Built Cultural Heritage in Antarctica

Remains and uses of the first Swedish South Polar expedition 1901-1903
BUILT CULTURAL HERITAGE IN ANTARCTICA
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Built cultural heritage in Antarctica. Remains and uses of the first Swedish South Polar expedition 1901–1903
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Argentine National Directory for Antarctica (DNA)
Argentine Institute for Research in Antarctica (IAA)
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University of Gothenburg (UGOT), Conservation and Centre for Digital Humanities
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Cover: The Winter Station on Snow Hill Island, Antarctica. Photo: Gunnar Almevik.

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The remains of the first Swedish South Polar expedition are constituents of different historical narratives and elements of cultural heritage to many nations. Through the Antarctic Treaty, four cultural environments, on Snow Hill Island, Hope Bay, Seymour-Marambio Island and Paulet Island, are listed as Historic Sites and Monuments to commemorate the history of science and exploration of Antarctica. The fact that the expedition hosted the Argentinian lieutenant José María Sobral, who stayed with Dr Otto Nordenskjöld on Snow Hill Island and participated in the research fieldwork, and furthermore that the final rescue came with the Argentine Navy ship Uruguay in November 1903, have placed our countries in a shared position to safeguard this cultural heritage. The value of this cultural heritage is not just the essence from a passed reality, but also a vital means for cultural tourism, research and international collaboration today. No cultural heritage is made just once, but constantly transforms through our different perceptions, uses and actions. Today, we find the Winter Station on Snow Hill Island urgently threatened by the effects of climate change. The building is rather well kept, but the very ground it stands on is destabilised by thawing permafrost, meltwater erosion, increasing precipitation and a raised sea-level. This is one of the big global challenges that will require international collaboration. In recent decades, the Argentine Antarctic Program carried out conservation tasks on the site, both regarding the structure of the hut and the material collection, in communication with the Swedish Antarctic Program, although, up until the CHAQ2020 expedition, there has been no official Swedish involvement in the field in the active safeguarding of cultural heritage in Antarctica. Through this campaign, we have established a new path for collaboration. We have substantial documentation and a knowledge base for the decisions we shall take on how to proceed. Antarctica is a remote place which is not disclosed to a large audience, but through the documentation that is now made accessible, many people may digitally roam these landscapes and places and also follow and engage in the process.

Joakim Malmström, Swedish National Heritage Board
Katarina Gårdfeldt, Swedish Polar Research Secretariat
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1. SUMMARY

The first Swedish South Polar expedition, 1901–1903

In 1901 Dr Otto Nordenskjöld led the first Swedish South Polar expedition with a multidisciplinary team of researchers in geology, geography, biology and medicine. The original plan was to hibernate in Antarctica and stay for one year to survey the land, measure the climate and collect samples, but their ship was wrecked and the expedition came to last more than two years until November 1903. When arriving on the continent, the expedition members divided into groups to explore the Antarctic Peninsula. A prefabricated Winter Station of wood was brought from Sweden and erected on Snow Hill Island, serving as a base for Nordenskjöld and five other members of the expedition, among them the Argentine Navy lieutenant José María Sobral. When the ship Antarctic sank in February 1903 the groups shattered and two provisional stone huts were erected for shelter, one on Paulet Island and another on Trinity Peninsula. The latter was named ‘Hoppets vik’ by the expeditioners, in English translation ‘Hope Bay’ and in Spanish ‘Bahía Esperanza’. The Winter Station, the remains of the two stone huts and a cairn that was erected by the expeditioners on Seymour–Marambio Island still exist and are protected as Historic Sites and Monuments (HSM) according to the Antarctic Treaty System (ATS).

A cultural heritage to many nations

The remains of the first Swedish South Polar expedition are located in an area of Antarctica claimed by Argentina as part of their national territory. The remains from the expedition are also valorised as an Argentinian cultural heritage by the fact that the expedition hosted the Argentinian lieutenant José María Sobral, who stayed with Nordenskjöld on Snow Hill Island and participated in the research fieldwork. The rescue of the expeditioners was also managed by Argentina, and the Winter Station is also protected by national Argentinian law since 1965 and the rescue ship Uruguay and various artefacts from Nordenskjold’s expedition are part of the Argentinian national naval museum and and the historical collection of the Instituto Antártico Argentino (IAA). In the early 1970s, Argentina and the United Kingdom proposed the listing of the Winter Station at Snow Hill Island and the stone hut in Hope Bay according to ATS. Later, Argentina, the United Kingdom and Norway also proposed to include the stone hut on Paulet Island.

Figures 1–9. The expedition has been illustrated by various painters. The American painter Frank Wilbert Stokes joined Nordenskjöld’s expedition during 1902. He depicted a colourful pastoral Antarctic landscape (1, 7 and 8). Episodes from the expedition were also illustrated at a later date by Swedish painters Erik Lange (2, 6 and 9) and John Bauer (3-5) for Nordensjöld, Andersson, Larsen and Skottbergs’s two-volume book Antarctic from 1904 (pages 173, vol. I., 161, 325, 301, 289, 351 vol. II., 165, 81 vol. I., and 375 vol. II.) (PDM).
**Formal status and protection**

According to ATS, the four listed HSM related to the Swedish South Polar expedition of 1901–1903 are proposed to be managed in collaboration between Sweden and Argentina, and with Norway concerning Paulet Island. The first safeguarding actions were taken in the early 1950s by the Argentinian military but a more systematic preservation was initiated in the 1980s by the Instituto Antártico Argentino (IAA) under the Dirección Nacional del Antártico (DNA). The Winter Station at Snow Hill Island has long been part of a system of refuges in Antarctica with a depot of basic provisions and supplies for the distressed. However, since 2009, the site guidelines define the station as a museum and restrict the use for temporary or periodical dwelling. Up until the CHAQ2020 expedition, there has been no official Swedish involvement in preservation and maintenance of the remains of the first Swedish Antarctic expedition.

**Swedish concern and initiative CHAQ2020**

The question about an extended and official Swedish involvement in the safeguarding of cultural heritage in Antarctica has been the subject of initiatives since at least the late 1990s. It has involved diplomats, researchers and faculty at Swedish universities and professionals within the International Council on Monuments and Sites (ICOMOS). Building on these initiatives, CHAQ2020 emerged as a result of a research project on cultural heritage called CHAQ, funded by the Swedish Research Council (VR) and a decision of the National Heritage Board of Sweden (RAÄ) to explore its possible role in matters pertaining to cultural heritage in Antarctica. The RAÄ became involved in 2016 after staff from SANAE (South African National Antarctic Expedition) found a depot of artefacts originating from an international Norwegian-British-Swedish research expedition dating to 1949–1952 (NBSX) on Queen Maud Land in Antarctica. SANAE contacted the Swedish Polar Research Secretariat (SPRS), which in turn initiated a discussion involving the Royal Institute of Technology (KTH), the Swedish Ministry of Education and the RAÄ about the assessment of the NBSX depot in regard of HSM, and more broadly on how matters pertaining to cultural heritage in Antarctica could be handled in Sweden. In 2017 the RAÄ made a formal statement that the remains of the depot had heritage values matching the requirements for a HSM and simultaneously called for a unison strategy for Swedish cultural heritage in Antarctica based on international collaboration. In 2018 SPRS decided to support an application by KTH to conduct fieldwork at the remains of the first Swedish Antarctic expedition in Antarctica for the VR-funded project CHAQ and including it within its Swedish Program for Antarctic Research (SWEDARP). The name of the expedition was CHAQ2020. SPRS facilitated CHAQ2020 through collaboration with its Argentinian sister organisation DNA-IAA. In 2019 the RAÄ accepted an invitation from KTH to participate in CHAQ2020 as a Swedish contribution to the conservation efforts by the IAA at the remains from the Swedish expedition. The RAÄ commissioned two experts in built environment and heritage documentation to join. The DNA-IAA organised and funded the CHAQ2020 logistics within the framework of their Antarctic research program, under the leadership of Pablo Fontana.
The fieldwork

The fieldwork presented in this report is the result of a collective effort by all members of the expedition, including logistics staff of the DNA-IAA. The data presented in the report was generated by Gunnar Almevik, Dag Avango, Valeria Contissa, Pablo Fontana, Kati Lindström and Jonathan Westin, with logistic collaboration in the field work of the captain Héctor Mamani Ovejero of the Argentine Army, during one month in Antarctica, from the 10th of January to the 10th of February 2020. The objectives for the fieldwork were: a) the need for a knowledge base for policy and decision making concerning Swedish Cultural Heritage in Antarctica and b) to collect data for the research project CHAQ. Hence, the main tasks for the fieldwork were to document the remains, assess the condition and propose recommendations. Another objective was to collect data to potentiate public digital accessibility to this remote cultural heritage, and also to support future research on climate and cultural heritage in Antarctica. For this purpose, by initiative of the IAA geodist Andrés Zakrajsek, a weather station and data loggers were set up on Snow Hill Island to record temperature, earth-temperature, humidity, wind-speed, sunlight and precipitation. The documentation involved manual scale drawings, drone-based and land-based photogrammetric triangulation, laser scanning, photography and sound recording. The digital or digitised data from the fieldwork is open and accessible through a project repository provided by the University of Gothenburg’s Centre for Digital Humanities and the Department of Conservation (accessible at https://antarctica.dh.gu.se). The survey was made according to the international standard SS-EN 16096:2012 for in situ condition surveyal of cultural heritage, comprising sources and information management, object descriptions, condition surveys, risk assessments and recommendations. This fieldwork report also involves analysis of cultural heritage significance and scenarios for possible alternative approaches to intervention and management. The main priority was the Winter Station and the assemblage of elements of former expeditions on Snow Hill Island. The stone hut at Hoppets vik/Bahía Esperanza/Hope Bay on the Antarctic Peninsula was also extensively investigated. The logistic situation did not permit a visit to Paulet Island where the other stone hut is situated, but information and previous documentation has been compiled and presented. The cairn in Penguin Bay on Seymour-Marambio Island was visited and documented during a one-day excursion.

The Winter Station and laboratory landscape on Snow Hill Island

The Winter Station on Snow Hill Island, inscribed as HSM 38, was built in February 1902 on the east shore of the Island about 150 metres from the sea and at the verge of inclination of the mountains. The station functioned as a base for the field research, and in the nearby surroundings several small buildings and huts for protecting equipment were set up. The station was erected on top of a small hill with a salient curved contour and is still standing as a landmark in the landscape, with views to James Clark Ross Island towards the east and Cockburn Island to the north. The one-storied building plan is about 6.30 x 4.10 metres and with a small vestibule located by the entrance in the east. Both the roof and the outer walls are covered with tarred wallpaper. Two diagonal plank struts are supporting the northern façade. Recently, steel wires are also mounted in each corner of the building and fixed to the ground to
The building contains a kitchen, three small dormitories with a bunkbed and a desk, and a centre room, which has a stove and a dining table. The building is largely in good condition. With regular inspection and a continuous maintenance of the reinforcing wires, the tarred surfaces, the windows and the entrance door, the building can withstand many years to come. The threats relate to the hill and the very ground that the station stands upon, caused by thawing of permafrost and earth erosion from the glaciers’ meltwater in the mountain. Today, most of the remains of the many small fieldwork stations have been swept away to the sea and remain only as archaeological traces. Re-photography shows that the landscape has transformed dramatically over the last 30 years, and with the ongoing stresses of climate change, there is an urgent risk that the hill on which the Winter Station stands, will be lost to erosion in the near future. Reinforcement work done and terraces of the hill have been carried out, managed by the IAA from the 1990s to the mid-2010s. This has probably counteracted the effects of erosion. To continue this work and monitor the climate change is recommended.

The stone hut in Hope Bay

The stone hut in Esperanza, inscribed as HSM 39, was built in February 1903 by the explorers Olof Gunnar Andersson, Toralf Grunden and Samuel Duse to hibernate in during the Antarctic winter. The name of the location, Hoppets vik in Swedish, concurrently Hope Bay and Bahía Esperanza, was denominated by the Swedish expeditioners to express their sentiments as they were waiting for their mother ship *Antarctic* to come to their rescue. The dry-stone wall construction is made of metamorphic stones and chippings, about 1.70 metres in height, comprising one main room measuring from the exterior about 4 x 4 metres and a southside antechamber of 3 x 2 metres with a small door facing east. When functioning as a dwelling, a tent was located in the main space and a sledge was put between the walls and covered by a piece of a sail to sustain the climate. The construction is fairly well preserved but has undergone a comprehensive restoration in the 1990s with concrete, reinforcing bars and epoxy glue that are harming rather than safeguarding. The most urgent treatment is to remove the roofing of iron bars and grid. There is a high risk that it will fall and take at least the top of the wall down.

The stone hut in Paulet Island

The hut on Paulet Island, inscribed as HSM 41, was built in February 1903 by the crew on *Antarctic* when their ship was wrecked outside the coast. A cairn was erected at the highest point to draw the attention of rescuers, who finally came in November 1903. One member of the crew, the Norwegian sailor Ole Christian Wennersgaard, died on the island and his grave is now part of the historic environment with the stone hut and cairn. The plan was to visit the island and examine the construction but due to logistical problems this was not possible.

The cairn in Penguin Bay

On the southeast side of Seymour-Marambio Island is an Adélie penguin colony where the expeditioners hunted penguins and collected their eggs. They
named the place Penguin Bay. On top of a hill, close to the shore, they made a cairn and raised a wooden pole, originally about four metres high. The location was sighted and there, the rescue team found the Swedish team. The crew of the Uruguay installed there a depot and a pole with a wooden plaque. The site has been visited by many expeditioners after leaving depots of victuals and requisites. At Penguin Bay, the IAA made a monument of cast concrete with bronze plaques to commemorate the rescue ship Uruguay. Today, Nordenskjöld’s cairn and pole with the memorial monument of Uruguay is inscribed as HSM 60. The cairn has fallen apart and the remains consist of a concentration of stones and a 40 cm snippet of the wooden pole. The penguins’ nests are on and around the remains of the cairn and it is not possible to visit the site without disturbing the wildlife. The remains of the cairn and surroundings have been documented and the exact coordinates taken. No more actions are recommended.

Cultural significance

The remains of the first Swedish South Polar expedition are constituents of different historical narratives and elements of cultural heritage to many nations. The expedition was a united Swedish-Norwegian endeavour that came to also involve Argentina. The project received part of its finance from the British government. All these countries have been involved in the safeguarding of, and are the proposing parties to authorise, these historic sites and monuments through the Antarctic Treaty System. The still-standing Winter Station and the laboratory landscape are remarkable memorials of Antarctic history of science. The assemblage of the Winter Station, with the science equipment, the many field laboratories and routes in the landscape, form a testimony on the making of science. The research team were genuinely transdisciplinary. They performed systematic studies of the Antarctic climate and produced discoveries that reverberated in the natural sciences. The expedition was carried out at a time when much of this continent was unknown. Several places in the Antarctic Peninsula and archipelago got their names through the expeditioners, like Hope Bay, Duse Bay, Mount Flora, Andersson Island and Nordenskjöld Lake, Coast, Basin, Glacier and Peak. The Winter Station on Snow Hill Island has served not only as a memorial and museum of the research expedition but has also served continuously as a refuge with an open door and a depot of victuals and requisites.

