April 2018 (Figure 1), a completely new aspect of polar bear denning ecology was discovered, almost by accident. Overwinter maternity dens

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What Makes a Polar Bear...a Polar Bear?

"The polar bear genome is approximately 3.5 billion base pairs in length, with all those base pairs packaged into 37 pairs of chromosomes."

By Dr. Evan Richardson and Dr. Joshua Miller

Polar bears are universally recognized the world over. Their large body size, white fur, hooked claws, and small ears are all defining features of a predator that is highly adapted to the Arctic environment. But how did these features evolve? In short, it all comes down to genetics.

A PRIMER IN GENETICS

One of the single greatest discoveries made in the fields of biology and medicine in the 20th century was the structure and function of DNA. James Watson, Francis Crick, Rosalind Franklin, and Maurice Wilkins are credited with putting together the pieces of the puzzle to identify the elegant double helix structure of DNA. Collectively, they identified both the structure of DNA and how it replicates itself.

DNA is like the blueprint to a house, where specific sequences of nucleotides, called genes, lay out the plans for *constructing proteins*, which go on to combine, like bricks and mortar, all the structures in a cell and body. Genes and gene expression control everything that happens in life. They form the foundation for the biological diversity that exists today.

These blueprints are handed down from one generation to the next. Long DNA strands are organized into chromosomes. Children inherit these from their parents, combining the blueprints from mom and dad, sometimes with modifications. Some traits are controlled by a single gene, but many are influenced by multiple genes. Much of the field of genetics is focused on identifying the genes that control various traits of an organism and understanding how they are inherited and expressed from one generation to the next.

The polar bear genome is approximately 3.5 billion base pairs in length, with all those base pairs packaged into 37 pairs of chromosomes (humans have 23). And that is what makes a polar bear … a polar bear!

HOW DID POLAR BEARS EVOLVE?

At its most basic level, the process of evolution by natural selection involves individuals with beneficial traits leaving more offspring than individuals who lack those traits. If the traits are controlled by genes, then the frequencies of the advantageous genes will increase in a population in response to selective pressures. Although Darwin knew that traits were inherited from parent to offspring, it was Watson and Crick who described the molecular basis for that inheritance, later winning the Nobel Prize for their groundbreaking work.

In the 70 or so years since the discovery of DNA, science has advanced to the point where it is now possible to determine the entire sequence of DNA of any species, its genome sequence, for less than the cost of a plasma screen television. By sequencing the genomes of polar bears and brown bears we know that polar bears shared an ancestor with brown bears roughly 500,000 years ago. This is a relatively recent branching off and is a well-known example of rapid evolution.

So, what can genetics tell us about how polar bears have adapted to the Arctic in such a short time frame? Recent research suggests that both preexisting genetic variation in the genome and novel mutations (random changes/errors that are made when DNA is being copied) are likely to have played an important role in the rapid emergence of polar bears.

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Photos © Daniel J. Cox/NaturalExposures.com

From paws to fur, polar bears are beautifully adapted to a life hunting seals on the sea ice. DNA sequencing shows that polar bears split off from brown bears about 500,000 years ago.

CAN POLAR BEARS GO TERRESTRIAL?

(The Short Answer: **No***)*

By Dr. Thea Bechshøft

Caribou, muskox, birds and bird eggs, beached whales, seals, fish, berries, and other plant foods … humans and other animals have been successfully living off the land during the ice-free summers in the High Arctic for millennia. Why can't polar bears just do the same?

The answer: evolution! Over the past 500,000 years or more, polar bears have become hyperspecialized to living on the Arctic sea ice and preying on seals. Their adaptations to this lifestyle are evident in their behavior, physiology, and ecology. Studies show that even the size and structural integrity of the polar bear's skull and teeth are adapted to surviving on soft blubber and flesh. This extreme specialization is the beauty of the bears as well as their bane. It makes them the undisputed top predators in the Arctic marine ecosystem, but also extremely vulnerable to changes in their environment.

Polar bears have evolved for a life on the sea ice, preying on blubber-rich seals. While it's tempting to think the bears could adapt to a terrestrial diet, their extreme specialization makes them unable to do so within a short evolutionary time frame.

"Polar bears may eat berries, kelp, bird hatchlings, meadow voles, and the like if there are no seals to be found. However, none of these food items are a viable long-term option."

CURIOUS BY NATURE

Every now and then a story will pop up in the media about polar bears that were spotted eating prey other than seals and how this shows their potential to adapt to a life without sea ice. Unfortunately, this is wishful thinking. While polar bears are extremely specialized, they are also very curious, intelligent, and opportunistic animals. If something looks new and potentially edible, they are very likely to want to take a closer look and an experimental nibble.

