Expedition: Hearts in the Ice

Field Study: Exploration, Conservation and Education

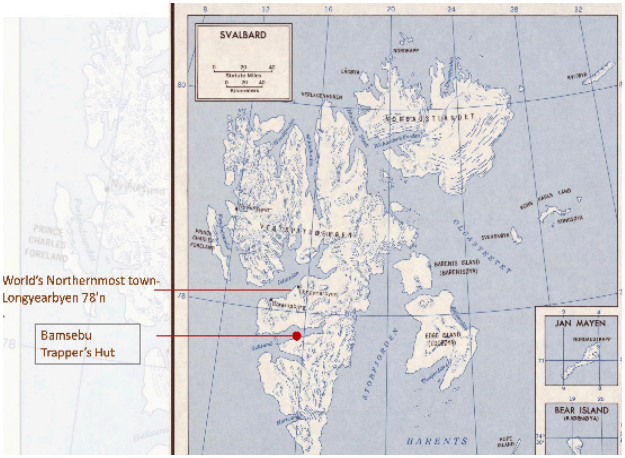
Summary: Sunniva Sorby, born in Tonsberg, Norway, and raised in Canada and Norwegian Hilde Fålun Strøm are pioneers in women's polar exploration and citizen science. With the goal of bringing together students, scientists and environmental organizations they created Hearts in the Ice with the common goal of protecting the health of our planet through conservation and exploration. In the fall of 2019, Sunniva , Hilde and Ettra, their 4-legged friend, set out for Svalbard, Norway. Their expedition was to last for 9 months with the goal of collecting data for 9 climate related science projects as " citizen scientists" and to connect with youth around the world as they surveyed rapid climate change.They became the first team of women to overwinter in the Arctic without men. Planning to finish their expedition in May 2020, they emerged from the dark arctic winter to find a changed world; the lockdown response to COVID-19 made it such that no ship pickup was possible. As seasoned explorers with a passion for their work, Sunniva and Hilde continued their research and data collection through another long winter making their stay last for 9 months. They were aided by a WINGS WorldQuest Emergency Relief Fund Grant which supported their continued satellite communications and virtual classrooms. The data, photos and samples collected from the sky, the snow/ice, wildlife, and even their own psychological wellbeing contributed to many studies across multiple organizations and institutions.

THE EXPEDITION

What is Hearts in Ice?

Hearts in the Ice is the team of Sun- niva Sørby & Hilde Fålun Strøm, who have served as Citizen Scientists collecting science data and obser- vations as Polar Ambassadors With expertise in collaborating with a Global network of diverse partners, Hearts in the Ice is a platform that inspires, connects, educates and ig- nites collective action around press- ing Climate Change issues as we all navigate towards a more thoughtful and sustainable way forward that will impact all of us, our children and our natural world. Hearts in the Ice has already proven to be a model for how scientists, industri- al partners, explorers, artists and

Sunniva Sorby, Hilde Fålun Strøm and ETTRA, Flag #14, Svalbard



Svalbard, Norway

other stakeholders can meet in a common action to focus on Polar climate changes.

Citizen Science at Bamsebu:

From 2019-2021 Hilde and Sunniva spent 19 months at Bamsebu with 6 months in the "Polar Night" of darkness navigating the challenges of isolation and the fact that their closest neighbors were polar bears. They had over 100 Polar bear encounters. They were the first women in recorded history to overwinter in the Arctic without men.

Bamsebu, the rustic trapper's cabin built in 1930 for Beluga hunting- which measures a quaint 20 m2 (215 sq ft) was the location and home where they lived a rather simple, purposeful existence. They contributed concrete data for a team of international researchers, shared real-time observations with students around the globe and stories of their time living off the grid 140 km/87 miles from the nearest neighbor.

Auroras / Aurorasaurus: At : At 140 km from Longyearbyen, Hilde and Sunniva were literally closer to space, and the bottom edge of the beautiful aurora (100 km), than they were to people. Auroras are born of the interaction between nitrogen and oxygen in Earth's atmosphere and incoming charged particles previously trapped in the magnetosphere.

Geomagnetic storms, which can energize the magnetosphere with large amounts of charged particles, directly

WHO
Sunniva Sorby & Hilde Fålun Strøm

WHAT
A 19 month over-wintering expedition to collect data for multiple fields of science which served as a bridge between science and the public's understanding.

WHEN
September 2019 - May 2021

WHERE
Van Keulenfjorden / Bellsund "Bamsebu Trappers Cabin," 78' North Svalbard, Norway

WHY
Citizen Science and Education Outreach to inspire global dialogue and ignite social engagement to embrace the planet!