The condition of the Winter Station is intertwined with the transformation of the very ground on which it stands. The Antarctic climate is harsh with natural erosion from wind and precipitation but the effects of climate change have accelerated the process of decay. Meltwater from the mountain glaciers is fiercely eroding the slants, while the melting permafrost causes land drift on the plateaus. Comparison of historic photography shows that the climate has transformed the landscape, and that the change has exacerbated over the last 30 years. The Winter Station and the laboratory landscape will not be possible to preserve forever. Its transformation and decay also possess a significance as an indicator of climate change. The location may be far from Sweden but the question and concern fall on common ground.
SAMMANFATTNING

Den första svenska sydpolarexpeditionen 1901–03


Ett kulturarv för många nationer


Figures 10-20. Photos of the expeditioner's fieldwork and research equipment. Photos included in an album from Otto Nordenskjöld's archive at the University of Gothenburg (UGOT). Known photographers are Gösta Bodman (Figures 2, 4, 17) and Otto Nordenskjöld (Figure 15) (PDM).
Formell status och skydd


Ett utökat svenskt engagemang och initiativet CHAQ2020


Fältarbete

Fältarbete som redovisas i denna rapport är resultatet av gemensamma ansträngningar av samtliga expeditionsmedlemmar samt logistikpersonal från DNA-IAA. Den data som rapporten presenterar insamlades av Gunnar Almevik, Dag

**Vinterstationen och landskapet på Snowhillön**


**Stenhyddan i Hoppets Bukt**


**Stenhyddan på Pauletön**


**Fyrbåken i Pingvinbukten**

På sydöstra sidan av Seymour-Marambio finns en pingvinkoloni där expeditionsmedlemmarna lämnade en depå med förnödenheter, och senare också jagade pingviner och samlade deras ägg. De kallade platsten för Pingvinbukten. På toppen av en kulle uppfördes ett stenröse med en träpåle, ursprungligen cirka fyra meter hög. Platsten har senare besöks av många expeditioner, bland andra av räddningsseppet Uruguay, och efterlämnat ytterligare depåer av förnödenheter. Här finns också
ett argentinskt monument i betong över den argentinska räddningsaktionen. Idag är Nordenskjölds stenröse med träpålen samt minnesmärket i betong inskriven som HSM 60. Stenröset har ramlat ihop och är knappt urskiljbara som kulturlämnning om det inte vore för den 40 cm långa stumpen av pålen som anger platsen. Pingvinbon finns på och runt röset, och det är inte möjligt att besöka platsen stora delar av året utan att störa djurlivet. Lämnningen och dess omgivning har dokumenterats och exakta koordinater har tagits. Inga fler åtgärder rekommenderas.

**Kulturhistorisk betydelse**


RESUMEN

La primera expedición sueca del Polo Sur 1901-03

En 1901, el Dr Otto Nordenskjöld dirigió la primera expedición sueca del Polo Sur con un equipo multidisciplinario de investigadores en geología, geografía, biología y medicina. El plan original era invernar en la Antártida y permanecer un año para explorar la región, estudiar el clima y recolectar muestras, pero su barco naufragó y la expedición debió permanecer más de dos años hasta noviembre de 1903, cuando fue rescatada por la expedición argentina de la corbeta Uruguay. Al llegar al continente, los miembros de la expedición se dividieron en grupos para explorar la Península Antártica. Una estación de madera prefabricada de invierno fue traída de Suecia y erigida en la isla Cerro Nevado, sirviendo como base para Nordenskjöld y otros cinco miembros de la expedición, entre ellos el alférez argentino José María Sobral. Cuando el barco Antarctic naufragó en febrero de 1903, los grupos quedaron divididos y dos cabanas de piedra provisionales fueron erigidas como refugio, una en la isla Paulet y otra en la península Trinidad. Este último fue nombrado bahía Esperanza por los expedicionarios, en sueco "Hoppets vik". La estación de invierno, los restos de las dos cabanas de piedra y un mojón que fueron erigidos por los expedicionarios en la isla de Marambio todavía existen y están protegidos como Sitios y Monumentos Históricos (SMH) de acuerdo con el Sistema del Tratado Antártico (STA).

Un patrimonio cultural para muchas naciones

Los restos de la primera expedición sueca del Polo Sur se encuentran en un sector de la Antártida reclamado por Argentina como parte de su territorio nacional. Los restos de la expedición también son considerados patrimonio cultural argentino por el hecho de que la expedición fue anfitriona del alférez argentino José María Sobral, quien se quedó con Nordenskjöld en la isla Cerro Nevado y participó en el trabajo de investigación. El rescate de los expedicionarios también fue administrado por Argentina, y hoy la estación de invierno también está protegida por la ley nacional argentina desde 1965, el barco de rescate ARA Uruguay es un museo y varios artefactos de la expedición de Nordenskjöld son parte de la colección del Museo del Instituto Antártico Argentino y el Museo Naval de Tigre. A principios de la década de 1970, en la Reunión Consultiva del Tratado Antártico, Argentina y el Reino Unido propusieron la inclusión de la estación de invierno en la isla Cerro Nevado y la cabaña de piedra en bahía Esperanza, y luego Argentina, el Reino Unido y Noruega propusieron incluir también la cabaña de piedra en la isla Paulet. El interés nacional noruego en este remanente se relaciona con el capitán del barco Antarctic, Carl Anton Larsen,

quien también lideró el grupo que se refugió en la isla Paulet. Larsen regresó a la Antártida un año después para cazar ballenas estableciendo el asentamiento ballenero de la Compañía Argentina de Pesca en Grytviken, en las islas Georgias del Sur, el cual significó la primera ocupación humana permanente de esas islas.

**Estado formal y protección**

Según el STA, se propone que los cuatro SMH enumerados relacionados con la expedición sueca del Polo Sur 1901-03 se gestionen en colaboración entre Suecia y Argentina, y en relación con la isla Paulet también con Noruega. Las primeras medidas de salvaguardia fueron tomadas a principios de la década de 1950 por la Armada Argentina, pero una preservación más sistemática fue iniciada en la década de 1980 por el Instituto Antártico Argentino (IAA) bajo dependencia de la Directorio Nacional del Antártico (DNÁ). La estación de invierno en la isla Cerro Nevado es desde hace mucho tiempo parte de un sistema de refugios en la Antártida con un depósito de provisiones básicas y suministros en caso de urgencia. Sin embargo, desde 2009, las pautas del sitio definen la estación como un museo y restringen el uso de viviendas temporales o periódicas. La participación sueca en la preservación y el mantenimiento ha sido esporádica y dependió de iniciativas privadas, sobre todo por parte del Dr Fred Goldberg y su apoyo al centenario de la expedición en el año 2001.

**Preocupación Sueca y la Campaña CHAQ2020**

La pregunta sobre una participación sueca permanente y oficial en la salvaguardia del patrimonio cultural en la Antártida ha sido objeto de iniciativas desde al menos finales de los años noventa. Ha involucrado a diplomáticos, investigadores y profesores de universidades suecas y profesionales de ICOMOS. Sobre la base de estas iniciativas, CHAQ2020 surgió como resultado de un proyecto de investigación sobre patrimonio cultural llamado CHAQ, financiado por el Consejo de investigación sueco (VR) y una decisión de la Junta del Patrimonio Nacional de Suecia (RAÄ) para explorar su posible papel en asuntos relacionados con Patrimonio cultural en la Antártida. RAÄ se involucró en 2016 después de que el personal de SANAE (Expedición Antártica Nacional de Sudáfrica) encontró un depósito de artefactos procedentes de una expedición de investigación internacional noruego-británica-sueca que data de 1949-52 (NBSX) en un nunatak en la Antártida. SANAE contactó a la Secretaría de Investigación Polar de Suecia (SPRS), que a su vez inició un diálogo en la que participaron el Royal Institute of Technology (KTH), el Ministerio de Educación sueco y RAÄ sobre la evaluación del depósito NBSX respecto a su condición de SMH, y más ampliamente sobre cómo los asuntos relacionados con el patrimonio cultural en la Antártida podrían manejarse en Suecia. En 2017, RAÄ hizo una declaración formal de que los restos del depósito tenían valores patrimoniales que coincidían con los requisitos para un SMH y, al mismo tiempo, pidió una estrategia al unísono para el patrimonio cultural sueco en la Antártida basado en la colaboración internacional. En 2018, SPRS decidió apoyar una solicitud de KTH para realizar trabajo de campo en los restos de la Primera Expedición Antártica Sueca en la Antártida para el proyecto CHAQ financiado por VR e incluirlo dentro de su Programa Sueco de Investigación Antártica (SWEDARP). El nombre de la expedición fue CHAQ2020. SPRS colaboró con el CHAQ2020 a través del contacto con su or...
ganización hermana argentina, la Dirección Nacional del Antártico, y el Instituto Antártico Argentino (DNA-IAA). En 2019, RAÄ aceptó una invitación de KTH para participar en CHAQ2020, como parte de la contribución de Suecia a los esfuerzos de conservación de IAA en los restos de la expedición sueca. RAÄ comisionó a dos expertos en construcciones en medio ambiente y documentación de patrimonio para unirse al grupo. DNA-IAA organizó y financió la logística y el trabajo de campo de CHAQ2020 en el marco de su programa de investigación antártica, bajo el liderazgo del Dr. Pablo Fontana.

**El trabajo de campo**

El trabajo de campo presentado en este informe fue realizado por Gunnar Almevik, Dag Avango, Jonathan Westin y Valeria Contissa durante un mes en la Antártida, del 10 de enero al 10 de febrero de 2020, con ayuda del capitán Héctor Mamani Ovejero (Ejército Argentino) como logístico. El motivo del trabajo de campo fue la necesidad de una base de conocimiento para la toma de decisiones y políticas sobre el patrimonio cultural sueco en la Antártida. Por lo tanto, el mandato era documentar los restos, evaluar su condición y proponer recomendaciones. Otra directiva fue recopilar datos para potenciar la accesibilidad digital pública a este remoto patrimonio cultural, y también para apoyar futuras investigaciones sobre el clima y el patrimonio cultural en la Antártida. Para este propósito, se instaló una estación meteorológica y sensores en la isla Cerro Nevado para registrar temperatura del aire y la tierra, humedad, velocidad del viento, luz solar y precipitación. La documentación incluye dibujos manuales a escala, triangulación fotogramétrica basada en drones y terrestres, escaneo láser, fotografía y grabación de sonido. Los datos digitales o digitalizados del trabajo de campo están abiertos y accesibles a través de un repositorio de proyectos proporcionado por la Universidad de Gotemburgo, el Centro de Humanidades Digitales y el Departamento de Conservación, en antarctica.dh.gu.se. La encuesta se realizó de acuerdo con la norma internacional SS-EN 16096: 2012 para la encuesta de condición in situ del patrimonio cultural, que comprende fuentes y gestión de información, descripciones de objetos, encuestas de condición, evaluaciones de riesgo y recomendaciones. Este informe de trabajo de campo también implica el análisis de la importancia del patrimonio cultural y los escenarios para posibles enfoques alternativos de intervención y gestión. La principal prioridad era la estación de invierno y el ensamblaje de elementos en la isla Cerro Nevado. La cabaña de piedra en bahía Esperanza, en la península Trinidad, también fue ampliamente investigada. La situación logística no permitió una visita a la isla Paulet, donde se encuentra la otra cabaña de piedra, pero se ha compilado y presentado información y documentación previa. El mojón de bahía Pingüino en la isla Marambio, fue visitado y documentado durante una excursión de un día.

**La estación de invierno y el paisaje de laboratorio en Cerro Nevado**

La estación de invierno en la isla Cerro Nevado, inscrita como SMH 38, fue construida en febrero de 1902 en el lado oeste de la isla, a unos 150 metros del mar y al borde de la inclinación de las montañas. La estación funcionó como base para el trabajo de campo de investigación y en los alrededores cercanos se instalaron varios edificios pequeños y cabañas para proteger el equipo. La estación se erigió en la cima de una pequeña colina con un contorno curvo sobresaliente y
sigue en pie como un hito en el paisaje, con vistas a la isla Ross hacia el oeste y la isla Cockburn al norte. El plano de construcción de un piso es de aproximadamente 6.30x4.10 metros y con un pequeño vestíbulo ubicado junto a la entrada en el este. Tanto el techo como las paredes exteriores están cubiertas con papel pintado alquitranado. Dos puntales de tablones diagonales sostienen la fachada norte y recientemente también se montan cables de acero en cada esquina del edificio y se fijan al suelo para soportar las fuertes tormentas del sur. El edificio contiene una cocina, tres dormitorios pequeños con una litera y un escritorio, y una habitación central con una estufa y una mesa de comedor. El edificio está en general en buenas condiciones y con una inspección regular y un mantenimiento continuo de los cables de refuerzo, las superficies alquitranadas, las ventanas y la puerta de entrada, el edificio puede resistir muchos años por venir. Las amenazas se relacionan con la colina y el terreno sobre el que se encuentra la estación, causadas por el derretimiento del permafrost y la erosión de la tierra por el agua de deshielo de los glaciares en la montaña. Hoy, la mayoría de las antiguas instalaciones de trabajo de campo han sido arrastrados al mar y permanecen solo como rastros arqueológicos. La fotofotografía muestra que el paisaje se ha transformado dramáticamente en los últimos 30 años, y con el cambio climático actual, hay un alto riesgo de que todos los restos y también la colina sobre la que se encuentra la estación de invierno se erosionen en un futuro cercano. Se han realizado trabajos de refuerzo y terraplenes en la colina, administrados por IAA desde la década de 1990, que probablemente han contrarrestado los efectos de la erosión. Se recomienda continuar con este trabajo y también monitorear el cambio climático.

La cabaña de piedra en bahía Esperanza

La cabaña de piedra en bahía Esperanza, inscrita como SMH 39, fue construida en febrero de 1903 por los exploradores Olof Gunnar Andersson, Toralf Grunden y Samuel Duse para sobrevivir durante el invierno antártico. El nombre de la ubicación, bahía Esperanza, Hoppets vik en sueco, fue denominado por los expedicionarios suecos para expresar sus sentimientos mientras esperaban que el buque de su expedición, el Antarctic, viniera a rescatarlos. La construcción del muro de piedra seca está realizado con piedras metamórficas y pedregullo, de aproximadamente 1,70 metros de altura. Comprende una sala principal que desde el exterior mide unos 4 x 4 metros y una antecámara del lado sur de 3 x 2 metros con una pequeña puerta hacia el este. Cuando funcionaba como vivienda, se ubicaba una tienda de campaña en el espacio principal y entre las paredes se colocaba un trineo cubierto con un trozo de vela para mantener el calor interior. La construcción se encuentra bastante bien conservada, pero se ha sometido a una restauración integral en la década de 1990 con hormigón, barras de refuerzo y resina epoxi que actualmente perjudica en lugar de proteger. El tratamiento más urgente es eliminar el techo de las rejas y barras de hierro. Existe un alto riesgo de que se desprenda y destruya al menos la parte superior de la pared.

La cabaña de piedra en la isla Paulet

La cabaña en la isla Paulet, inscrita como SMH 41, fue construida en febrero de 1903 por la tripulación del Antarctic cuando su barco naufragó fuera de la costa.
Se erigió un mojón en el punto más alto para llamar la atención de los rescatistas, que finalmente llegaron en noviembre de 1903. Un miembro de la tripulación, el marinero noruego Ole Christian Wennersgaard, falleció en la isla y la tumba ahora es parte del conjunto histórico junto a la cabaña de piedra y el mojón. Se ha erigido una cerca de hierro para evitar el anidamiento de pingüinos sobre los restos de la cabaña y así poder realizar tareas arqueológicas sin afectar a los mismos, pero la construcción ha demostrado ser peligrosa para los pingüinos de la colonia Adelia en la isla. El plan era visitar la isla y examinar la construcción, pero no se contó con el tiempo suficiente.