This holds true for most polar bears, but especially for those that are summering on land while they wait for the sea ice to re-form or those that find themselves in areas with few seals. Polar bears in such situations may eat berries, kelp, bird hatchlings, meadow voles, and the like if there are no seals to be found. However, none of these are a viable long-term option for polar bears; only blubber from seals (and the occasional whale carcass) has a high enough energy content to do this. A round polar bear is a happy polar bear, and it requires a lot of energy to keep a polar bear plump!

LIMITING FACTORS

In addition to terrestrial foods generally being leaner and thus less calorie-dense than seals, there are two other reasons why these alternative food items cannot work as a long-term prey substitute for polar bears.

First, the terrestrial food sources are limited. For example, eggs from ground-nesting geese or eiders are a reasonably energy-rich food. However, bird eggs are very small compared to a seal. This means that the bears must consume a much higher number of eggs to get the same amount of energy they would from eating a single seal. Studies have found that a single bear's visit can be devastating to a bird colony, and that in some areas bear predation of nesting sites has increased seven-fold since the 1980s. In other words, foraging on eggs may have the potential to be a good strategy for a few bears for a while, but if most of the eggs produced by the birds in a colony are eaten every year, it won't take long before that colony simply doesn't exist.

The comparatively barren areas in the High Arctic where the polar bears are likely to end up when there is no sea ice do not provide anything close to the amount of food the bears would need. This scarcity of food is also why barren-ground grizzlies (the northernmost brown bears) are the smallest of their kind. Additionally, the areas on land that are suitable for terrestrial bears are already filled by these grizzlies. Even if polar bears were able to evolve at lightning

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Connecting People *with* Polar Bears

A chat with Alysa McCall, director of conservation outreach and staff scientist

By Barbara Nielsen

Growing up in the mountains of Kamloops, British Columbia, it wasn't unusual for Alysa McCall to see black bears, deer, and other wildlife wander into her backyard. But nothing matched the excitement of seeing wild polar bears on the sea ice.

"I'll never forget my first day of fieldwork," she recalls. "We were out on the sea ice of Hudson Bay, assessing a female bear with two cubs. We looked up and saw another polar bear family walking by, parallel to us. It was a quiet, sunny day, and we could hear the sea ice cracking. All of us just stopped what we were doing and watched them. It was the most serene, powerful nature moment I've ever had."

Sharing her experiences with polar bears is all part of a day's work for Alysa, who directs Polar Bears International's Tundra Connections® webcast program as well as other education and science projects. She recently talked with

us by phone from her home in Whitehorse, Yukon, reflecting on her work with PBI and her passion for science and conservation outreach.

Q: What sparked your interest in biology?

Growing up in Kamloops, I always loved seeing wildlife. My dad was interested in nature and hiking, and I grew up with a love of the outdoors. When I was about 12, one of my friends told me about her dad, who was a regional wildlife biologist. I was like, "*That's so cool! That's a job?*" From that point on, I knew that's what I wanted to do.

For my undergraduate degree, I went to Thompson Rivers University in Kamloops, which has a phenomenal wildlife biology program. It was the perfect fit for me, with incredible mentors. During that time, I worked as a research assistant for a master's student, studying deer mice. We would trap the mice and weigh them, then fit them with these teeny-tiny radio collars. I remember going out to the grasslands at 5 a.m. to track deer mice.

Q: How did that lead to working with polar bears?

When I was looking into a master's program, my advisor, Karl Larsen, suggested I reach out to Dr. Andrew Derocher at the University of Alberta. Karl had gone to school with Andy and said, *"You should email Andy, he studies polar bears.*" Fortunately, I had just been awarded a scholarship that would pay for a year studying wherever I wanted to go. So, I reached out and Andy got back to me right away, saying, "*Sure, come aboard, you can start this fall*."

I thought it was a joke at first. Later, I found out there was a bit of serendipity, as Andy had just been awarded some grant money for a project and needed additional help. I flew out to meet Andy in February and started in the fall. The University of Alberta is known for its great wildlife biology program, and I felt lucky to be there, studying under Andy.

Q: You started volunteering with Polar Bears International while working on your master's. How did that come about?

I was in the first month of my master's program, and one day Andy came into the lab and told me about PBI's Tundra Connections program. He wanted more of his students to be involved with outreach and felt that PBI's webcasts from the tundra would be great training. So, I went up to Churchill for the fall program. I remember meeting some of PBI's advisors—well-known polar bear scientists—and I was very shy. They were like, "*Who are you?*" And I was like, "*I study mice*."