Sunniva Sorby, Svalbard

impact the creation and appearance of auroras. Scientists aren't yet able to reliably and accurately predict space weather disturbances like geomag- netic storms, but large geomag- netic disturbances can affect the functionality of communications systems and power grids, so predict- ing their arrival is important.

Sunniva Sorby and Hilde Fålun Strøm taking ice core samples, Svalbard, Norway

Aurorasaurus connected Hearts in the Ice with international rocket scientists who use artificial aurora to study the upper atmosphere from Norway. In coordination with a sound- ing rocket launch, Hearts in the Ice contributed photographic data that can complement other data being gathered and provide a unique perspective that helps to better unravel the complex four-dimensional dynamics at play earning the team the official title "Rocket Citizen Scientists".

Drone Flights / BCIT: Remotely Piloted Aircraft Systems (RPAS), commonly known as drones, are amazing technological tools for environmental data gathering. The visible and thermal data collected by drones has numerous applications from quantification of surface phytoplankton concentration, to wildlife observation, and snow-depth estimation.

The team carried out 22 Indro-Robotics drone flights over the period of 19 months, and the resulting 3D maps are the only data of its kind captured over the course of the autumn, winter, spring and summer seasons at one constant location. Furthermore, it adds tre- mendous value to determine whether drones can effectively be deployed into harsh Polar areas to gather data related to climate change.

Wildlife observed during year one: Polar Bears, Arctic Foxes, Belugas, Minke Whales, Walruses, Bearded Seals, Ptarmigans, Reindeer, Pink-footed Geese, Barnacle/Brent geese, Common Eiders, King Eiders, Northern Fulmars, Sanderlings, Purple Sandpipers, Skuas – Long tailed/Arctic, Kittiwakes, Glaucous Gulls, Iceland Gulls, Arctic Terns, Black Guillemots, Little Auks, Snow Buntings, Puffins & Whooper Swans.

Sample Collections: Sunniva and Hilde collected phytoplankton throughout their Arctic winters– something few scientists have funding, resources or time to accomplish. Phytoplankton are microscopic algae that drift in the oceans. They play a critical role in drawing carbon dioxide out of the atmosphere and contribute to over half of the Earth's oxygen- more than the trees and plants on land combined. Collecting samples over time contributes to a greater dataset that helps scientists understand how melting glaciers influences phytoplankton. They also collected plastic during their stay. Litter is causing extensive pollution of the seas, con- taminating the shores, the seabed and the water itself.

In addition to collecting plastic they also dissected the stomachs of any dead Fulmars to look for microplastics and marked each sample with species, date and location. The Northern Fulmar is primarily a pelagic species which remains far out at sea except during the breeding season.

They feed on small pelagic animals near the sea surface; in Svalbard they feed mainly on squid, polychaetes, pteropods, crustaceans and small fish. They often mistake microplastics as a food source, which eventually renders their stomach incapable of digestion which leads to starvation and death.

Ice Observations and Sampling: The team conducted daily observations of sea ice distribution in the bay, weekly snow depth measurements and observations of icing layers on snow (i.e. rain during winter). Sunniva and Hilde took ice core samples from the area around Bamsebu to identify organisms living in the ice. Not much is know about these microscopic organisms living inside sea ice and we are losing the sea ice habitat.

Ice core sampling allowed them to study microscopic algae that grows inside sea ice. These highly specialized algae grow almost without light and can bloom up to two months earlier than phytoplankton in the water column below. That makes ice algae a critical early food source for many Arctic marine invertebrates, giving them a head start on reproduction and growth.

Sunniva Sorby and Hilde Fålun Strøm, Flag #14, Svalbard, Norway

These tiny organisms are comprised of small larvae stages of bottom living organisms important nursery ground for some bottom species. Here their larvae can hide in the small brine channels and feed on ice algae – safe for larger predators which cannot access the sea ice due their too large body sizes.

Systematic Observation of Polar Bears: In the area near and around Bamsebu there have been pollution studies regarding polar bears (performed by Jon Aars in collaboration with Heli Routti) showing that polar bears from the west side of Svalbard have higher levels of contaminants and are in poorer condition than bears from the eastern side. Species observations in an Arctic setting can be difficult and time consuming.During the seasons Hearts in the Ice recorded their encounters with polar bears. This data helped scientists understand polar bear behaviors, distribution and health.The result of 19 months of observation on N26131- a female Polar Bear resulted in a 13min film short in collaboration with Polar Bears International called "VIOLET- A polar bear story."