**El mojón en bahía Pingüino**

En el lado sureste de la isla Marambio, o isla Marambio según la nomenclatura británica, hay una colonia de pingüinos Adelia donde los expedicionarios los cazaban y recolectaban sus huevos. Llamaron al lugar bahía Pingüino. En la cima de una colina instalaron un mojón con un poste de madera, originalmente de unos cuatro metros de altura, y cerca a él un depósito de víveres. El lugar fue avistado y visitado por el barco argentino ARA Uruguay cuando rescató a la expedición e instaló allí un depósito de emergencia de mayor tamaño. El sitio fue visitado por diversas expediciones. Allí, en bahía Pingüino, el IAA erigió un monumento de hormigón colado con placas de bronce para conmemorar el rescate, junto a un poste con un cartel que aparentemente sería el original instalado por la tripulación argentina de la corbeta ARA Uruguay al momento de realizar el rescate. El monumento conmemorativo está inscritos como SMH 60, al que se le sumó el mojón y el poste de Nordenskjöld cuando fueron identificados en 2016 por el IAA. El mojón se ha desmoronado y los restos consisten en una concentración de piedras y un fragmento de 40 cm del poste de madera. Los nidos de los pingüinos están sobre y alrededor de los restos del mojón y no es posible visitar el sitio sin perturbar la vida silvestre. Los restos del mojón y sus alrededores han sido documentados y se han tomado las coordenadas exactas. No se recomiendan más acciones.

**Importancia cultural**

Los restos de la primera expedición sueca del Polar Sur son parte de diversas narrativas históricas y elementos del patrimonio cultural de diferentes naciones. La expedición fue un esfuerzo conjunto sueco-noruego que involucró también a Argentina. El proyecto obtuvo parte de su financiación del gobierno británico. Todos estos países han participado en la salvaguarda y propuesta de las partes para autorizar estos monumentos y sitios históricos a través del Sistema del Tratado Antártico. La estación de invierno aún en pie y el terreno del observatorio magnético son notables monumentos a la investigación científica. El conjunto de la estación de invierno, con el equipo científico, los numerosos laboratorios de campo y las rutas en el paisaje forman un testimonio sobre el desarrollo de la ciencia. El equipo de investigación fue genuinamente transdisciplinario, realizó estudios sistemáticos del clima antártico y produjo descubrimientos que repercutieron en las ciencias naturales. La expedición se llevó a cabo en un momento en que gran parte de este continente era desconocido. Varios lugares en la Península Antártica y el archipiélago obtuvieron sus nombres a través de los
expedicionarios, como bahía Esperanza (Hoppets bukt), bahía Duse Bay, cerro Flora, isla Andersson y lago Nordenskjöld, así como la costa, la cuenca, el glaciar y el pico de ese nombre. La estación de invierno en la isla Cerro Nevado ha servido no solo como monumento y museo de la expedición, sino también continuamente como un refugio con una puerta abierta y un depósito de víveres y requisitos necesarios. La condición de la estación de invierno se entrelaza con la transformación del terreno en el que se encuentra. El clima antártico es duro, con la erosión natural por viento y precipitación, pero los efectos del cambio climático han acelerado el proceso de erosión. El agua de deshielo de los glaciares de montaña está erosionando ferozmente las pendientes, mientras que el derretimiento del permafrost provoca el deslizamiento de la tierra en las mesetas. La comparación con fotografías históricas muestra que el clima ha transformado el paisaje y que el cambio se ha acelerado en los últimos treinta años. No es posible preservar para siempre la estación de invierno y el terreno del observatorio. Su transformación y deterioro también poseen un significado como indicador del cambio climático. La ubicación puede estar lejos de Suecia, pero la pregunta y la preocupación están muy cerca de los bienes comunes.
2. THE FIRST SWEDISH ANTARCTIC EXPEDITION AND ITS AFTERLIFE

2.1. The first Swedish Antarctic expedition, 1901–1903

The first Swedish Antarctic expedition took place in the years 1901–1903. Its objective was to carry out scientific investigations within geology, geography and zoology in the Antarctic Peninsula area of the western Antarctic. The Swedish geo-scientist Otto Nordenskjöld, PhD in Geology at Uppsala University at the time, was the leader of the expedition. The expedition team consisted of the meteorologist – and physicist – Gösta Bodman, oceanographer K. A. Andersson, the botanist Carl Skottsberg, army officer and cartographer Samuel Duse, Argentinian Lieutenant and cartographer José María Sobral and the zoologist Axel Ohlin who left the expedition in its early stage, replaced by another Uppsala geologist, Johan Gunnar Andersson. In addition, medical doctor Erik Ekelöf took part in the expedition. As its platform the expedition used a whaling and research ship named Antarctic and hired Norwegian whaler Carl Anton Larsen as captain, together with a crew of Swedes and Norwegians. The scientific objectives of the expedition were novel within Antarctic research at a time when the primary motives for going to Antarctica were to break the record for travelling furthest south and to discover new land. Their ambition to stay over one winter in the area in a wintering station they brought was also an undertaking that stood out. The expedition had, however, economic objectives too. Partly funded by actors interested in seal blubber, they aimed to explore possibilities for seal hunting in the area.

The expedition was Swedish, with Norwegian crew members considered in the context of the Swedish-Norwegian Union at the time. The expedition also had a strong relation to Argentina. As mentioned in the above, one of its prominent members was the Argentinian Lieutenant and cartographer José María Sobral. In addition, the Argentinian state and military provided the expedition with crucial goods such as food and coal for the expedition ship’s steam engine, but also various items the expedition needed, for instance glass bottles. Since Argentina is the country with the greatest proximity to the Antarctic Peninsula, the Argentinian navy also took on the task of keeping track of when the expedition ship was supposed to return from Antarctica to Argentina.

The first Swedish Antarctic expedition left Sweden on the 16th of October in 1901. Two months later, on the 15th of December, it arrived in Buenos Aires, taking on board Sobral and stocking up. On the 21st of December the expedition headed on to Antarctica via the Malvinas/Falkland Islands and commenced to explore the western side of the Antarctic Peninsula in January 1902. The expedition’s main target area was the Weddell Sea, however. In January and February of 1902, they tried to push as far south as possible on the eastern side of the Antarctic Peninsula, reaching 60° 10’ South/45° 7’ West when massive amounts of sea ice forced them to stop. The expedition proceeded to establish its Winter Station. Nordenskjöld’s original idea was to place it at Seymour-
Marambio Island (in Spanish later referred to as Marambio) because of known rich deposits of fossils there. After initial and not very promising investigations and without finding a suitable spot for the Winter Station, the expedition opted for a peninsula on the western coast of the northern side of Snow Hill – an island located just south of Seymour-Marambio Island. The reason for Nordenskjöld's choice was the rich deposits of fossils he found in the area and a geography he deemed as suitable for building a Winter Station. Therefore, on the 12th of February in 1902, the wintering party of the expedition went on shore with a pre-fabricated house from a Stockholm firm, instruments for scientific research and huge amounts of provisions, clothes, tools, cooking and heating equipment. Otto Nordenskjöld led the wintering team, which included Sobral (cartographer and meteorology assistant), Bodman (meteorologist), Ekelöf (medical doctor) and key crew members Ole Jonassen (sailor) and Gustaf Åkerlundh (cook). In addition, they took 12 dogs on shore for the planned winter sledge expeditions. The expedition proceeded to follow its plan for the austral winter of 1902. Under Nordenskjöld's leadership, the team established the Winter Station and a magnetic observatory on the peninsula of Snow Hill Island. They explored the ice-free northern part of the island for fossils and established a system of reference points inland for the purpose of properly mapping the island. Nordenskjöld and Sobral
Figure 34. The route from Sweden to Antarctica. Visualisation by Jonathan Westin.

also conducted long sledge-based research journeys to the south, mapping land- and seascapes as well as the massive ice shelves in the south of the Weddell Sea.

Onboard their ship Antarctic, the rest of the expedition headed north to South Georgia, where they explored and mapped the northern coastal area of the main island, which is characterised by deep bays offering protection against the extreme weather conditions of the southern Atlantic. During this effort, Johan Gunnar Andersson discovered a well-protected bay in which he found the archaeological remains of a sealer’s blubber cookery. Andersson named it Grytviken. After the expedition in 1904, on the initiative of the expedition captain Carl Anton Larsen, Argentinian investors formed a whaling company in Buenos Aires that established the first settlement in South Georgia in this bay. After leaving South Georgia as the 1902 winter was approaching, the expedition headed for the Malvinas/Falkland Islands. There they stayed on for a part of the winter and thereafter proceeded to Argentina to refuel on coal and pick up new equipment and materials.
In the austral spring of 1902, the expedition onboard the Antarctic again turned back to the Antarctic Peninsula area for the purpose of picking up Nordenskjöld and the wintering team at Snow Hill Island. When trying to enter the Weddell Sea east of the Antarctic Peninsula however, they encountered severe ice conditions. Larsen and his crew made numerous attempts to push south to Snow Hill Island but couldn't make it through the ice. The team on the Antarctic then worked out a plan B. A group of three – led by geologist and geographer Johan Gunnar Andersson together with cartographer Samuel Duse and sailor Toralf Grunden – went on shore at a bay later named Hoppets vik (Hope Bay in English and Bahía Esperanza in Spanish) with the purpose of making their way south across the Antarctic Peninsula and over the sea ice to the Winter Station at Snow Hill Island. There they would pick up Nordenskjöld and his team, go back to Hope Bay with as much of their scientific specimens and instruments as possible, board the Antarctic and proceed to return. Meanwhile, the expedition ship Antarctic, under the lead of Captain Larsen, would make more attempts to make it down to Snow Hill, hoping that the ice situation would improve.

Plan B did not work out as planned, however. Andersson's group made it south across the Peninsula but were unable to cross the ice to Snow Hill Island and had to return back to Hope Bay without Nordenskjöld's team. There they camped, waiting for the expedition ship Antarctic to return. Meanwhile, Larsen and his crew made several attempts with the Antarctic to find a way across the sea but they eventually became stuck in the sea ice where they drifted for weeks. On the 12th of February 1903, the ship finally sank in the Weddell Sea. Larsen and his crew of 20 people had realised what was coming and had therefore unloaded plenty of supplies from the ship, which they hauled across the ice to the nearest land – Paulet Island.

As a consequence of these events, the expedition was divided into three groups: Andersson's group at Hope Bay, Larsen's group at Paulet Island and Nordenskjöld's group at the Winter Station at Snow Hill Island. At Hope Bay, after the date for their rendezvous with the Antarctic had passed and the ship did not return, Anderson's group realised that they were up for a wintering. Therefore, they built a hut out of local rocks, tent cloth and equipment they had previously brought on shore from the Antarctic. They assembled a storage of penguin meat, from penguins they killed before the winter arrived. At Paulet Island, Larsen's crew acted in a similar way, building a hut out of rocks for wintering and killing off penguins to eat throughout the winter. Nordenskjöld's team also realised that there wasn't going to be any ship picking them up, and that they were better off in their well-established Winter Station, where they still had supplies of food and fuel for heating.

Against all odds, the three teams of the expedition made it through the winter with only one casualty – Ole Christian Wennersgaard, who died on Paulet Island. In the spring, Johan Gunnar Andersson's group tried again to make their way south to Snow Hill Island and succeeded. On their way across the sea ice, they ran into Nordenskjöld and Sobral and proceeded to the Winter Station in their company. At this point, none of them still had any idea of what had happened with the
Antarctic. When the ice started to break up, Larsen was one of a group of five who went to Hope Bay to pick up Andersson’s team but found only their empty stone hut, since they had already left for the Winter Station at Snow Hill.

It was the Argentinian navy that eventually rescued the members of the first Swedish Antarctic expedition. When the expedition did not return as planned, the Argentinian government sent a rescue expedition onboard of the navy vessel *Uruguay* to look for the expedition. They arrived at the Winter Station at Snow Hill in the early Antarctic summer, on the 8th of November. A few hours later, Captain Larsen, who had taken his small boat from Hope Bay down to Snow Hill Island, also arrived. The expedition took onboard as much of their equipment from Snow Hill Island as possible. Thereafter, the *Uruguay* went north to Paulet Island to pick up the rest of Captain Larsen’s team. On the 2nd of December, the *Uruguay* arrived in Buenos Aires. Eight days later, the expedition team headed back to Sweden, returning to Stockholm on the 10th of January 1904.

![Figure 36. Return of the rescue vessel *Uruguay* to Buenos Aires in December 1903. Wikimedia Commons (PDM).](image)
2.2. The afterlife of the material remains from the expedition

The activities of the first Swedish Antarctic expedition, described in the above, left behind material remains in four main locations: at Snow Hill Island, at Hope Bay, at Paulet Island and at Seymour-Marambio Island. In addition, the expedition may also have left remains behind at other locations which have yet to be found. Since the expedition left aboard the vessel Uruguay in 1903, the remains from the expedition have been subject to the forces of the Antarctic environment as well as to human action. In the following, we will focus on the latter: the post-expedition history of the known material remains from the first Swedish Antarctic expedition.

2.2.1. The remains at Snow Hill Island

The material remains of the first Swedish Antarctic expedition of 1901–1903 at Snow Hill Island, Seymour-Marambio Island, Hope Bay and at Paulet Island are not only shaped by the Swedish expedition. Their appearance, context and state of conservation is the result of environmental processes and human action through the 120 years that have passed since Otto Nordenskjöld and his team left aboard the vessel Uruguay in 1903. In this section we focus on the activities of Swedish, US, British and Argentine expeditions that have interacted with the sites after the Swedish expedition left.

The first expedition to visit was a Swedish expedition, sent there for the purpose of rescuing the expedition. Onboard a ship named Fritiof, they arrived soon after Nordenskjöld’s expedition had left. They visited Snow Hill Island and Esperanza, where they found notifications from Nordenskjöld’s team about the fact that they had already been rescued by the Argentinian navy. The expedition took a number of photographs of the sites. We have, as yet, found no indications that members of the rescue expedition had interfered with the buildings at the sites.

The second visit took place some 20 years later, this time by an expedition from the United States of America under the leadership of James Ellsworth. He visited the Winter Station at Snow Hill Island in 1936, in connection with one of several attempts of his to fly across the Antarctic continent. Ellsworth took photos of the Winter Station but, just as his predecessors, he and his team do not appear to have interfered with the remains of the station in any significant way.

In August 1945, a British expedition became the third group to visit Snow Hill, and the second to visit Esperanza. The expedition was part of a British program in the region named Operation Tabarin, which had the overarching objective to strengthen Great Britain’s presence in the region within the context of an intensifying conflict with Argentina over the sovereignty of the western Antarctic. The British expedition visited the abandoned Winter Station at Snow Hill Island to use it as a station. Upon arrival, however, the expedition team found the hut to be filled with ice – a result of snow seeping through cracks, melting and refreezing, and successively filling up the cabin. The phenomenon is common in abandoned buildings in the Antarctic as well as in the Arctic. For the British expedition, this
meant that they would need to invest substantial work to make it inhabitable. Consequently, they decided to give up the project and leave.

In the years that followed, the conflict with Britain in the west Antarctic intensified. In this context Argentina sent an expedition to the Winter Station at Snow Hill Island in 1953, by the fiftieth anniversary of the rescue. The expedition had the same objective as the previous British one – to support Argentina’s claim to the region. Like the British team, they found the Winter Station filled with snow and ice, but nevertheless proceeded to claim the hut for Argentina. In order to slow further influx of snow into the hut, the expedition blocked the window openings with wooden boards.

The 1953 expedition conducted two more activities at Snow Hill Island; one was to build a shelter on the northernmost coast of the island, and the other was to erect a sea marker on the eastern coast of the northern part of the island. Both of these structures are described at section 4.7 of this report.

During the 1960’s and 1970’s, there were several expeditions to visit Snow Hill Island. There are two commemorative plaques from the 1960’s, one dating 1962 and another from 1965, the year when the hut was declared a historical monument by Argentina. When writing this report, our knowledge about this expedition’s specific objectives and activities in the area is incomplete. According to heritage practitioner Ricardo Capdevila, the expedition left a message in a bottle inside the Winter Station during their visit at the site (Capdevila 2007:30).