But, from the beginning, everyone was so nice and supportive. Since I knew nothing, and had not even seen a polar bear before, I was given the task of being the moderator. Back then, we had a full schedule of webcasts, Monday to Friday, with three or four a day. It was intense, but I took to the role immediately. I'd been involved with public speaking throughout my undergraduate years, and as far back as elementary school, so I felt comfortable speaking under pressure. So, I emceed and the next morning woke up to see a polar bear outside the Tundra Buggy® Lodge! From that point on, PBI invited me back and now I direct the Tundra Connections program.

Q: What was it like the first time you took part in polar bear fieldwork?

I saw my first polar bear on the sea ice in March 2011. I was taking part in a research project on western Hudson Bay with the University of Alberta and Environment and Climate Change Canada. The project was led by Dr. Nick Lunn. It was my first time in a helicopter, and the pilot was Jon, who I later married.

Being on the sea ice is like being on another planet. There's such a stillness but you also can hear the ice cracking and shifting. It's white as far as you can see and there are no other people.

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The First 40 Years:

LONG-TERM RESEARCH IN WESTERN HUDSON BAY

By Dr. Nick Lunn

October 5, 2021, will be the 40th anniversary of my first trip to Churchill. I had no sooner crossed the tarmac of the old Churchill airport when I was whisked away to help in the handling of X05547, a 3-year-old subadult male captured not far from the Churchill dump. To a recent university graduate, I was amazed at being in Churchill and to be up close to an iconic predator. Little did I know where this first encounter would lead.

At the time, I had no way of knowing that I was contributing to what would arguably become the best dataset for any population of polar bears, one that would eventually allow us to understand the link between climate warming and the well-being of polar bears across their range.

EARLY DAYS

When Dr. Ian Stirling established a polar bear research program near Churchill in 1980, his goal was to answer basic and fundamental ecological questions that were applicable to polar bears across the circumpolar Arctic. Back then, global warming was not on anyone's radar screen.

Churchill was an ideal location to study polar bears because Hudson Bay is ice-free for three to four months each year. During that time, the bears are forced ashore, where they gather in a relatively small area. Thus, rather than try to sample bears of all age and sex classes on the sea ice of Hudson Bay where they occur in lower densities, Dr. Stirling recognized that it would be much easier to do so while the bears were on land in an area that is less than one percent of the size of the bay. Further, the logistics of operating from Churchill, which had air and rail service, were much more cost-effective than undertaking similar studies in the remoteness of the High Arctic.

"Little did I know where this first encounter would lead."

Our research consisted of a series of studies, each lasting two to five years, to answer specific but interrelated questions. The social behavior of bears, reproductive ecology, population dynamics, and even the significance of onshore feeding

"I had no way of knowing that I was contributing to what would arguably become the best dataset for any population of polar bears."

were some of our earliest studies. Answering the questions most effectively required us to handle a sample of bears to uniquely identify them, record body measurements (e.g., length, girth), assess overall health (e.g., tooth wear, fatness), and collect various biological samples.

Although these are relatively simple and straightforward to collect, we took great care to do so systematically and consistently, thus ensuring comparability between individual bears both within and across years. Novices were taught how to take these measurements, which were then double-checked. Nothing was left to chance. We all learned how to handle polar bears by doing, not by watching!

INVALUABLE HISTORIES

Over the years, the annual handling of a sample of bears resulted in a growing database of marked individuals for which there were corresponding body measurements, health assessments, and biological samples—providing an incredible record of changes over time. Bears handled in previous years and later recaptured told interesting stories about where and when they were encountered, and when they had cubs (and how many). Over time, we started picking up independent juveniles and adults that we had first captured as cubs.

The information gained not only provided interesting stories but also important insights. For example, the annual captures contained a number of independent yearling bears (21 months old), which demonstrated that, in western Hudson Bay, mothers were able to successfully wean young a full year earlier than in most other populations.

By the end of the first two decades, we noticed that some of the measurements were changing significantly over time. In particular, we recorded reductions in the body condition of males and females, the number of cubs being produced, and the number of independent yearling bears in our capture samples. While these would be far more difficult to interpret with only three to four years of data, what we had documented over 20 years of studying Western Hudson Bay bears definitely signaled something was afoot.