Observation of Insects: In the fall and spring, Sunniva and Hilde collected data on insects spot- ted around the cabin using an "insect tent." This will contribute to a growing dataset of where insects are found in the Arctic and their seasonal activity. There are over 250 species of insects recorded from Svalbard, including flies, wasps, beetles, moths, fleas and even aphids. Of these, two-winged insects (flies and gnats), makes up the most abundant and diverse group, with about 130 species. In terrestrial habitats they constitute an important food source for birds, and in the absence of bees and butterflies, they play a major role as pollinators in the Arctic. The samples from Bamsebu will render more information about which species are the first to arrive

in early spring; when they start flying, and which overwintering strategies are involved in the survival of these "spring pioneers".

Clouds and NASA Globe Observer: Bamsebu's vantage point of the Earth, from the ground looking up and into the horizon, is unique. Looking at clouds and the sky, Sunniva and Hilde could see the bottom of the clouds while satellites see the top of the clouds. The combination of both views creates a complete story. This view of changes is also unique and can highlight events of the changing Earth that would be hard to detect using other sources of data.

GLOBE Observer invited HITI (Hearts in the Ice) to make environmental observations that complement NASA satellite observations to help scientists studying Earth and the global environment. Sunniva and Hilde took observations for NASA to help their satellites better understand how clouds assist in the overall changes in our planet's climate. They accomplished this by timing their observations with the exact time that satellites fly right over Bamsebu.

In addition there is particular interest in two specific cloud types that they will photograph when visible:

- Polar Stratospheric Clouds – A big component of the ozone hole over Antarctica is occur- ring more and more over the Arctic (there is also an ozone hole over the Arctic but it is not as severe as the one over Antarctica).
- Noctilucent Clouds – Information about these clouds and their importance with methane emissions can be found here.

Exploring and Coping with Isolation: Gro Gro Mjeldheim Sandal, a professor in psychology at the University of Bergen, Norway has been leading projects focusing on the psychological reactions during spaceflights and in other extreme environments. Sunniva and Hilde con- tributed to Professor Sandal's research by providing valuable data on psychological health, coping strategies, work motivation and team processes during the entire time on Bamsebu.

Wildlife observed during year one: Polar Bears, Arctic Foxes, Belugas, Minke Whales, Walruses, Bearded Seals, Ptarmigans, Reindeer, Pink-footed Geese, Barnacle/Brent geese, Common Eiders, King Eiders, Northern Fulmars, Sanderlings, Purple Sandpipers, Skuas – Long tailed/Arctic, Kittiwakes, Glaucous Gulls, Iceland Gulls, Arctic Terns, Black Guillemots, Little Auks, Snow Buntings, Puffins & Whooper Swans.

EXPEDITION GOALS:

- Citizen Science and Education Outreach to inspire global dialogue and ignite social engage- ment to Embrace the Planet!

Polar Bear and Cub, Svalbard, Norway

- Bamsebu allowed for year-round observations that can strengthen and enhance scientists' ability to utilize remote sensing data to evaluate that climatic state in the region. Contributing photographs of Auroras that can complement other data being gathered and provide a unique perspective that could help better unravel the complex four-dimensional dynamics at play.

Sunniva Sorby and Hilde Fålun Strøm taking ice core samples, Svalbard, Norway

- Carrying out Indro-Robotic drone flights to create 3D maps captured over the course of the autumn, winter, spring, and summer seasons at one constant location adding tremendous value to determine whether drones can effectively be deployed into harsh Polar areas to gather data related to climate change. Collecting plastic and dissecting the stomach for microplastics of any dead Fulmars. Observing the sea ice distribution in the bay combined with weekly snow depth and ice thickness measurements. Taking ice core samples from the sea ice around Bamsebu to identify organisms living in the ice.
- Recording encounters with polar bears. This could help scientists understand polar bear behaviors, distribution, health, and how the bears react when they come into close proximity to humans.
- Collecting data on insects spotted around the Bamsebu cabin using an "insect tent". This would contribute to a growing dataset of where insects are found in the Arctic and their seasonal activity.
- Photographing Polar Stratospheric Clouds and Noctilucent Clouds assisting in the observation on how clouds assist in the overall changes in our planet's climate.
- Providing valuable data on psy- chological health, coping strate- gies, work motivation and team processes during the entire time on Bamsebu.