None of the above-described expeditions had the explicit objective of framing the remains of the Winter Station as heritage. Having taken position of it for Argentina, it became a representation of effective occupation in the absence of people. The first initiatives to define the remains of the Swedish expedition as heritage were taken in the early 1970s, within the framework of the Antarctic Treaty System (ATS). In 1972, member states of the treaty decided to list 43 sites in Antarctica as protected cultural heritage under the term Historic Sites and Monuments (HSM). The HSMs consisted of material remains from Antarctic history, as well as places of historical significance. On the initiative of Argentina, three sites with remains pertaining to the first Swedish Antarctic expedition were added to the list: the stone wintering hut at Hope Bay (HSM 39), the stone wintering hut at Paulet Island (HSM 41) and the wintering station at Snow Hill Island (HSM 38).

Following the listing of the remains from the first Swedish Antarctic expedition as HSMs, the first initiatives to undertake practical work to conserve or restore the buildings was started in 1979. This year the Argentinian organisation for research

Figures 37-38. Above, the Winter Station in 1902-03, Centre for History of Science, the Royal Swedish Academy of Science. Below, the Winter Station in August 1945. Photo by I. M. Lamb, Nordenskjöld’s archive, UGOT (PDM).
in Antarctica, Dirección Nacional del Antártico (DNA) and Instituto Antártico Argentino (IAA), launched a program for conserving and restoring historical sites in Antarctica - the Museoantar. A group of Argentinian scholars led the program: Santiago Mauro Comerci, Ricardo Capdevila and Néstor Enrique Iribarren. The objective of Museoantar was to fulfil the responsibilities of preserving the HSMs on the 1972 list which Argentina had responsibility for (Capdevila et al. 2000). The same group started to prepare for undertaking practical conservation and restoration tasks at the Winter Station on Snow Hill Island.

Comerci and Capdevila took the lead in the work conducted by Argentinian actors at Snow Hill Island in the decades that followed. Their objective was to rescue and restore the remains of the Winter Station. They prepared their work by translating Otto Nordenskjöld’s two-volume book on the expedition into Spanish. They also trained themselves in a restoration approach which visualised the difference between original and new materials, under the leadership of architect Ricardo Alvis, expert in historic archaeology at the University of La Plata Natural Sciences Museum in Argentina. They also took inspiration from restoration work conducted by New Zealand scholar David Harrowfield on huts remaining from British explorers Scott and Shackleton (Capdevila 2007:21–22).

Comerci and his team started their work at Snow Hill in 1980. When they arrived at the scene, the Winter Station was characterised by the slow but persistent impact of the Antarctic climate and environment. Capdevila describes the situation they faced in an article published in 2007 (Capdevila 2007). The building was filled with solid ice, up to 1.8 metres thick from the floor in the southern part of the building. The tar paper on the inside and outside walls were shattered, the stove severely rusted and its chimney incomplete and the bunk beds were damaged, as was other furniture. The kitchen stove, also rusted, was broken into pieces and the wires which Nordenskjöld’s crew had installed to hold the building in place were broken. From a conservation perspective, the ice was not only a problem. In the same manner as Johan Gunnar Andersson in 1944, Capdevila argued that it was unlikely that the Winter Station would still have been standing had it not been for the ice inside of it (Andersson 1944; Capdevila 2007:28). The recurring extreme storms in the region, in particular after wires had broken off, would most likely have blown the building into pieces.

The first challenge the team had to deal with was obviously the glacier inside of the hut. They removed it using pick and axe which, according to Capdevila, inflicted damage on an original linoleum floor that remained. According to oral sources, the method also left marks on other components and artefacts in the interiors of the Winter Station. In their first campaign in 1980, the team cleared out ice from most of the building and began the work of, as Capdevila put it, recovering objects of museological value (Capdevila 2007:30–31).

Figure 39. Documentation of the Winter Station by the Argentinian Army in 1972. Document from the Argentinian Navy Archive (CC BY-NC-ND).
In the austral summer of 1981, the team returned again to Snow Hill Island and continued their work on the hut. They removed the remaining ice from the kitchen of the Winter Station and from a shack in its vicinity, cleared their way to the Winter Station’s attic by removing ice and things left by the Nordenskjöld expedition that were blocking their way (tar paper, canvas, leather) and continued the work of recovering artefacts (Capdevila 2007:32).

The work of recovering artefacts in 1980–1981 consisted in the removal of ice. Inspired by Harrowfield, they also conducted this work using a pick and hammer — “until the object was almost reached.” The last remaining ice was removed by melting it using a small gas stove or by wrapping objects in polyethylene film and exposing it to sunlight. For each object de-iced in this way, the team registered it and indicated the place where they had originally found it. The objects they recovered were mostly things left behind there by the first Swedish Antarctic
expedition: primus heaters (one still full), china, cutlery, a wooden chest with artefacts such as tools and fossils (Capdevila 2007:30–32).

After these two initial years of work to remove ice from houses and artefacts, the team shifted their focus to restoration work. From 1982 until the mid-2000s, Comerci, Capdevila and other Argentinian professionals returned to the Winter Station at Snow Hill every summer. Their work over those years consisted of repairing components in the Winter Station’s interiors such as the desks, bunk beds, windows and a folding table. They also re-constructed parts of the building: the attic, the external wires holding the Winter Station building in place (adding concrete foundations to secure them in the ground), and they placed new tar paper on the facade.

A substantial amount of the work Capdevila’s team did consisted of constructing installations meant to stop erosion of the Winter Station hill. Their first efforts on this involved casting concrete buttresses under the moraine outside of the Winter Station building. In his 2007 article on their work, Capdevila pointed out rising temperatures resulting in permafrost thaw as the reason for the erosion of the Winter Station hill. He also described how a glacier extending to the north from the inland ice covering the southern part of Snow Hill Island had rapidly retreated over the period he and his team had worked there. When they commenced their efforts in 1980, this glacier extended along the shoreline 100 metres to the north-west of the Winter Station. By the time Capdevila wrote his chapter in 2006–2007, the glacier front had retreated over a kilometre to the inland (Capdevila 2007:24,32). In interviews we conducted, members of Capdevila’s team have confirmed that the glacier front still extended along the coastline just west of the station as late as 1996. Photos taken at the site by members of a Swedish team in 2001 reveal that the glacier at that time had already retreated inland, over a kilometre from the shoreline by the Winter Station. As will be further described in this report, the glacier front is currently situated some 2 kilometres from the point it was at in 1980.

Their work to stop erosion also consisted of the construction of massive chests, covering the slopes of the Winter Station hill. The upper and lower limitation of these chests they constructed from aluminium pallets type AM-2 for prefabricated runways (brought to Snow Hill from the Argentinian research station Marambio), which they placed in a vertical position on their long sides by digging them into the moraine and supporting them with basalt rocks which they brought from the vicinity of the station. The space between these upper and lower aluminium board walls was filled up with moraine. Finally, it was covered with chicken wire. Capdevila’s team had already begun this construction work in 2001 (Figure 28).

As mentioned above, Capdevila and his team conducted their work within the framework of a DNA-IAA program named Museoantar. As the name suggests, its leadership thought of the remains from the first Swedish Antarctic expedition as museums. In line with this idea, on the 12th of January 2005, the program inaugurated the Winter Station at Snow Hill Island as a museum. This event can be seen as a milestone in the work to conserve the Winter Station building, but not the finalisation of it. Much work still remained before the chests for stopping erosion would be finished and there were artefacts in need of conservation.
On the 9th of July 2008, Ricardo Capdevila passed away. This was a loss for the team of Argentinian professionals who had worked with him as well as for conservation work at large. The efforts led by Argentinian Antarctic authorities continued in the years that followed, now under different leadership and partly new members on the teams.

2.2.2. The remains at Hope Bay

The first visit to Hope Bay after the first Swedish Antarctic expedition had left the site in 1903 was the Swedish expedition onboard the ship *Frithiof* in the same year. Thereafter, the site was left for decades to the forces of the Antarctic environment and its fauna. Personnel from a British expedition were the first to visit the site in 1945, within the framework of Operation Tabarin. The personnel of the expedition took photos of the remains of the stone hut, but there are no indications in the written sources from the expedition of any interference with the hut. The British established a station by the shoreline a kilometre to the east of the stone hut - Base D. Their objective with the visit and Base D was to strengthen Great Britain’s presence in the region within the context of the above-mentioned conflict with Argentina over the sovereignty of the western Antarctic.

The stations were transferred to the FIDS after the war, in the beginning of 1946. FIDS remained at Hope Bay in the years that followed. Base D burnt down in
1948, with two casualties, and the United Kingdom withdrew from the place. The burnt remains of the station, with two graves of the deceased, provide an archaeological source on the events. Argentina established its presence in January 1952 by building the research station Base Esperanza. The following month, FIDS established a new station — Trinity House — in its place. The close presence of the two main competitors for control in the area led to one of the most severe actions of hostility in Antarctica, that included also warning shots. In the years that followed, Argentina expanded its Esperanza station. FIDS left Trinity House in 1964. Argentina, on the contrary, turned its Esperanza base into a full-scale settlement with family housing, a school with classes from kindergarten level to secondary school, a hospital with capacity for handling births, and facilities for social spare time activities.

Just like in the case of Snow Hill, the first initiative to turn the remains of the stone hut at Hope Bay into heritage was taken by Argentinian officials who placed it on the first list of HSMs in 1972. Already in 1952, the Argentine Navy had placed a sign at the hut and in the early 1960s they installed a concrete column at one corner of the hut with a plaque and the Swedish and Argentine flags. However, it was the group organising the IAA’s program Museoantar that took the first concrete actions to conserve the remains of the stone hut. The group began their work there later than at Snow Hill Island — in 1992. At the
time, Capdevila reports, the hut consisted of a collapsed pile of rocks. The group aimed not only to conserve the hut but to reconstruct it. They conducted this work using original stones from the pile of collapsed rocks on site. When conducting this work, they marked the rocks they had used for reconstruction with red paint (see Figure 51). The wooden door of the hut they were unable to find because Johan Gunnar Andersson had used it to make a box to carry geological samples to the Uruguay back in 1903. Instead, the Museoantar group used wooden boards they took from the remains of the burnt down Base D to make a replica of the original door. In order to protect the structure from penguins and visitors, they raised a fence around it. In addition, they placed a steel net across the top of the stone hut, gluing it with epoxy to the re-constructed uppermost layer of the building.
Capdevila ended his work at the Hope Bay stone hut in the mid-2000s. The Argentine military, which operates Esperanza, continued to maintain the remains of the hut however. In 2010, when a Swedish-Dutch team of archaeologists and heritage researchers visited Esperanza, the station manager reported that he had people from his station crew put stones back into place once a year. The IAA has also kept a regular check on the state of the remains up until this day. After the Museoantar program ended, however, no larger conservation has taken place there. The IAA was planning for conservation actions in 2018, but in 2019 it was decided to work together with the Swedish team on the condition survey and action plan.

Finally, it is important to recognise the work of the Argentine Army to lift the history of the Esperanza station and the remains of the stone hut in the his-
torical context. The military has created a museum which from the beginning contained a section devoted to the history of the first Swedish Antarctic expedition of 1901–1903. The museum exhibition narrative takes its point of departure from the wintering of Andersson, Duse and Grunden and connects it with a larger narrative about the local Antarctic environment and the history of Argentine activities in Antarctica. The base leadership has created a similar narrative in the landscape surrounding the stone hut. Along the path from the jetty, where many visitors enter the station, there is a row of monuments commemorating actors of importance for the station’s history. In the middle of this historical walkway, the visitor will encounter the stone hut. Beyond the path passes a row of objects from the history of the base, ending with the museum and the walkways into the rest of the base. In this way, the stone hut visually becomes a core component of a larger narrative of the base and Argentinian activities there.
2.3. Cultural significance

The first Swedish South Polar expedition’s remains are listed and acknowledged within the Antarctic Treaty’s instrument for safeguarding historic sites and monuments. In 2009, ATCM agreed on a resolution (ATCM 2009, no. 3) for the assessment and management of heritage in Antarctica. Here, seven criteria are proposed along with guiding questions and examples.

1. A particular event of importance in the history of science or exploration of Antarctica.
2. A particular association with a person who played an important role in the history of science or exploration in Antarctica.
3. A particular association with a notable feat of endurance or achievement.
4. Representative of, or forms part of, some wide-ranging activity that has been important in the development and knowledge of Antarctica.
5. Particular technical, historical, cultural or architectural value in its materials, design or method of construction.
6. Potential, through study, to reveal information or has the potential to educate people about significant human activities in Antarctica.
7. Symbolic or commemorative value for people of many nations.

The cultural significance of the sites and monuments associated with the first Swedish South Polar expedition may be interpreted as responding to all the criteria of the ATCM’s resolution. The still-standing Winter Station and the laboratory landscape are remarkable memorials of research. The assemblage of the Winter Station, with the science equipment, the many field laboratories and routes in the landscape, form a testimony on the making of science. The research team were genuinely transdisciplinary, performing systematic studies of the Antarctic climate and producing discoveries that reverberated in the natural sciences. The expedition was carried out at a time when much of this continent was unknown. Several places in the Antarctic Peninsula and archipelago acquired their names through the expeditioners, like Hope Bay, Duse Bay, Mount Flora, Andersson Island and Nordenskjöld Lake, Coast, Basin, Glacier and Peak. The Winter Station on Snow Hill Island has served not only as a memorial and museum of the research expedition but also served continuously as a refuge with an open door and a depot of victuals and requisites.

The sites and monuments of the expedition are associated with different historical narratives and elements of cultural heritage to many nations. The expedition was a united Swedish-Norwegian endeavour that came to also involve Argentina. The project received part of its finance from the British government. All these countries have been involved in the safeguarding of, and are proposing parties to authorise, these historic sites and monuments through the Antarctic Treaty System. The condition of the Winter Station is intertwined with the transformation of the very ground on which it stands. The Antarctic climate is harsh with natural erosion from wind and precipitation but the effects of climate change have ac-
celerated the process of decay. Meltwater from the mountain glaciers is fiercely eroding the slants, while the melting permafrost causes land drift on the plateaus. Comparison of historic photography shows that the climate has transformed the landscape, and that the change has exacerbated over the last 30 years. The Winter Station and the laboratory landscape will not be possible to preserve forever. Its transformation and decay also possess a significance as an indicator of climate change. The location may be far from Sweden but the question and concern fall on common ground.
3. CHAQ2020

3.1. Context

Cultural heritage management in Antarctica is regulated within the framework of the Antarctic Treaty System (ATS). Sweden joined the Antarctic Treaty in 1984 but has not actively engaged in the management of cultural heritage there until the CHAQ2020 expedition in 2020. In the following, we place the CHAQ2020 expedition in the context of heritage designation and management in Antarctica and previous Swedish efforts to engage with Antarctic cultural heritage.

The Antarctic Treaty was signed in 1959 by twelve states from where scientists had participated in Antarctic research during the International Geophysical Year (IGY) 1957–1958. The IGY was the third International Polar Year and the largest scientific collaboration effort at the time in Antarctica. The twelve states ratified the treaty on the 23rd of June 1961. The core objectives of the treaty were to keep the continent from becoming yet another arena for Cold War military build-up and to make it a continent for peaceful cooperation in scientific research.

Although the basis for designating material historical remains as cultural heritage was established in 1961, it was only in 1972 that the signatory states of the Antarctic Treaty agreed on a list of sites to be protected as cultural heritage. This list consisted of 43 sites, designated as Historic Sites and Monuments (HSM). These included the three main material remains from the first Swedish Antarctic expedition – the Winter Station at Snow Hill Island (HSM 38), the stone hut at Hope Bay (HSM 39) and the stone hut at Paulet Island (HSM 41). The main initiative for inscribing those three sites on the HSM list was Argentina. Today the list has grown to 94 HSMs and includes yet another site connected with the first Swedish Antarctic expedition – a cairn, a wooden pole and a plaque in Penguin Bay (HSM 60), inscribed in 1990 on the initiative of Argentina.