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Learning Across Landscapes & Cultures

By Kt Miller

Early in March 2020 I packed my bags to depart from Svalbard after assisting with our maternal den study in Norway. As I tried to figure out how to fit all my warm field gear into my bag, I wondered if we would have any trouble getting home. Thanks largely to good weather and a little bit of luck, my colleague, BJ Kirschhoffer, and I had completed our research a few days early and decided to cut costs and travel back ahead of schedule. With another bit of luck, we arrived in the U.S. just days before the border closed.

Innovation has always driven our work at Polar Bears International, but when the reality of the global pandemic set in, our staff's ability to pivot and build new technology systems was truly tested. As research and travel was put on hold, the demand for online education exploded. Parents, teachers, and students had to adapt, and so did we.

GLOBAL CONNECTIONS

Our education team quickly found new software and built a new computer and streaming system in our small office in Bozeman, Montana. Simultaneously, we turned our bedrooms into broadcast studios, turned on our cameras, and revamped our Tundra Connections® program, offering a new series of immersive science-based webcasts for students learning online. Over the course of eight weeks in April and May 2020, we connected with over 100,000 viewers as teachers switched to an online learning environment and global lockdowns kept students at home.

This was the beginning of a new normal that continued into the fall, forever changing the way we conduct our educational programs. We are now using software that allows us to bring in panelists from anywhere as long as they have an

Through our Tundra Connections webcasts, we connect with students, teachers, and life-long learners around the globe.

internet connection, giving us more opportunities than ever to connect students with fascinating people who do cutting-edge science and have amazing field stories.

As engagement in our Tundra Connections program continued to increase exponentially, the interest in our live cams, archives, and one-on-one connections also soared. We used this momentum to strengthen and improve our other educational programs. Although we have been working on these programs for years, we were able to embrace the educational opportunities provided in 2020 and 2021 to push exciting growth beyond webcasts.

NORTHERN CLASSROOMS

For example, through our partner Connected North (part of TakingITGlobal) we facilitated a handful of direct educational connections between researchers and classrooms in northern Canadian communities. These are similar to our Tundra Connections webcasts in that a scientist might share a graphic of the Arctic food web or talk about their research. The difference is that these one-on-one broadcasts become two-way conversations, giving scientists the opportunity to truly connect with students, exchanging information and learning from them.

Northern youth who live in the Arctic and have intimate, lived experiences of what it's like to coexist with polar bears and depend on the sea ice for day-to-day life can offer an incredible wealth of knowledge that cannot be found elsewhere. These connections also provide an opportunity for scientists to explain and answer questions about their research methods and how they create knowledge and gain insights through things like radio collars and mathematical models. As our staff scientist Thea Bechshøft shared, "One of the highlights of my month was connecting with an 11th grade class in Taloyoak, Nunavut, for a talk about contaminants, recipes, new monitoring methods, and everything in between!"

CHURCHILL SCHOOL PROGRAM

Although we have been supporting different aspects of some school programs at the Duke of Marlborough school in Churchill for many years, our lack of full-time local staff was limiting. However, now that our educational interpretive center in Polar Bears International House is complete and we have two full-time staff members based in Churchill, we have been thrilled to deepen our ties.

In partnership with Parks Canada and the Churchill Northern Studies Centre, PBI staff member Dave Allcorn, a skilled naturalist, joined local high school students as part of the 4+1 program during the month of June. Dave was able to learn alongside the teens while sharing his own regional expertise not only about polar bears and the ecology and history of the region—but also on the different careers they might be interested in pursuing in conservation and ecotourism. Dave noted that the group spent time on the sea ice and learning from the land.

"At first, the students seemed silent and intimidated. I thought, perhaps, it was me, as I introduced myself as part of PBI's staff. However, after a few days in the field doing interpretive walks, beluga spotting, and coastal trails, the students really opened up. The local knowledge they have is outstanding. It was great to see the students blossom from being shy and quiet into inquisitive and curious individuals!"

We are excited to be able to offer PBI House as a learning hub and meeting space for teachers and students and to better support the school year-round, as requested.

Thanks to all our participants, viewers, teachers, students, and supporters who make this programming possible. We could not do it without you!

Kt Miller is Polar Bears International's senior manager of conservation communications and outreach.