"Our goal has always been to bridge the gap in understanding between science and ordinary people, to take people out of Climate despair, a form of depression, and into Climate optimism which is all about hope and action." - Hearts in the Ice

CHALLENGES FACED AND LESSONS LEARNED

Challanges during the expedition included six months of complete darkness, no regular Internet, over 100 polar bear encounters, small cabin for 2 people plus 1 dog- 20 sq mtrs total space, no running water, no electricity, and no insulation in the hut. We spent 14,000 plus hours together though we had helpful coaches on communication/problem solving and counted on each

other for our lives, safety. Wellbeing takes work, but there is no better work to be done. We learned how infinitely powerful a community of women are when when surrounded by other women- we are rather unstoppable.

We are so grateful for the emergency funding we received from WINGS as our initial 9 months was extended to 19 months due to COVID-19. This made logistics and extra supplies possible for us- thank you!

EXPEDITION RESULTS

The Arctic tundra is more threatened by climate change than any other terrestrial biome on Earth. Observations and samples collected by Sunniva and Hilde as citizen scientists through Hearts in the ice was an invaluable contribution to science. Their 19 months of data during their stay in a remote part of Svalbard helps to better inform research on conservation, climate change, and isolation.

Sunniva and Hilde collaborated with and collected data voluntarily for NASA - GLOBE Cloud Observations, NASA Aurorasaurus, Scripps Institution of Oceanography- FjordPhyto, British Columbia Institute of Technology, University of Svalbard, and the Norwegian Polar Institute. Each of these organizations and institutions benefited immensely from their nineteen-month expedition and have used Hearts in the Ice as a model for cross-collaboration between research silos and the power of storytelling to educate and inspire action.

"We connected with over 100,000 youth around the world through our live video calls joining experts, students and us from our remote Bamsebu to share engaging interactive content on Climate change topics & how important it is to engage everyone. To stay passionately curious is to stay forever young and relevant." - Hearts in the Ice

ABOUT THE FLAG CARRIER

Sunniva Sorby is the project co-leader of Hearts in the Ice, polar ambassador, author , Keynote speaker, citizen scientist, Senior Polar Guide for PTGA (Polar Tourism Guides Association), a WINGS WorldQuest Flag Carrier, Chair of the BC/Yukon Explorers Club, a Fellow of the RCGS (Royal Canadian Geographical Society), a member of the Society of Women Geographers, a participant of the 1992-1993 historic Women's South Pole Expedition, the first Canadian female expedition leader of the 1999 Greenland Crossing, and an expedition leader of the 1998 King George Island Crossing. Sunniva has also hiked, backpacked, camped, biked, kayaked, and explored some of the most remote places on the planet.

On January 14th, 1993, Sunniva Sørby made history as one of the four team members of the Amer ican Women's Antarctic Expedition. They reached the South Pole following a grueling 700-mile trip across the snow and ice of Antarctica with fellow WINGS Flag Carrier (and 2008 WINGS Fellow) Ann Bancroft as the Expedition Leader. The team skied for 67-days into head-winds of up to 50 miles an hour, pulling 200- pound sleds in temperatures that dropped to 67 below zero. They were the first women's team to ever reach the South Pole on foot without the aid of sled dogs or motorized vehicles.

Hearts in the Ice Co-Founder, Hilde Fålun Strøm, is an Arctic Advocate, Explorer, TEDx speaker,

author and Citizen Scientist. She has been an eye-witness to climate change in the Arctic. With three decades of exploring the Arctic she has a unique competence and a deep urge to protect the polar regions and the sea ice. Hilde and Sunniva are Godmothers for Hurtigruten´s hybrid Expedition ship MS Fridstjof Nansen.

Hearts in the Ice reached 100.000 schoolkids around the world together with invited experts on climate related themes. They also collected important data for 9 science institutions like NASA and the Norwegian Polar Institute.

Hilde is an international member of the Explorers Club, a Flag Carrier of Wings World Quest, a member of Society of Women Geographers and received the Honorary Old Girl award from Trafalgar School for Girls in Montreal. Hilde is an international member of the Explorers Club, a Flag Carrier of Wings World Quest, a member of Society of Women Geographers and received the Honorary Old Girl award from Trafalgar School for Girls in Montreal.

CITIZEN SCIENCE AND EDUCATION - HEARTS IN THE ICE

Sunniva and Hilde's four decades of experience in and passion around the polar regions of Antarctica and the Arctic inspired the name "Hearts in the Ice". They are not heroines but they are concerned citizens who believe that we all have the power to make some contribution to the planet that is in dire need of all us to engage and understand what is happening to the ecosystem and our resources.

EXPEDITION TEAM

Sunniva Sorby - Co-Leader, Climate Engagment Officer
Hilde Fålun Strøm - Co-Leader, Climate Engagment Officer
ETTRA - Alaska Malamute and Greenlandic Husky

CONTACT INFORMATION

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