From 2005, the Antarctic Treaty Consultative Meeting (ATCM) included heritage protection in the Environmental Protocol of the Antarctic Treaty, annex five and six. The protocol itself was signed in 1991 and entered into force in 1998. Annex five, on area protection and management, came into effect in 2005 and regulates the procedure for establishing historic sites as cultural heritage in the region governed by the Antarctic Treaty – south of the 60th parallel. According to annex five, any party to the Antarctic Treaty can propose that a historic site in Antarctica should be listed as a HSM. The proposals are then evaluated and decided upon by the Antarctic Treaty Consultative Parties (ATCP) at the recurring ATCMs (Avango 2018).

Sweden became a member of the ATS in 1984 and from 1988 with full consultative status. During the same period, to meet the requirements for joining the treaty, Sweden established two permanent research stations in Antarctica – Svea in 1988 and Wasa in 1989. Both stations are located on Queen Maud Land and
have served as bases for natural science research. In 2006 Sweden adopted a law about Antarctica (SFS 2006:924) to incorporate the goals of the 1959 Antarctic Treaty and the 1991 environmental protocol (also referred to as the Madrid protocol) in the Swedish national constitution. Authorised by the Swedish Ministry of Education, the Swedish Polar Research Secretariat (SPRS) is representative in the ATCM and is also actively involved in the Scientific Committé for Antarctic Research (SCAR).

Up until the early 2000s, Swedish research and collaboration in Antarctica was dominated by the natural sciences. From then on, research within humanities and social science has grown. Research projects in historical archaeology, sociology of science and cultural heritage, often in broad international constellations, have engaged with contemporary and historical issues pertaining to the continent. Several projects have included fieldwork in Antarctica within the framework of the SPRS program for Antarctic research SWEDARP, some of them focusing on cultural heritage (Avango 2018, 2017, 2016a, 2016b, 2011a, 2001b; Elzinga et al. 2004, 2012; Dodds et al. 2017; Roberts et al. 2016).

Direct state involvement in the management and protection of cultural heritage has, however, been absent before CHAQ2020, despite the fact that Sweden has shared responsibility with Argentina for the management of the four above-mentioned HSMs (also involving Norway in the case of HSM 41). Argentinian state organisations have led and performed management and conservation, initially via the military and from the late 1970s through the Dirección Nacional del Antártico (DNA), which directs and ofciates all Argentinian activities in Antarctica, and Instituto Antártico Argentino (IAA), which executes scientific expeditions.

The first initiatives in Sweden to bring active Swedish participation in the management and conservation of historical sites pertaining to Swedish Antarctic activities were taken in the late 1990s and early 2000s. Among the actors of this time were the Swedish Antarctic Ambassador[1] and Swedish government representatives at the ATCM, who discussed the state of the HSMs related to the first Swedish Antarctic expedition with Argentinian diplomats. The discussions involved plans for celebrating the centenary anniversary of the expedition. However, because of the severe economic crisis in Argentina in 2001, these plans came to a halt. In 2005, Argentinian authorities decided to declare the Winter Station as a museum. At the inauguration, the Swedish Ambassador to Argentina participated.[2] In 2006, Argentina followed up the initiative by inviting a Swedish delegation to visit the Winter Station at Snow Hill. The DNA-IAA arranged the visit which took place in 2007, involving Sweden’s Antarctic Ambassador[3], Sweden’s representative to the International Council on Monuments and Sites (ICOMOS), the International Polar Heritage Committee (IPHC) and a board member of the SPRS[4]. Among the Argentinian delegates were the head of their delegation to the ATCM and two heads of Argentina’s Antarctic military command. The visit resulted in a planning discussion between Swedish and Argentinian participants on the content of site guidelines for visitors at Snow Hill Island as well as future maintenance work at the site (Widgren and Joriksson 2007).
In the late 1990s and early 2000s, there was also a network of historians, archaeologists and sociologists who took the initiative to arrange an expedition to Antarctica with focus on the four HSMs from the Nordenskjöld expedition.[5] They did not receive funding but the planning effort fuelled a substantial cooperation between the Swedish group and researchers and conservation officers at the Naval Museum of Ushuaia in southern Argentina. The team working at this museum, largely devoted to the history of Antarctica, involved a key actor in Argentinian heritage management in Antarctica – Ricardo Capdevila. The group launched a traveling exhibition in 2003 and arranged a major scientific conference in Ushuaia, resulting in a book focusing on the legacies of the first Swedish Antarctic expedition (Elzinga et al. 2004).

Another initiative growing out of the plans to celebrate the centenary anniversary of Nordenskjöld’s expedition was an initiative by Polar history enthusiast Fred Goldberg. In 2001, Goldberg, together with the head of the Skanska office Lars Wiklander in Buenos Aires, visited the Winter Station at Snow Hill Island with the logistical help of the DNA-IAA. There they conducted measurements of the Winter Station and established a cooperation with the work led by Capdevila. In the following years, Goldberg gave material support to the work at Snow Hill Island. Unlike the above-mentioned Swedish state representative visits in 2005 and 2007, Goldberg’s cooperation with the DNA-IAA did not represent an official Swedish engagement.

In 2008, Capdevila passed away and Goldberg’s engagement ended. Actors within Swedish diplomacy and SPRS worked hard to build support for an active, official Swedish engagement with the management and conservation of the HSMs.[6] In 2010, the Swedish-led LASHIPA 8 expedition – a historical-archaeological expedition within the framework of SWEDARP – represented Sweden on a visit to the remains of the stone hut at Hope Bay, on the initiative of the Swedish Ministry of Foreign Affairs.[7] Their visit involved discussions with the chief of the Argentinian Esperanza station at Hope Bay about future Swedish cooperation in conservation at the HSMs related to the Nordenskjöld expedition. The visit generated a report, submitted to the Swedish Ministry of Foreign Affairs and to SPRS (Avango 2010).

The 2010 report did not lead to any immediate official Swedish engagement, but it did play a role in the making of the CHAQ2020 expedition. In the spring of 2016, a representative of SANAE (South African National Antarctic Expedition) informed SPRS that a group of South African Antarctic researchers had found a depot with remains from an expedition known as the Swedish-British-Norwegian Antarctic expedition NBSX 1949–1952, at a nunatak on Dronning Maud Land. SANAE also contacted the Norwegian Polar Institute (NP) and the British Antarctic Survey (BAS) on the same matter. The depot was located within reach of a South African research station in the area. Therefore, SANAE wanted guidance on how the organisation should handle these remains and whether Sweden, Norway and Britain wanted them declared as a HSM. Since there was not an established praxis in Sweden on how to deal with such issues, the SPRS director took the initiative to collaborate with the Royal Institute of Technology (KTH) and IPHC.[8]
SPRS, KTH and IPHC took this as an opportunity not only to deal with the NBSX depot but also to draw up a suggestion for how to deal with heritage matters pertaining to Antarctica in Sweden. The result was a proposal based on how Norway deals with heritage in Antarctica, in which their National Heritage Board plays a key role.[9] In order to discuss the matter, SPRS arranged a meeting with the leadership of the Swedish National Heritage Board (RAÄ), SPRS, KTH and IPHC.[10] The meeting discussed the possibility of establishing a model similar to the Norwegian model, with the difference that the RAÄ – which does not have in-house expertise on heritage in polar areas – ask for expert advice on Antarctic heritage from relevant university departments in Sweden and from Swedish members of IPHC.

The meeting also discussed the possibility of an active involvement of the RAÄ regarding the existing HSMs from Nordenskjöld’s expedition. In late 2016, an opportunity to work towards that end appeared when the Swedish Research Council (VR) approved funding for the research project “On constructing cultural heritage in Antarctica” (CHAQ). This research project involves KTH and Luleå University of Technology (LTU) as well as other universities abroad.[11] The objective of CHAQ is to explore and explain heritagisation processes in Antarctica. The VR funding did not include resources for conducting fieldwork in Antarctica, however. Dag Avango and Lize-Marié van der Watt therefore applied for logistical support from SPRS in 2017, for an Antarctic expedition named CHAQ2020. The objective of the expedition would be to collect data on how competing actors in Antarctica manage and narrate cultural heritage, with a focus on the HSMs pertaining to the first Swedish Antarctic expedition. In December the same year, SPRS approved CHAQ2020 with Dag Avango and Lize-Marié van der Watt as Principal Investigators (PIs).

However, the date for the expedition was pushed forward in time to 2019–2020 as a result of the Swedish government’s decision to move the SPRS from Stockholm to Luleå. In 2018, SPRS advised building CHAQ2020 as a collaboration between the SPRS and the IAA. In order to build such a collaboration, the CHAQ PIs suggested to the SPRS to explore whether the RAÄ would consider sending along conservation expertise on the team who could support the efforts of the IAA in the preservation of the HSMs. The SPRS supported the proposal, and Avango and van der Watt proceed to explore this possibility with the RAÄ, which invited them to present CHAQ2020 at the RAÄs offices in Gotland and at a conference on Heritage Science at the RAÄ in November 2018.[12]

In the spring of 2019, the CHAQ2020 PIs together with SPRS established a formal cooperation with the DNA-IAA, with the Director of the IAA, Rodolfo Sánchez, the chief of the Environmental Department of the Dirección Nacional del Antártico, Patricia Ortúzar, and the chief of the Humanities and Social Sciences Area of the Instituto Antártico Argentino, Pablo Fontana.[13] With this CHAQ2020 a Swedish-Argentinian collaboration project was developed, first and foremost funded and organised by the DNA-IAA. The expedition remained part of the SPRS SWEDARP program, with SPRS supporting it by providing equipment and assisting with the permit process and Environmental
Impact Assessment for Antarctic research. The SPRS also supported the expedition by building an automatic weather station to be placed at Snow Hill Island and sharing 50% of its cost with the KTH-based CHAQ project.

In the spring of 2019, the board of the RAÅ decided to set aside funding for placing two building conservation and documentation experts on the CHAQ2020 expedition team and proceeded to recruit Gunnar Almevik and Jonathan Westin from the Department of Conservation and Centre for Digital Humanities at Gothenburg University (UGOT) for the mission. Their work would take its point of departure in previous statements by the IAA on urgent risks to the four HSMs caused by the effects of climate change. Most severe were the threats to the Winter Station and assemblage on Snow Hill Island. Therefore, the IAA was particularly interested in receiving expert assessments and advice on relevant actions for safeguarding these remains. The mission from the RAÅ was to collect data for assessing how it could contribute to the long-term preservation and management of the HSMs pertaining to the first Swedish Antarctic expedition.

In the spring of 2019, Lize-Marié van der Watt withdrew from the expedition team leaving Dag Avango as PI and expedition leader for CHAQ2020. Gunnar Almevik was in charge of the RAÅ mission and together with Jonathan Westin made all preparations for their documentation and state of conservation work. Argentinian expedition leader of the IAA – Pablo Fontana – made the overall planning of the expedition, consulting with Avango on key issues. CHAQ researcher Kati Lindström joined the team as researcher in van der Watt’s place and took part in the preparation of research tasks pertaining to the VR project CHAQ. In November the team took part in a two-day training course organised by SPRS at Abisko research station in Arctic Sweden. On the 26th of December 2019, CHAQ2020 took off to Buenos Aires.

3.2. Aim and objectives

CHAQ2020 is the result of a collaboration between the Argentinian parties IAA and DNA, the Swedish organisations SPRS and RAÅ, and three Swedish universities, KTH, LTU and UGOT.

The common aim is to investigate and support the shared cultural heritage in Antarctica between Sweden and Argentina with a focus on the remains from the first Swedish South Polar expedition, 1901–1903. The objectives and tasks commissioned by the Swedish National Heritage Board are:
- to document the historic sites and monuments with traditional and digital technologies;
- to make the documentation, including virtual reality mediations, accessible to a broad audience through an open access digital platform;
- to survey the condition of the standard Conservation of cultural property – Condition recording for movable cultural heritage, 16096:2012;
- to compile a report that can serve as a knowledge base for strategic decisions and future management.
The above-mentioned goals also serve the objectives of the research project CHAQ, together with the additional objectives of:
- documenting evidence pertaining to Argentinian heritage management and related activities at the four main sites of investigation;
- establishing equipment for local climate monitoring on Snow Hill Island to initiate a potential for future research on climate and cultural heritage in Antarctica.

3.3. Field work methodology

The CHAQ2020 expedition team comprised four Swedish members: the CHAQ researchers Prof. Dag Avango and Dr Kati Lindström, and the commissioned conservation experts Prof. Gunnar Almevik and Dr Jonathan Westin. The Argentine team had three members: Dr Pablo Fontana, conservator Valeria Contissa, and military logistic captain Héctor Emanuel Mamani Ovejero. The fieldwork related to this report was carried out by Gunnar Almevik, Dag Avango and Jonathan Westin. Pablo Fontana carried out all the previous administrative procedures, coordinated the fieldwork of the team, solved logistical problems, and contributed with results from previous research and fieldwork carried out in the region. He had camped in the area during three Antarctic campaigns and knew the terrain well. Pablo Fontana, Valeria Contissa and Kati Lindström contributed to documentation photography and re-photography. Kati Lindström also carried out some of the interviews which informed this report.

The fieldwork in Antarctica was carried out over one month, from the 10th of January to the 10th of February. However, extensive amounts of time were spent on transportation, logistic preparatory work and waiting. The places were visited on the following dates (effective work):
- Snow Hill Island, 11–24 January (11 days)
- Hope Bay, Trinity Peninsula, 24 January – 5 February (3 days)
- Penguin Bay, Seymour-Marambio Island (isla Marambio), 5 February (3 hours)
- Larsen Cairn, Seymour-Marambio Island (isla Marambio), 6 February (2 hours)

The time spent on each site reflects the priority. HSM 38 on Snow Hill Island was the main priority and HSM 39 on Hope Bay the second priority. The less complex HSM 60 on Penguin Bay and HSM 94 Larsen's Cairn had the lowest priority. Due to the logistical situation of that time, it was not possible to reach Paulet Island, which was a priority. The descriptions of the site and remains are based on previous records from the DNA-IAA with information updated in 2018. Larsen’s Cairn HSM 94 on Seymour-Marambio Island does not originate from the Nordenskjöld expedition. However, Sweden, together with Norway, Argentina and the United Kingdom, was one of the proposing parties and also has obligations to support the management of the site. The cairn was raised by the Norwegian captain and whaler Carl Anton Larsen during an expedition in 1892–1894. Larsen was later recruited by Nordenskjöld for his knowledge and experience of the waters of the Antarctic Peninsula. This site was discovered by Pablo Fontana in 2016 and was inscribed as a HSM in 2019 (ATCM XLII, measure 12, 2019). Finally, remains from a wooden boat from the Nordenskjöld expedition were briefly documented and assessed. The remains were found on the shore of Seymour-Marambio Island and are stored on the military base.
The weather conditions during the fieldwork varied, with effect temperatures between -15°C and +15°C and wind from 0 to 30 s/m. Wind and precipitation mainly caused disturbance for digital documentation but there were days with good circumstances which enabled the recording of fully satisfactory results.

The fieldwork documentation and analysis that was carried out involved:
- Text descriptions
- Photography
- Re-photography from historic photographs
- Terrestrial photogrammetric triangulation
- Drone-based photogrammetric triangulation
- Drone-based landscape scale orthophotography
- Laser scanning
- Structure-from-light scanning
- Sound recording
- Manual scale mapping and drawing
- Condition survey and risk analysis
- Interviews
- Climate logging
Text descriptions and photography

All main objects and surroundings at the visited sites have been described in text and documented through photography. The main photography was captured with a Nikon model D800 and a FujiFilm model TX2 with a Fujinon XF 10-24 OIS. The structure of text descriptions of the Winter Station and the Hope Bay Hut follows the standard Condition recording for movable cultural heritage. The many remains from the surroundings of the Winter Station have been mapped in a number series from 1 to 67 and described and documented through photography. The majority of the text description and documentation photography was created by Gunnar Almevik and Dag Avango.