MATERNITY DENNING

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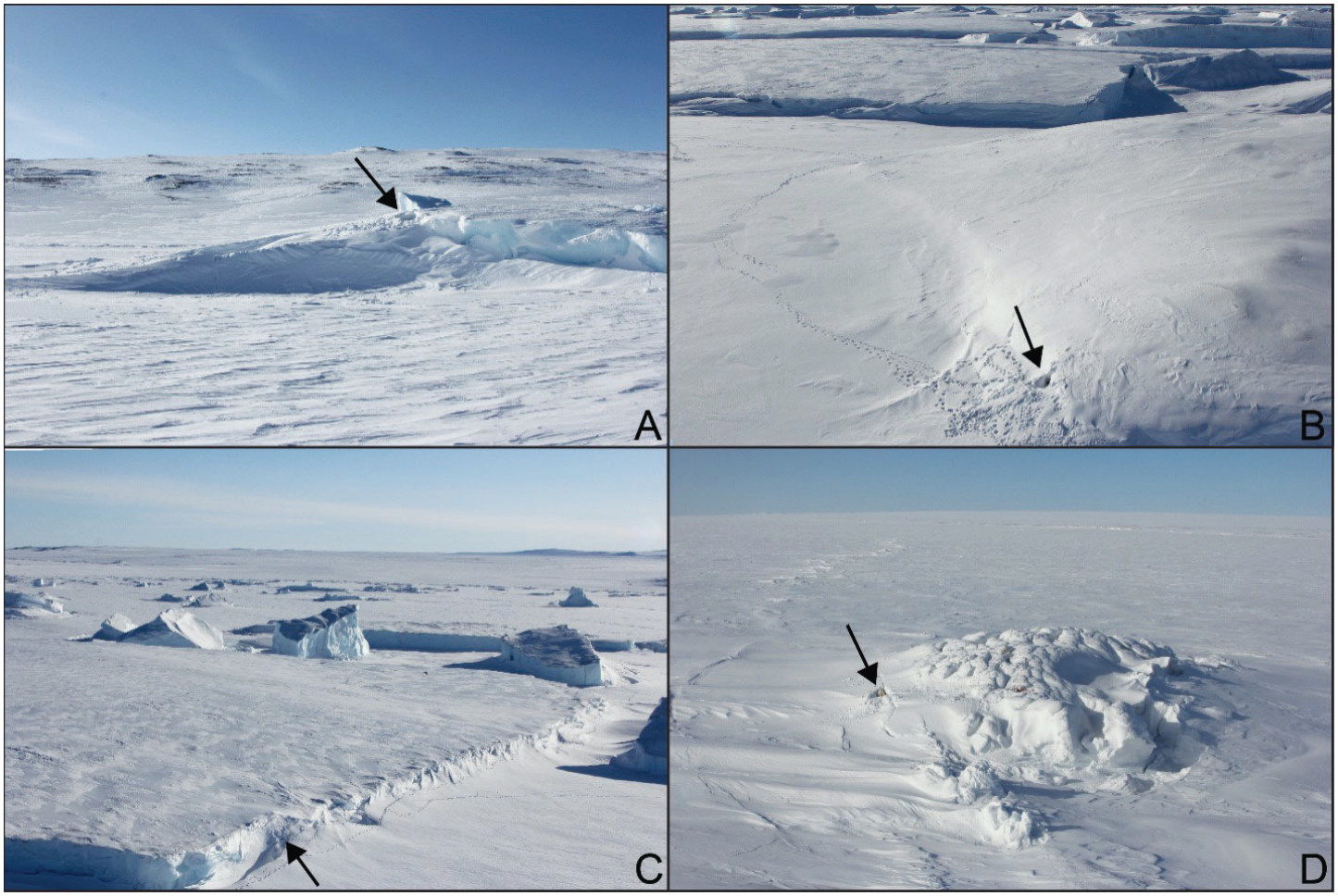
dug by three adult female polar bears were found in snowdrifts formed by wind around the base of large icebergs (freshwater glacier ice) grounded on the sea floor and/or frozen into both annual and multi-year fast ice. This fascinating behavior had never before been reported in the scientific literature. In the following year, two more similar dens were confirmed, and a third suspected one, further north near Station Nord (Figure 1). In total, five polar bear maternity dens were confirmed, and a probable sixth one reported, approximately one to 10 kilometers offshore dug into snowdrifts around the grounded icebergs. Figure 2 illustrates the locations of four maternity dens in snowdrifts by grounded icebergs.

This type of potential maternity denning habitat is limited in distribution and is only possible in heavily glaciated regions of the Arctic where calving of marine-terminating glaciers form icebergs large enough to drift away, become grounded offshore, and remain in place for months or years. Although northeast Greenland has long been known to be an important maternity denning area for polar bears, with reports of dens on land as well as sightings and captures of females with young cubs in the spring, the use of snowdrifts around grounded icebergs for maternity denning had not been scientifically documented before.

WHY ICEBERGS?

Of course, one of the first questions that comes to mind when finding maternity dens in a new habitat for the first time is whether there might be something different ecologically about them. For example, one major ecological difference in the terrestrial habitat in northeast Greenland is that it is a polar desert, meaning there is little snowfall. Consequently, there is much less snow

Figure 2. *Images of maternity dens built in icebergs grounded in the fast ice. Arrows show the location of the den opening on or at the base of the iceberg. In Figure 2D the adult female is visible at the den opening.*



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for forming suitable drifts for denning. However, when we compared the basic habitat needs of pregnant polar bears, including predictable and stable overwinter habitat, the discovery was less surprising but equally fascinating.

Overall, it appears that the driving factors determining the long-term fidelity of adult females to maternity denning habitat by grounded icebergs are much the same as those that characterize terrestrial maternity denning habitat elsewhere in the Arctic. These include: 1) annual predictability of abundant suitable snowdrifts for denning; 2) abundant habitat; 3) stable snowdrifts because of very cold conditions; and 4) proximity to rich feeding grounds in spring, in this case the biologically productive Northeast Water Polynya (an area of open water surrounded by ice), where seals are abundant and accessible for hungry females with cubs shortly after breaking out of their dens in the spring.

Thus, for the moment, the combination of features described above creates an excellent maternity denning habitat for pregnant females in the autumn, for much the same reasons that they dig dens on land in other parts of the Arctic. However, the continued decline of sea ice throughout the Arctic as a consequence of continued climate warming may eventually have a negative influence on the stability of grounded icebergs as sites for maternity denning if break-up expands into new areas or occurs earlier. Similarly, it is uncertain what the effects of increased human activity might be in nearby offshore areas because of their greater accessibility as the sea ice declines in future decades. These will be important issues to monitor in future years.

Dr. Kristin Laidre is a research scientist at the University of Washington and a biologist with the Greenland Institute of Natural Resources. Dr. Ian Stirling is an adjunct professor with the Department of Biological Sciences, University of Alberta, and a research scientist emeritus with Environment and Climate Change Canada.

POLAR BEAR GENETICS

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ADAPTING TO ARCTIC LIFE

For instance, there are signs of selection in genes associated with the most obvious and striking adaptation in polar bears: their coat color. Brown bears can have fur ranging in color from dark brown to blonde, but polar bear fur lacks pigmentation, making it appear white. You can imagine how a white bear would have a greater chance of sneaking up on prey on the sea ice and therefore may have been more successful in passing on their genes to the next generation.

Polar bear skulls and dentition also changed significantly as they adapted to life in the Arctic. Adaptations include sharpened molars, which allow polar bears to shear off pieces of frozen seal. Brown bears, on the other hand, have flat molars that allow them to grind up the vegetation and berries that form a large component of their omnivorous diets.

In addition, polar bears had to adapt to the high fat content of their marine mammal prey. Because of their fat-rich diet, polar bears have high levels of LDL cholesterol (the "bad" cholesterol), which in humans represents a significant health risk. However, because of their genetics, polar bears do not have fatty deposits in their arteries despite their fat-rich diets. These are just a few examples of how genes have influenced polar bear evolution. Genes controlling body fat, fatty acid metabolism, heart function, and fur pigmentation may have all played significant roles in the adaptation of polar bears to the Arctic marine environment.

INSIGHTS INTO POLAR BEAR ECOLOGY AND THE FUTURE

What else can genetics tell us about polar bears? Having a DNA sample from an individual bear gives us their unique genetic fingerprint. Like DNA profiling on your favorite crime investigation series, DNA profiles of polar bears allow scientists to track individual bears through time to look at variations in their survival and reproduction. The data gained helps inform our understanding of changes in population size and growth.

Having individual DNA profiles also provides detailed insights into the polar bear mating system. Observations of polar bear mating are extremely rare. However, by using individual genotypes researchers can build pedigrees that contain both maternal and paternal assignments. As a result of long-term research in western Hudson Bay led by Environment and Climate Change Canada, researchers have been able to develop a pedigree containing over 4,300 individuals spanning six generations of bears.

Delving into the pedigree, researchers have found several interesting things. For instance, it has provided evidence of identical twins in polar bears, the first and only case of identical

"Because of their genetics, polar bears do not have fatty deposits in their arteries despite their fat-rich diets."

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Polar Bear Cam

Every fall, Polar Bears International, Frontiers North Adventures, explore.org, and Parks Canada team up to stream the annual gathering of polar bears from the shores of Hudson Bay to people around the world. Watch the live cam at **explore.org/polarbears** or **polarbearsinternational.org/polar-bear-cams**.

twins in any bear species. Researchers have also identified several cases of cub adoption: Females were observed in the field taking care of cubs that ended up being genetically unrelated to them. This unique behavior was first described in polar bears in the mid-1990s and nobody is sure as to why it happens. Polar bear mothers may be so primed to look after their cubs that they are willing to adopt cubs that appear orphaned or are on their own.