Re-photography

Some re-photography has been carried out, but not systematically.

Photogrammetric triangulation

All main objects at the visited sites have been documented through terrestrial photogrammetric triangulation. The objectives for using this technology were to act as a backup if laser scanning failed and for situations where the laser scanner was not feasible. The cameras used were a Fujifilm model TX2 with a wide angle Fujinon XF 10-24 OIS and an iPhone XR. The stone hut was documented in two sessions, with the iPhone XR on the 22nd of January 2020 (1870 photos) and with the Fujifilm TX2 on the 30th of January (1260 photos). The high-resolution mesh of the Hope Bay Hut consists of 42 million polygons. The Snow Hill Island Winter Station (exterior and interior) as well as the hill in its entirety and the remains of the magnetic station were photographed with the Fujifilm (8904 photos), as were the three monuments and the boat on Seymour-Marambio Island. The result from the structure-from-motion scanning is published as both point clouds and textured meshes.

Drone-based photogrammetric triangulation has mainly been used at Snow Hill Island due to restrictions on flying drones in the Adélie penguin colonies at Hope Bay. Permission was received to fly the drone at a height of 140 metres over non-restricted walking areas of Hope Bay, resulting in an orthophoto with a resolution of 10 mm per pixel. At Snow Hill Island we were able to fly at a range of altitudes – at some places of particular interest just five metres over ground, which meant we could create orthophotos with a resolution of just a few millimetres per pixel in certain areas. While our main goal was to document the entirety of the shore stretching all the way to the present limit of the glacier, we were also able to capture images from which we produced high resolution structure-from-motion models of the Winter Station and the hill it is built on. Two drones were used: a DJI Maverick 2 Pro and a DJI Phantom 4 Pro. The manner of photography, the number of images and the height of drone flights varied depending on both the object and the circumstances. Images have been processed in Agisoft Metashape for outputs in orthophotos, Digital Elevation Maps (DEM) and 3D models. The terrestrial photogrammetric triangulation was made by Gunnar Almevik and Jonathan Westin. Jonathan Westin and Dag Avango were responsible for drone documentation.
Figures 54–57. The survey involved traditional and digital documentation methods. Photos by Gunnar Almevik.

Laser scanning

The Winter Station on Snow Hill Island and the stone hut in Hope Bay were documented with the laser scanner. The scanning was performed by Jonathan Westin with a Faro Focus m70. The 3D documentation of the stone shelter consists of two complete sessions with 21–25 individual scanning positions in each session. The result from the laser scanning is published as three point clouds; one collecting all scans into one point cloud, and a separate point cloud for each session. The median error margin of the registered point clouds is 3.4 mm, and they average about 210 million measure points. The Snow Hill Island Winter Station and hill were documented in five different sessions. The first two sessions documented the interiors with 30 scanning positions, while the remaining sessions documented the exteriors. Due to non-optimal weather conditions, the colour information of many of the exterior scans is unreliable and unsharp as this information took longer to capture. However, the position of each individual point does not seem to have been negatively impacted. The data is published as registered point clouds collecting the scans from the interiors and exteriors. The raw data from each individual scanning position is also made available.
Structured-light scanning
A few pieces of interest from the deposit of conservation objects in the Winter Station were scanned with an Einscan 2X Pro Plus Structured-light scanner. The objects, chosen by the conservator, all proved difficult, as they were either very dark, of shiny metal, or made from soft fabrics and were therefore virtually impossible to handle without changing their shape.

Sound recording
Sounds were recorded mainly on Snow Hill Island but also from Hope Bay and Seymour-Marambio Island. The purpose of the sound record is to augment the VR model that is processed from the digital documentation data. The sound uptake involves, for instance, the local wildlife of birds, the sound of the sea at the shore, the sound of the pouring water from the river, the sound of a storm, and the sound of entering and walking around the Winter Station. The sound was recorded with a Zoom Handy Recorder H6.

Manual scale mapping and drawing
The near landscape surrounding the Winter Station at Snow Hill Island was mapped by manual methods, with aiming compass, clinometer and measure tape. As there were no detailed orthophotos at hand nor a large-scale map, the manual drawing was needed for the fieldwork's mapping of sites of interest and location of data loggers. The hand-drawn map was also used in the ‘walking interviews’. The Winter Station was thoroughly measured in ground plane, facades, sections. Details of doors and windows were also recorded. In 2001, a team with Fred Goldberg, Lars Wiklander and Ricardo Capdevila made documentation drawings of the Winter Station at Snow Hill Island. The drawings present measures and construction in principle and do not disclose details and irregularities. Therefore, it was decided to produce new scale-measured drawings in the system which included more detail. The scale drawing concepts were also used for notation and the mapping of traces, materials and damages. The measuring was carried out using a scale ruler, a measure tape, plum lines and a leveller. The scale was 1:20 for the building and from 1:10 to 1:1 for the detail. The accuracy is estimated to +/−3 cm. A ground plane and two sections of the stone hut in Hope Bay were also made using the same manual methods. The measuring and drawing were performed by Gunnar Almevik and Jonathan Westin.

Condition survey and risk analysis
The condition survey and risk assessment follow the standard Condition recording for movable cultural heritage. A simplified approach to the survey was made on the smaller cairns on Seymour-Marambio Island. The mapping and scale-measured drawings were used as a documentation base for the survey, involving text notations, photography and sketch drawings.

Figure 58. Interview notes from a “walking interview”, using the triangulation map and feature inventory as a starting point. Drawing and notes by Gunnar Almevik.
Interviews

Key people with responsibility for management of the Swedish-Argentine HSMs have been interviewed. The information fed into this report in relation to historic resources, previous and current management, risk assessment and recommendations. Interviews were carried out with Patricia Ortúza (Buenos Aires, 3rd of February 2020), Rodolfo Sánchez (Buenos Aires, 4th of February 2020), Lars Wiklander (Stockholm, 3rd of March 2020). Interviews with Pablo Fontana and Valeria Contissa were done on site on Snow Hill Island as a ‘walking interview’ following the mapping of remains. The interviews were carried out by Dag Avango and Kati Lindström.

Climate logging

The automatic weather station was named “Bodman” and was located on a small hill to the south of the Winter Station and river, close to the base-camp ground. The structure was made using a reused four meter radio truss tower in aluminium, provided by Argentina and brought from the Marambio base. The loggers are powered by a solar panel connected to two 12V car batteries. The data logging equipment was prepared by the Swedish Polar Research Secretariat and comprises instruments for measuring solar radiation, soil temperature, air temperature, relative humidity, wind speed and wind direction. The aim is to collect data corresponding to that collected by Nordenskjöld and his team in 1902–1903. Three wooden tubes were reconstructed by Pablo Fontana after the original from Nordenskjöld’s measurements of earth temperature and placed at...
the same location and depth. Furthermore, two data loggers for temperature and relative humidity were placed inside the Winter Station. The aim is to monitor the climate on a yearly basis and to see whether there are critical periods for growth of mould and fungus. In total, six temperature data loggers are placed in tubes at various heights located on the hill to the station. The aim is to monitor earth temperature and possible impact on the depth of permafrost.

3.4. Sources and management information

Fieldwork data
The data from the fieldwork, including digital photographs, sound files, point clouds, 3D models, digitised notebooks and measured drawing originals, are attributed with metadata, catalogued and stored at the Swedish National Dataservice (snd.gu.se). The transcriptions of interviews are stored locally at KTH under the research project CHAQ. The project, with a selection of data aiming to reach a broader public, is presented on an open access platform provided by the UGOT Centre for Digital Humanities (see antarctica.dh.gu.se).

ATS documents
The Secretariat of the Antarctic Treaty provides several databases with digital and digitised material concerning the procedures within the treaty. The Secretariat holds several databases and archives, like an Environmental Impact Assessment Database, an inspection database, a meeting document archive and a contact database. The most viable databases in regard of cultural heritage are:
- The Antarctic Treaty Database, which ‘contains the text of all Recommendations, Measures, Decisions and Resolutions and other measures adopted by the ATCM together with their attachments and information on their legal status’.
- The Antarctic Protected Area Database, which ‘contains the texts of the management plans for Antarctic Specially Protected Areas and Antarctic Specially Managed Areas, their legal status, location in the Antarctic continent and a brief summary of the purpose of designation. The database also contains information related to the list and location of Historic Sites and Monuments in Antarctica.

Geographical data
The Norwegian Polar Institute provides a collection of open Antarctic geographical datasets (Quantarctica) for research, education, operations, and management in Antarctica (www.npolar.no/en/quantarctica/). In addition to a base map, terrain data and geology, the datasets contain layers for glaciology, biology, environmental management, geology, and social sciences. The last includes present stations, historical sites, routes, and monuments.

Swedish archives
There are several archives that hold particular collections of the first Swedish South Polar expedition. In 2012-14, the Swdish Research Council financed a collaborative digitisation project of sources from Swedish polar expeditions and fieldworks. The project involved Stockholm university, the Royal Swedish
The Academy of Science, and the university libraries at Lund and Gothenburg university. 7000 photos whereof 148 from Nordenskjöld’s expedition are available through the platform for digital collections and digitised heritage, ALVIN (https://www.alvin-portal.org). Here is also a catalogue of the sources from Swedish polar expeditions and fieldworks 1868-1958.

- The Otto Nordenskjöld Archive at the University of Gothenburg Library was transferred from the Swedish National Archive in 2004. The archive comprise photographs from Nordenskjöld’s expeditions, as well as manuscripts, newspaper articles and, not least, the ship’s diary from the Antarctic expedition. Most of the photos presented in this report are included in a photo album, unfortunately without names of the photographers. Original glass plate negatives from Otto Nordenskjöld’s expedition to Antarctica, and also previous expeditions to Greenland and Tierra del Fuego, were found at the Department of Earth Sciences, now included in Nordenskjöld’s archive.

- Centre for History of Science, the Royal Swedish Academy of Science has extensive documents, like diaries, scientific documentation and also plans for a follow up expedition. Photographs from the expedition are accessible through ALVIN (see link above).

- The National Museum of Science and Technology has a collection of Nordenskjöld’s expedition, and furthermore the archive of the polar explorer Fred Goldberg who were involved in the centenary anniversary of the expedition. The documents are not yet digitised.

- The Swedish National Archive. The Otto Nordenskjöld Archive was transferred to the University of Gothenburg Library in 2004, but there is still a folio with personal documents and letters.

- The Polar Centre at Gränna Museum holds an archive of Nordenskjöld’s expedition with documents and photographs.

- The Maritime Museum holds an archive of the failed rescue expedition with the vessel Frithjof, led by Olof Gyldén.

**Argentinian archives and collections**

There are several archives with acts concerning the Winter Station (Refugio Suecia) on Snow Hill Island (Cerro Nevada), the stone hut at Hope Bay (Esperanza), the stone hut on Paulet Island, and the remains at Penguin Bay. There are also museums that hold collections of artefacts from the expedition.

- IAA conservation reports and collection
- DNA
- National Naval Museum in Le Tigre
- The museum ship Uruguay

**Biographies**

The historical events of the first Swedish South Polar expedition are well described in several biographies written by the expeditioners themselves. The whole expedition is presented and reflected in chronological order in the two-volume book *Antarctica* (1904) by Otto Nordenskjöld and John Gunnar Andersson. The
life in the stone hut in Hope Bay is described in the biography of Samuel Duse, *Bland pingviner och sälar: Minnen från Svenska sydpolarexpeditionen 1901–1903* (1905) and also in his book *Min vän Grundens historier. Minnen från öfvervintringen i Hoppets vik* (1909). Andersson has also written a monograph of the ship Antarctica including this and other journeys with the Norwegian vessel. The results from the expedition’s research are also presented in various publications, where the four-volume *Wissenschaftliche ergebnisse der Schwedischen sëudpolar-expedition 1901–1903*, edited by Otto Nordenskjöld, is the most complete. This multivolume work also contains in-depth descriptions of the fieldwork procedures and equipment.

### 3.5. The report format

The HSMs from the first Swedish Antarctic expedition are remote and costly to visit. Although the DNA-IAA organises conservation work at these sites on a yearly basis, the opportunities for heritage scholars to re-visit on a regular basis are limited, as is the possibility of repeating the massive collection of data conducted by CHAQ2020. For this reason, this report is both comprehensive and detailed. The extensive report therefore has an introductory executive summary and continuous summaries to the chapter. The target groups are both policy and decision makers regarding Swedish cultural heritage in Antarctica, and experts involved in present and future management of the monuments and sites. The report is accompanied and linked also to an interactive portal, where the photography and drawings can be studied in greater resolution and the digital documentation can be roamed in 3D, enhanced with sounds. The main target groups are interested communities and the broader public. Furthermore, the full fieldwork data is catalogued and stored at the Swedish National Dataservice (snd.gu.se). The target group for the database is foremost researchers.

![Figure 60. Idea of the interaction between the project presentation formats and their target groups. Model by Gunnar Almevik.](image)
Figures 61–62. Screenshots from the web-portal at the Center for Digital Humanities, UGOT. The visitor may access the various media for documentation; the 3D point clouds and meshes, the orthophotos, photos, videos and drawings.

Visit: Antarctica.db.gu.se
Figures 63–65. The visitor may access the 3D documentation, with the metadata, and also retrieve for instance polygons and measures through tools provided on the platform. All documentation including the point clouds is downloadable.

Figure 66. The source data including all 3D data and images for the photogrammetric triangulation is archived at the Swedish National Data Service, SDN.

Visit: SDN CHAQ2020
3.6 The condition survey and the conservation process

The condition survey follows the main procedure, structure and concepts of the European Committee for Standardization’s (CEN) standard Conservation of cultural property – Condition recording for movable cultural heritage (16096:2012). In turn, this standard is grounded on ICOMOS guidelines for the conservation process and quality principles of built heritage (ICOMOS 1996; 2003). This report also acknowledges ICOMOS’s recent quality principles (2017; 2019), the objectives of the ATCM environmental protocol (1998) and, in particular, the ATCM guidelines for historic remains (2001), the designation and protection of Historic Sites and Monuments (2009), and the assessment and management of Heritage in Antarctica (2018).

Figure 67. The report covers the anamnesis and diagnosis of the conservation process. The model is an interpretation of the process presented by Arja Källbom and Gunnar Almevik (2020) in turn based on ICOMOS guidelines for Analysis, Conservation and Structural Restoration of Architectural Heritage (2003).

The CEN standard states that the condition survey “is the first step in a process to develop plans and measures needed to keep built cultural heritage in a stable well-maintained condition.” The report presents a documentation and condition survey with recommendation on coherent short-term and long-term conservation actions. As such, the report provides a management tool. However, it does not give instruction on how to execute restoration and maintenance and, for that reason, future management plans and operation plans for conservation actions will be needed. This report may serve as a knowledge base for future conservation actions and monitoring.
Figures 68–70. Classification protocol for building components’ condition, urgency and overall recommendation in CEN standard conservation of cultural property – Condition recording for movable cultural heritage (16096:2012). The condition has implications for the cultural historical value of the monument. The urgency needs to be considered in the time plan for maintenance and restoration. However, the different recommendations have a large impact on the budget.

Figure 71. Risk urgency is a factor of probability and consequence. Matrix by Gunnar Almevik.