The pedigree has also provided valuable insight into male mating success and has shown that prime-aged males between 10-18 years of age do most of the mating. In addition, by looking at litters with multiple cubs we know that some cubs in the same litter have different fathers.

So why is understanding polar bear genomics important? We know from many species that genetic diversity enhances the probability of population survival over time. Thus, understanding how their genetic diversity is distributed among the world's polar bear populations is an important first step to assessing the potential ability of the species to adapt to environmental change, including ongoing climate warming. Although random mutations can result in adaptation to novel new environments, the standing genetic variation in populations forms the bulk of the raw material for adaptation and change. Assessing and conserving the genetic variation that exists amongst the world's polar bear populations is an important first step for the long-term conservation of the species.

Dr. Evan Richardson is a polar bear research biologist with Environment and Climate Change Canada. Dr. Joshua Miller is a postdoctoral researcher funded by Polar Bears International and the San Diego Zoo Wildlife Alliance.

TERRESTRIAL

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speed and change their diet completely, there would be definite competition between the two bear species, as they would be trying to fill the same ecological niche.

Second, polar bears specialize in hunting seals from the sea ice, not in hunting on land. Going back to the nest-raiding discussed above, a recent paper found that as fewer and fewer eggs were available (because the rest had already been eaten), polar bears were so inefficient at distinguishing full nests from empty ones that their search for eggs led to an overall declining net loss of energy.

Polar bears are also at a disadvantage when it comes to capturing moving prey. Although a polar bear can sprint the last 20 meters or so towards a seal lounging on the sea ice, running for much longer causes them to overheat, even in cold temperatures. A caribou or similar prey would likely have to be either very sick or very inattentive for a polar bear to catch it. I am by no means suggesting that a hungry polar bear wouldn't give it a try—in fact, a friend once witnessed a female polar bear chase a reindeer calf in Svalbard. Quite predictably, the chase ended with Calf 1, Bear 0.

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A LIFE TIED TO SEA ICE

In summary, although terrestrial foods could potentially benefit a few individuals out of a local population, polar bears that are seen snacking on land-based food sources during the summer are not adapting long-term, they are simply doing their best to survive short-term while waiting for the ice and the seals to come back. Blubber is the only food that's rich enough in energy to keep the bears alive and well long-term. The fatter the bear, the better its chances of surviving the summer and being healthy and ready to hunt again (and for some females, to give birth to their cubs) once the sea ice returns in the late fall.

Without sea ice, there will be no polar bears. Neither the bears nor their seal prey can tolerate the continued loss of their primary habitat.

Dr. Thea Bechshøft is a staff scientist with Polar Bears International based in Aarhus, Denmark. She has studied polar bears in Greenland, Norway, and Canada and is the author of the popular Polar Bear Questions series on Facebook and Instagram.

Q&A *continued from page 11*

It's just you and the wildlife. It's completely surreal.

Every day, we'd go onto the sea ice, looking for moms and cubs in -35-degree C weather. It was spring but I was bundled up in a parka and the coldest I've ever been. Seeing polar bear families on the sea ice solidified the importance of research and conservation for me. Moms and cubs are the most vulnerable groups of polar bears, and we need to do all that we can to help them.

Q: When did you become a full-time staff member with Polar Bears International? What is your role?

After finishing my master's in 2013, I stayed working for Andy as a research assistant while looking for other jobs. I started with PBI in 2014 on a part-time basis and, within a couple of months, joined the staff full-time, working with the Tundra Connections program and other educational outreach.

I really love to take the science and use different ways to tell people about it. It's an important part of polar bear conservation, whether I'm doing broadcasts, talking with people, doing media interviews, adding data to PBI's Bear Tracker map, creating lesson plans, appearing in videos, or writing blog posts.

Recently, I helped create a series of coloring books, tailored to different Arctic communities, that share kid-friendly messages on how to live safely with polar bears. It was a fun project and a great example of not only using science but also art, communications, and education, all wrapped into one. I'm excited to see how the project has taken off and to watch how far it will go.

Q: Do you have any advice for young people interested in a career with polar bears?