Figure 72. The horizon for conservation action has to take the remote location into consideration. Conservation action is possible only in summer, and even small repairs require extensive planning and logistic efforts. In this case, urgent and immediate action is aimed at occurring within one year; short-term action is within two to three years. The conservation horizon, and the overall ambition to keep this cultural heritage, is not possible to uphold for more than 50 years. Given the situation of climate change, 20 years is considered a long-term perspective. Timeline by Gunnar Almevik.
### ABSTRACT OF THE CONDITION SURVEY

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**Figure 73.** Summary of the condition survey presented in following chapters. Scheme by Gunnar Almevik.

The CEN standard follows a protocol which first provides information of the case history or anamnesis, using the standard sections: Object Information and Sources, and Information Management. The condition survey is structured by the building components: Structures, Ancillary Components, Surfaces, Installation and Services, and Outdoor Structures. The assessment of the components begins with a general component description followed by description and evaluation of the condition, risk assessment carried out through description and evaluation of the causes and consequences of the condition, and, finally, recommendation for action and the urgency with which this should be undertaken.
4. THE WINTER STATION ON SNOW HILL ISLAND (HSM 38)

4.1. Object information

Name: The Winter Station / Nordenskjöld's hut / Casa or refugio Suecia
Location: Snow Hill Island / Cerro Nevado
Geoposition: 64°21’50.0”S 56°59’30.7”W
Status: Argentinian national monument since 1965 according to law 266219; Historic Site and Monument (HSM) no. 38 according to the Antarctic Treaty since 1972
Proposing parties: Argentina and the United Kingdom
Parties undertaking management: Argentina and Sweden
Operative managed by: Dirección Nacional del Antártico - Instituto Antártico Argentino
Site guidelines: Resolution 2 (2019) - ATCM XLII - CEP XXII, Prague

4.2. Summary

The wooden hut was prefabricated in Sweden to function as a research station and dwelling during the Antarctic winter. The hut was called “the Winter Station” by the expeditioners, but is today named “Nordenskjöld’s hut” or “Casa Suecia” or “Refugio Suecia”. The Winter Station was erected in February 1902 on a hill between the sea and the mountains on the west side of Snow Hill Island. Six of the expedition members, including Otto Nordenskjöld and the Argentinian lieutenant José María Sobral, stayed in the hut for 22 months, until the Argentine ship Uruguay came for their rescue in November 1903. During the stay, the group performed research in geography, geology, bacteriology and meteorology. The near surrounding landscape was set up like a laboratory with various sheds and installations for observation and measurements. The effects of climate change with meltwater erosion and land drift have destroyed and even erased many of these remains. The Winter Station, a 4.0 x 6.3 metre wooden building, has, however, endured time and is well preserved, but the hill on which it stands is acutely threatened by the melting of permafrost and meltwater erosion. Efforts by the IAA from the 1990s up until the mid-2010s to reinforce the hill have probably kept the building from drifting and tumbling. Terraces were made of reused aluminium elements from temporary American aircraft runways used in Vietnam. The Winter Station has been maintained with many layers of tarred paper and new window sashes. If the building is to stand for the next 30–50 years, the recommendation is to continue regular building maintenance and to resume to reinforce the hill using the same methods that the DNA-IAA have applied in the past. The sites with remains from Nordenskjöld’s fieldwork are disappearing and require direct rescue archaeology.
4.3. Sources and management information

The sources of the history of the first Swedish South Polar expedition and the formation and use of the site during the years 1902–1903 are rich. There are several biographies with chronological and first-person narratives (e.g., Anderson 1904; Bodman 1904; Duse 1904; Nordenskjöld et al. 1904; Sobral 1904). The biographies contain photographs, maps of the site, and drawings of the Winter Station and fieldwork equipment. There are also several archives holding unpublished sources and photographs (see list in 3.3).

The sources of the site’s and building’s afterlife and documentation of conservation work are, on the contrary, scarce. The Argentine Navy’s archive has unique photographs from the second part of the 1900s. In the late 1970s, the IAA and DNA through the conservation officers Santiago Mauro Comerci and Ricardo Capdevila started thorough conservation work on Snow Hill Island that continued until the mid-2000s. The risk of soil erosion was revealed in January 1993, when the DNA-IAA team coordinated by Capdevila arrived at the site and spotted a large landslide in the northeast sector of the hill where the hut is installed. It reached the edge to the shelter’s wall. To reverse the process, the space was filled with rocks and sediments brought from 150 metres north of the

refuge. Over the same summer, the soil on the sides of the house was secured, two parallel concrete beams of 6.3 metres long by 15 cm on each side were buried at the edges of the ground, which were secured with four piles dug at 60 cm deep, and a concrete staircase was also built in front of the entrance of the refuge to avoid erosion of the hill by traffic in other places. In the following summer 1993/4 campaign, two additional landslides were observed: one on the west side of the ridge, which was also partially filled, and another in the northeast corner. Acrylics were also placed on the various windows, some of them replicas built the previous year, thus removing the wooden covers that covered them and allowing natural light to enter the interior (Capdevila 2000).

The booklet “The Swedish Hut in Antarctica” from 2001 by Fred Goldberg, Lars Wiklander and Ricardo Capdevila gives a good overview of the site’s history and describes the main conservation measures so far. There is also a conservation report from 2010 by Valeria Contissa and Victoria Nuñiala Antelo, DNA-IAA, with focus on the historic artefacts. There is a recent report by Yevgeny Yermolin, glaciologist of the IAA, that presents geological investigations with focus on the permafrost depth and the risks and measures for stabilisation of the hill. The recommendation is to measure the permafrost depth over time, to protect the
border zones from erosion, and to continue the terracing work but with stone-filled wire-net gabion boxes.

The documentation related to the Antarctic Treaty is accessible through the Secretariat of the Antarctic Treaty’s databases. There were no investigations prior to the listing of the hut as a HSM in 1972 but there are recent visitors’ site guidelines (VSL no. 14) for the “Snow Hill Hut” which mainly regulate the access and use of the Winter Station as a museum. To conclude, there exists no systematic up-to-date documentation or condition survey of the site.

Figure 78. Orthophoto of the Winter Station and surrounding landscape. Orthophoto by Dag Avango.
Figure 82. Map of the Winter Station site, by Gunnar Almevik.
4.4. The Winter Station

4.4.1. General description

The Winter Station is a small wooden building of timber-frame construction. The building's outer walls and roof are covered with black tarred paper and framed with lattices. The building is 4.0 x 6.3 metres, oriented lengthways south to north, and with the entrance through an extending vestibule on the west façade. The building location and form is designed to withstand the harsh climate. Two diagonal plank struts are supporting the northern façade and steel wires are mounted in each corner of the building and fixed to the ground. The building has no eaves and the walls are leaning inwards. By these accounts, the building is streamlined to sustain the storms. The ground plan comprises five rooms beyond the entrance vestibule: a kitchen, three small dormitories with a bunkbed and a desk, and a centre room which has a stove and a dining table. Above is an open
attic that is reached by a hatchway and a ladder. The walls are either bare planks or covered with tarred paper. In the dormitories the walls are also covered by a woollen felt. The original furnishing is intact but most of the historic artefacts are either lost or deposited. Some artefacts and photographs are arranged in a museum-like fashion and marked with information signs. The effect of the past is nevertheless palpable. A characteristic element is the many site-built desks and own-made shelves of wooden crates at all possible locations. The building is shaped by the production and daily life of fieldwork research.

The Winter Station is located on the north east shore of the island by the Admiralty Sound of the Weddell Sea. The station is situated on top of a small hill with a salient curved contour and stands as a landmark in the landscape, with views to Ross Island in the west and Cockburn Island in the north. The hill rises
about 13 metres above the sea delta with a plateau about 10 metres wide and extending about 60 metres from north to south. The hillside has steep slants in the south and north but is partly terraced and reinforced by poles, boards and piles of stones. The hill and surrounding land are in a state of constant transformation.

The climate in Antarctica is harsh to the historic monuments. The average temperature in the coastal areas is -6.0°C and 1.5°C in the zone of Snow Hill Island (Yermolin 2011). The highest temperature in Antarctica ever recorded – 18.3°C – was measured in February 2020 in Esperanza on the Antarctic Peninsula and in the zone of Snow Hill Island. Since 1960 the average winter temperatures on the Antarctic Peninsula have increased by 6°C. The disintegration of much of the Larsen Ice Shelf has been attributed to climatic changes (van Der Witt, Britannica).
The building has through its intelligent design, the recent reinforcement work with terraces and auxiliary installations for storm protection kept the building in a remarkably good condition. The inner climate in the building seems to be good with the reservation that it has not been monitored over time. There is no sign of biological growth and no bad smell from fungus and mould. Samples have been taken to analyse the existence of any such presence. However, climate change affects the very ground on which the Winter Station stands upon.

Figures 90–93. Ground floor and sections of the Winter Station, by Gunnar Almevik.
4.4.2. Condition, risk assessment and recommendations

4.4.2.1. Structures

*The hill*

The condition of the Winter Station is intertwined with the transformation of the hill on which it stands. As there is no vegetation, there is natural erosion from wind and precipitation. However, the effects of climate change have accelerated the process of decay. Meltwater from the mountain glaciers is fiercely eroding the slants. Furrows of water are running on all sides around the hill in summer. The hill’s soil is congealed by permafrost and probably also with the content of ice blocks or eventually a larger ice core from a pre-existing glacier. Comparison of photography of the hill taken at different times shows that the situation is exacerbating. The change is notable in the last 30 years (see Figures 105–110). The reinforcement work with terraces and stone-covered slants has probably slowed the rate of decay. However, only one part of the reinforcement work in the southwest side is completed as intended. Here, the terraces are all filled up with boulders, covered with a welded wire fencing and a last layer of gravel. To conclude, there are major symptoms of decay.

There is an obvious risk that the multi-caused deterioration of the hill will destabilise the ground upon which the building stands, eventually destroying the Winter Station. It is difficult to point at which of the intertwined causes is the most harmful, or to foresee when the deterioration will become a matter of immediate urgency. If no actions are taken, the threat may be acute in a period of 20 years, but if regular inspection and continuous repair and reinforcement are carried out, the building may last for yet another hundred years. The risk is a long-term one, but the consequence of the risk is devastating.

The recommendation is to continuously monitor the state of the hill through visual morphological survey, and also to monitor the earth temperature and depth of permafrost. The first and most urgent preventive intervention is to protect the border zones of the hill slant with stones. The aim of this action is to prevent meltwater erosion but also to function as a visible indicator of the precise location and rate of erosion.
The second recommendation is to resume and continue reinforcement work with terraces and stone-covered slants. This is a major intervention for which a project plan is required. Expert consultations are needed in different fields of expertise, like earth erosion and terracing methods, but this could probably be acquired on the basis of the detailed digital documentation.

There have been discussions within the IAA about performing more pervasive preventive actions, with cold climate technology and/or channelling the meltwater flood into a reinforced ditch of cast concrete. Furthermore, the possibility of dismantling and re-erecting the Winter Station on a safe location on Snow Hill Island has also been discussed. However, it is uncertain whether there exists a safe location on this island, protected from the effects of climate change and with similar qualities. The recommendation is,
first of all and before any large-scale intervention, to resume the reinforcement work of the hill, with protected border zones and terrace and stone-covered slants. Before starting the work, a project plan needs to be developed. It is also vital that the state of the hill is continuously monitored. Changes of the site’s morphology could be minutely measured based on the new digital documentation that is now at hand. The climate datalogging also provides opportunities for monitoring and control.
Figures 105–110. Re-photography of the Winter Station by Gunnar Almevik, Figures 109–110. Historic photo, Figures 105 and 106, from Nordenskjöld’s archive, UGOT (PDM) and Figure 107 from IAA, and figure 108 from Argentinian Military Archive (CC BY-NC-ND).
Figures 111–113. Re-photography of the Winter Station, Figure 113, by Pablo Fontana (CC BY-NC-ND). Historic photo, Figure 111, by Carl Anton Larsen from Nordenskjöld et al. 1904, page 192, vol.I (PDM), and Figure 112 from Argentinian Navy Archive (CC BY-NC-ND).
Figures 114–115. The foundation uncovered. The gravel is shovelled up to the wall, and consequently the sill is placed underground. A plastic film is placed under the tarred paper. Photos by Gunnar Almevik.

Building foundation

The building is placed directly on the ground. The sill is made of planks measuring 50 x 125 mm (2 x 5”) and dug down about 200 mm below ground level. Historic photographs show that the sill was placed on flat pieces of planks and levelled. The system of joists to the ground floor consists of two lengthways-placed planks to support the inner floorboards. The tarred wallpaper and an inner layer of plastic film continues underground and is folded outwards by the end of the sill. The gravel is partly shovelled up to the walls, making a small inclination for the runoff of water. (Gunnar Andersson writes in his monograph of Antarctica that he disagreed with Otto Nordenskjöld on not placing a row of boulders by the walls.)

The building has sagged approximately 100 mm towards the west, which is quite significant on the short distance of 4 metres. The cause is probably the uneven melting of permafrost. The permafrost depth was measured in February 2020 disclosing a difference of 0.4 metres on the west and east sides. The depth at the sagging west side was about 0.6 metres; by the more protected east side, it was only down to 0.2 metres. Another cause of the sag, or an exacerbating factor, could be the uneven traction force caused by the auxiliary wire installation which is in place for protection during storms. To conclude, there are symptoms of decay. The symptoms are moderately strong.

There is, as stated above, a risk that the meltwater will erode the hill step by step from below, and there is also a risk of landslide on the hill’s plateau caused by the melting of permafrost in combination

Condition Class:
CC 2. Moderately strong symptoms

Urgency Class:
UC 1. Intermediate term
with the erosion from wind and precipitation. The Winter Station could probably withstand a smaller landslide undermining a part of the foundation, but the auxiliary installation for storm protection would probably be corrupted. As a consequence, the building would become extremely vulnerable to storms.

The recommendation is to continuously monitor the state of the hill, the earth temperature on the hill and plateau, the depth of the permafrost on the plateau and near the building, and also the sag of the building. If the rate of decay and the effects are palpable, reinforcements are needed.

*Timber frame construction*

The building construction is a framework of planks. The most frequent dimension is 50 x 125 mm (2 x 5”), including the sill and all the vertical studs and longitudinal wall plates. The gable walls consist of five studs and the long sides of eight. The gable studs continue to the roof pitch and are connected to the outer rafters, and the central stud carries the ridge beam on which the rafters rest. The walls are covered with boards on both the inside and the outside but there is no insulation between. All studs are nailed to the sill and the long-side studs are fitted in a notch and nailed in two top plates; one in connection to the attic floor joists and the other to the rafters. The attic floor joists are also nailed to the studs. The centre distance of studs varies between 1 and 0.8 metres.

The timber frame construction has deformed. The construction has weighted towards the north, most probably caused by the winds and storms from the south. The construction had adapted to this deformation. The sag to the west caused by the melting of permafrost has visible consequences in the timber frame construction. The plate by the attic truss on the east side of the building has been partly pulled out about 30 mm from its position. The symptoms are moderately strong.

The sag and subsequent asymmetries in the construction are not a risk. On the contrary, to try to lift and straighten up the construction could cause more risk and negative side effects on the timber frame and the auxiliary installation for storm protection. There is a small risk that a continuous sag and deformation will disconnect the plate by the attic truss from the studs. The consequence could be that the building falls apart.

The recommendation is to fix the plate in the present position by drilling large wooden screws into the studs.

**Roof structure**
There are eight pairs of rafters connected to the ridge and mounted on the top plate and also nailed to the studs. The rafters are thick planks of 60 x 180 mm. The centre distance of rafters varies between 1 and 0.8 metres. There are no diagonal struts. On top of the rafters are tongue-in-groove boards of 28 x 125 mm. The roof structure is in good condition.

There are no particular risks associated with the roof structure, as long as the timber frame structure holds together, and walls and surfaces protect the attic from wind and rainfall.

There are no recommendations other than continuous inspection.