If they're specifically interested in polar bears, they should read a lot about them and not be afraid to reach out and ask questions. Look at science degrees but also look at PBI's staff and see all the different ways to work with polar bears, whether it's social science, policy, education, or field support. If there's a door open, go for it. And don't be afraid to ask mentors to help you open closed doors. Polar bears, conservation, and climate change issues will only continue to grow in coming decades, and young people can play an important role. In fact, seeing people around the world become aware and get involved is what motivates me every day. The decisions we are making today will determine the future for polar bears and for ourselves. By acting now, we'll improve conditions for us all.

Barbara Nielsen is Polar Bears International's senior director of communications.

DIVE INTO THE NEW POLAR BEARS INTERNATIONAL WEBSITE

A few highlights: an interactive Polar Bear Tracker, educational webcasts, tools for students and teachers, and a fresh new shop featuring adoptions and e-cards.

See you there!

www.polarbearsinternational.org

WHB RESEARCH *continued from page 13*

BUT WHAT WAS CHANGING?

Sea ice is a key component of the Arctic marine ecosystem and to the life history of polar bears—it's the platform from which they hunt seals, mate, and travel. During the same period in which we observed changes in the Western Hudson Bay polar bears, warming temperatures and a trend towards earlier breakup of sea ice in the spring had been documented by atmospheric scientists. An analysis of the data revealed a significant relationship between the date of sea ice breakup and the condition of bears when they came ashore. Bears came ashore in poorer overall body condition in years when breakup was earlier, presumably because they had less time on the sea ice to hunt.

One of the more striking results linking sea ice breakup to polar bear well-being was that cubs born in the winter of 1992 tended to be in better condition and have higher survival rates than cubs born in the years before and after. In June 1991, Mount Pinatubo, a volcano in the Philippines, erupted. Large amounts of particulates were released into the atmosphere, resulting in cooler-than-normal global temperatures in 1991 and 1992. Sea ice breakup in Hudson Bay was significantly delayed that year to the benefit of cubs born in 1992. This formed some of the earliest evidence that long-term research and data on polar bears could pick up larger environmental signals in the Hudson Bay ecosystem.

PUTTING THE PUZZLE TOGETHER

Although a growing body of evidence linked human-caused greenhouse gases to global warming, it was difficult to quantify the effects on polar bears. Understanding the impacts would require large datasets on many individual bears over time. Working with colleagues from the U.S. Geological Survey, we discussed using the long-term data from Western Hudson Bay—the best-studied bears in the world— to try to better understand how polar bears would respond to a warming climate. If these data could help answer the questions, the insights could help inform other, shorter, polar bear datasets.

Our collaboration resulted in an important finding: the data showed that the Western Hudson Bay polar bear population had declined by approximately 20% over a 20-year period. Evidence suggested that this decline was likely due to earlier breakup of sea ice and decreased survival of polar bears, particularly juveniles, subadults, and older bears.

Since these early studies, there has been a growing recognition of the value of long-term datasets, which allow one to tease apart changes that are part of the natural variation inherent in ecosystems from unidirectional changes that signal a fundamental change.

Today, loss of habitat due to climate warming is recognized by the five Polar Bear Range States as the primary threat to the long-term persistence of polar bears. Highly specialized species, such as the polar bear, are particularly vulnerable if their environment changes.

The Western Hudson Bay dataset now spans 40 years of research. In fact, we are now capturing descendants of some of the first bears we caught back in the early 1980s! Moving forward, this research will become increasingly important as we try to better understand how polar bears will respond to the impacts of global warming, estimate what may lie ahead for other populations not yet touched by these impacts, and provide science-based advice to help inform conservation actions.

Forty years ago, I began a journey with no idea of where it would lead. I am grateful for the opportunities that I have been given and hope that the ongoing research we have undertaken will lead to concrete actions to conserve and secure polar bears in the wild for many future generations to come.

Dr. Nick Lunn is a research scientist for Environment and Climate Change Canada.

Polar Bears International CALENDAR OF EVENTS

INTERNATIONAL POLAR BEAR DAY
February 27th

ARCTIC SEA ICE DAY
July 15th

BELUGA CAM
Mid July-mid September

POLAR BEAR CAM
Late October-late November

POLAR BEAR WEEK
First week of November

NORTHERN LIGHTS CAM
November-March

In Memoriam

We mourn the loss of polar bear scientist Markus Dyck, pilot Steve Page, and engineer Benton Davie, who died in a helicopter crash last spring while researching polar bears in Lancaster Sound, Canada. Our heartfelt condolences to their families, friends, and colleagues. They will be missed by all.

MAKE OUR WORK POSSIBLE 365 DAYS A YEAR

The polar bear's future depends on steady, reliable support from caring champions like you.

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