**4.4.2.2. Ancillary components**

**Auxiliary installation for storm protection**
In addition to the building’s streamline design without the eaves, the leaning walls and the compass layout in the direction of south to north with a slight north-northeast inclination of about 24°–25° to break the wind, and the entrance located towards the east to avoid the risk of ice and snow that might break the door, there is also an auxiliary installation for storm protection. The diagonal planks to support the north gable are original but still in place and in good condition.

### Condition Class
- **CC 2. Moderately strong symptoms**
- **CC 0. No symptoms**

### Urgency Class
- **UC 1. Intermediate term**
- **UC 1. Intermediate term**

### Recommendation Class
- **RC 1. Maintenance**
- **RC 0. No intervention**
condition. The planks are fixed with clamps and nails to the wall and to the ground with boulders. A more recent auxiliary installation was made in recent times with a steel wire from each corner of the top plate to the ground. An angle bracket is screwed into the plate at the outer corners and the wire is mounted on turnbuckles. The iron is worn and the brackets are skewed. Exactly how the wire is fixed into the ground is not known. In the northside corners, the wire has been remounted and runs through the wall and is fixed on the inside of the plate. Traces of hemp rope in the attic make it probable that there was a similar installation in the past. In the attic there are also interior angled brackets mounted in each corner. These are well fixed. A wire runs along the inner walls connected to the corner brackets which functions as a safety mechanism if the top plate and the walls were to fall apart.
Figures 127–130. Historic and new reinforcement system of a circular wire (rope) to connect the diagonal corner wires. Photos by Gunnar Almevik.

The different auxiliary installations for storm protection are important and their condition is fairly good, with back-up security from the circular wire in the attic. The most uncertain features to assess are the outer angled brackets and the anchoring of the diagonal wires. The symptoms of stress are moderately strong.

If a bracket or the anchoring of the supporting diagonal wires were to come loose, the consequences could be disastrous. The storm protection would be out of function. Other causes of decay and tensions in the building could be unleashed and amplified, for instance the sag and deformation of the timber frame construction.

Condition Class: CC 2. Moderately strong symptoms

Urgency Class: UC 3. Urgent and immediate
Figures 131–132. Standard square window of the northern dormitory, with two sashes in a frame and recently covered by an outer acrylic glass. Photos by Gunnar Almevik.

The recommendation is to fasten the corner brackets and inspect the anchoring in the ground. The wires and fittings should be regularly inspected, and replacement material should be acquired and put in place.

Windows
There are in all seven windows: one in the vestibule, one in each dormitory and kitchen, and one on each gable. The gable windows are covered with boards. All window frames are original but many of the sashes are reconstructed. The original larger west facade window is stored in the attic. This window has six instead of four panes, and the sash measures 730 x 1040 mm. The standard window has two separate sashes measuring 730 x 730 mm, one outer and one inner, fitted in the frame without interconnection. Each sash has muntins in a symmetrical cross form. The outer panes are filled with acrylic plates with the exception of the window on the west wall that has glass. The acrylic has become milky due to the low temperature, and the visibility is poor. The windows are not painted. The wood and windows are in fairly good condition.

The construction with double sashes and the acrylic plates is safe. The fixed double sashes with acrylic glass are sustainable and there is no urgent risk that they will break. If the boards covering the gable windows break, the wind could enter the attic, which could cause great damage.

Recommendation Class: RC 2. Repair and further investigation
Condition Class: CC 1. Minor symptoms
Urgency class: UC 1 Intermediate term
Figures 133–134. Drawings of the two types of original windows, by Gunnar Almevik.

Figures 135–136. Drawings of the outer and inner door types, by Gunnar Almevik.
The recommendations are to fasten the boards covering the gable windows and eventually to replace worn out boards. A further recommendation is also to change the milky acrylic glass to hardened security glass of 5 mm thickness. The motive is to restore the visibility and connectivity between the building’s interior and the surrounding landscape.

**Doors**

The entrance door is located on the east side vestibule. The door is a panel door of three plane panels in a simple construction. The door is original. By principle, the doors in the huts and refuges in Antarctica are not locked. The original locking is not in use, and instead there is an iron closing hasp.

There are five inner doorways: one from the vestibule to the central room, and one door to each of the dormitories and to the kitchen. Today, only the vestibule and kitchen doors are preserved. They are both panel doors of three plane panels in a simple construction.

The doors are in good condition.

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**Figures 137–139.** Outer doors and, to the right, the one preserved inner door. Photos by Gunnar Almevik.
Figures 140–145. The outer walls are covered with several layers of tarred paper. The outer layer has been repainted many times with asphalt and is very brittle. The first layer of the wall boards is a plastic film. Photos by Gunnar Almevik.
There are no risks of any hazards.

There is no need for action.

4.4.2.3. Surfaces

Outer walls and roofing

The outer walls of the timber frame construction are covered with tongue-and-groove boards of 28 x 125 mm and tarred wallpaper. Originally, there was also an outer layer of woollen felt. The felt has been worn off or removed during recent renovation. Today, the boards are covered with a plastic film and two or even three layers of tarred paper. The paper is mounted with 30 mm nails with a semi-large head. The plastic film and the tarred papers continue underground, covering the sill to a depth of 0.2 metres and is here folded outwards. The outer layer of the tarred wallpaper has been painted with a thick asphalt-like paint and the thick brittle layer has started to crack. Vertical and, occasionally, horizontal laths are placed to hold the paper and cover the seams. The dimension of the laths varies from 2 to 12 cm. There are possibly some original laths on the north facade. There are occasional repairs with cut and nailed pieces of tarred paper but also repairs with silicone. Almost all of the silicone repairs have come loose and do more harm than good.

The roofing is made using the same materials and methods as the walls. The rafters are covered with tongue-and-groove boards of 28 x 125 mm, a plastic film, and two or even three layers of tarred paper. The tarred paper is folded around the small eave and makes a continuous surface between the roofing and the vertical walls. The outer layer of the roofing is like the walls painted with a thick brittle asphalt that has started to crack. Vertical and, occasionally, horizontal laths are placed to hold the paper and cover the seams. A second layer of horizontal laths are placed as snowguards. The thick ageing asphalt provides a certain patina to the building but the many cracks in the covering are a risk. The wind gets under the layers of paper and expands the cracks to tears. The inner plastic film is intact but if this layer is torn, moisture will pass into and be kept inside the walls. This may cause growth of mould and fungus.

The recommendation is to plan for a renovation of the outer surfaces as a proximate goal. Old layers and the plastic film should be removed. Original layers should be kept. The aim should be to reuse the laths and to keep the positions and measures, at least approximately. The quality and brand of the wallpaper and pitch should be defined in the plan. Samples from the present and original wallpa-
Figures 146–150. Orientation of the Winter Station’s interior. Photos by Gunnar Almevik.

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per are taken and will be analysed. Meanwhile, the surface should be kept and mended, preferably by pieces of full breath between the laths. Proper hot dip galvanized nails for tarred paper should be used. Silicone should be ruled out.

**Inner walls**

The inner walls, like the outer walls, are covered with original tongue-and-groove boards of 28 x 125 mm. The inner walls are also covered with a plastic film, tarred wallpaper and a woollen felt, except for the kitchen, which has no felt, and the vestibule and attic, which have only boarded walls. The plastic film, the wallpaper and most of the felt originate from recent renovation work. Parts of the original felt are preserved on the west wall. To distinguish the original felt from the new felt, a distance of a few centimetres is kept. This gap has been painted in bright orange, which is a common colour in all the Argentine bases in Antarctica. The same colour was used to distinguish new stones from original ones in the restoration of the Hope Bay Hut (see Figure 51).

The condition of the interior walls is good. There is no bad smell or any alarming signs of biological growth or penetration of water or moisture. One data logger for temperature and relative humidity is placed by the west wall on the first floor and in the attic to monitor the indoor climate.

The plastic film placed both on the inside and outside of the boarded timber frame construction would be a real problem in an insulated and heated building. The plastic film may cause condensation of water, but as the building is neither insulated or heated, the risk is smaller. There is not a huge difference in temperature or humidity in the inner and outer climates. As the space between the boarding is filled with nothing but air and is open and ventilated through the attic, any potential condensation or moisture will not be totally enclosed. There is, however, no point in having this plastic film.

The recommendation is to keep the interior surfaces as they are, and to continue monitoring and observing the inner climate.
Doorspaintings
The kitchen door has at least three original but vaguely preserved lead pencil drawings. They are caricatures and seem to represent the cook, Gustaf Åkerlund. One of the larger drawings depicts Åkerlund with a puffed stomach, sitting on a wooden box eating the food: raisins, chocolate, dadles and dried apples.

The drawings on the kitchen door may be harmed by visitors touching or leaning on the surfaces.

The kitchen door with the drawings is the only remaining inner door and should not be removed. The recommendation is to consult a conservator on the risk factor and suitable methods for protecting the drawings in situ.

Figures 151–153. Lead pencil drawings on the kitchen door. The lines in the drawing to the left below have been enhanced by the authors. The sailor and cook Gustaf Åkerlund eating of the good provisions. In English: “Åkerlund comes clean…Raisin…Dried apples…Caramel…Dessert chocolate…marmalade.” On the drawing to the right, a man is walking with a packing seemingly unconcerned about the dangers on the trail. There is a yet another drawing of a happy man’s round face. Photos and interpretation by Gunnar Almevik.

Condition Class: CC 3. Strong symptoms

Urgency Class: UC 1. Intermediate term

Recommendation Class: RC 2. Further investigation
Floor

The floors are made of the same tongue-and-groove boards that cover the walls and roof. The floorboards of the ground floor are transversely placed with two straight seams, one at each of the longitudinal joists. The floor was not dismantled during the fieldwork, but Gösta Bodman describes the construction of the floor in his diary from 1902. According to Bodman, there are two layers of boards between which there is a layer of tarred paper and a layer of felt as insulation. The remains of linoleum bearing an intricate pattern in dark red and brown colours were found in the kitchen. Today, transparent plastic carpets are placed on the walking areas to protect the wooden floorboards. The museum’s rules demand that the visitors take off their boots, but despite this rule, there is a lot of gravel and sand brought into the house. To walk in bare socks on the floor is very cold and as no alternatives are provided, the visitor should bring their own soft shoes or slippers.

The attic floorboards are laid out lengthways with altering seams on the transversal system of joists. The holes where the chimneys of the stoves would have run through in the past have destabilised the floor area by the passages. Recently, a thick rubber carpet covers a large part of the attic floor. This rubber carpet was put in place when the remaining historic artefacts was registered and stored in the attic.

It is uncertain whether the plastic carpet protects or worsens the attrition of the floorboards. The carpet seems to be an excuse not to take off the boots. Sand and gravel are also present beneath the carpet and amplify the wear. In summer, the difference in temperature between the ground floor and the attic is palpable. The rubber carpet on the attic floor contributes to the separation of these climate zones, and there is a potential risk for condensation followed by fungus and moisture. The areas around the chimney holes in the attic floor are a real risk as people could easily fall down them.

The recommendation is to acquire boot covers for temporary visitors. Both the plastic carpet on the ground floor and the rubber carpet on the attic floor should be removed. A fine sweeping brush and shovel should be kept in the vestibule to facilitate the housekeeping. The area around the holes for the chimney should be strengthened.

Condition Class: CC 1. Minor symptoms

Urgency Class: UC 2. Short term

Recommendation Class: RC 2. Moderate repair and preventive conservation
4.2.2.4. Installation and services

Stoves and chimneys
There are two stoves on the ground floor; one kitchen stove and a heating stove. The stoves were coal fired with metal pipe chimneys. The kitchen stove is a Husqvarna model no. 6 with three hobs and an oven. The three-legged heating stove is of an unknown brand. The hatch is missing and also parts of the hob. The boarding wall to the heating stove was protected with an Eternite millboard, a hazardous Asbestos material. Fragile and discomposed parts of the Eternite are preserved. As mentioned above, the area around the holes for the chimneys is weakened.

The fragile and discomposed parts of the Eternite millboard by the heating stove are a potential health risk. The areas around the chimney holes in the attic floor are, as mentioned above, a real risk as people could fall down them.

The recommendation is, following safety procedures, to carefully dismount and store the parts of the Eternite millboard. The area around the holes for the chimney should be strengthened.

Fire extinguisher
There are two powder fire extinguishers, one placed in the vestibule on the floor and another in the southwest room. The extinguishers are of a type ABC of 5kg, and renewed every year by DNA-IAA.

The extinguisher stands directly on the floor and could easily be overturned or carried away.

The recommendation is to mount the extinguisher on a standard holder, on a visible and uncluttered part of the vestibule wall, and furthermore to ensure continuous inspection and replenishment.

Furnishing and artefacts
There is one original table and three Thonet chairs. The table is mended and also bears traces of deep cuts originating from the uncovering work in the 1970s when the building was filled up with snow and ice. There are three site-built bunk beds and three desks, one in each dormitory. There is also a foldable desk located by the window in the central room. There are about 20 site-built shelves of wooden crates at all possible locations. Some historic artefacts and fragments are displayed in the house with information signs
Figures 154–159. The Winter Station has two fireplaces: one in the kitchen and one heating stove. The chimneys have been dismantled. Photos by Gunnar Almevik.

in a museum-like way. Some prints of historic photographs and documents are folded in plastic and hung on the walls, also with information signs. Things have previously been taken from the Winter Station to the IAA, the Naval museum in El Tigre, and also to the ship Uruguay. Most of the original artefacts that are still at the Winter Station are stored in cardboard boxes and polythene packaging in the attic. Two windows are stored in the attic, and several spare rolls of turred paper.

The condition of the artefacts varies but is now stable through preventive conservation.

Condition Class: CC 1. Minor symptoms
There is a risk that artefacts could be stolen. Things have disappeared or have been taken without authority, like the hatch to the heating stove. The tarred paper is aged and frangible and is not a good material for repairs. The rolls are very heavy and the load could be a factor in the play of forces with the diagonal auxiliary installation for storm protection.

The recommendation is to keep and care for the furnishings and artefacts as they are. The tarred paper rolls should be removed and discarded but preferably when the diagonal auxiliary installation for storm protection is reconditioned or renewed.

Figure 160. Interior of the Winter Station with the many site-built shelves. Note the “Deadman’s anchor” from the Magnetic Hut on the wall between the doors. Photo by Gunnar Almevik.

Urgency Class: 
UC 1. Intermediate term

Recommendation Class: 
RC 1. Preventive conservation
Figures 161–166. Comparisons between the historic and the contemporary furnishing and arrangement of artefacts. Photos by Gunnar Almevik. Historic photos by Gösta Bodman, from Nordenskjöld’s archive, UGOT (PDM).
Figures 178–184. Historic photos of the laboratory work and installations in the landscape. Above, the large 'thermometer cage' with thermograph, hydrograph and a bowl to measure evaporation, Figure 178 by Otto Nordenskjöld and 179 by Gösta Bodman, from Nordenskjöld et al. 1904, pages 413 and 225, vol.I. Middle, solar altitude measurement and the astrological observatory, photos by Gösta Bodman from Nordenskjöld et al. 1904, pages 441, vol.I, and 369, vol.II. Below, mapping, photography and earth temperature measurement, from Nordenskjöld's archive, UGOT (PDM).
Figure 185. Orthophoto of the landscape surrounding the Winter Station. Photo by Dag Avango.
Figures 186–191. Re-photography of the Magnetic Hut location and the remains of the “Deadman’s anchor” once used with the diagonal reinforcement ropes of the hut, by Gunnar Almevik. Historic photos by Erik Ekelöf, Figure 186, and by Gösta Bodman, Figure 188, from Nordenskjöld’s archive, UGOT (PDM).
4.5. The laboratory landscape

4.5.1 General description

The first Swedish Antarctic expedition conducted a variety of scientific investigations during their stay at Snow Hill Island. One of them is located in the vicinity of the Winter Station – the Magnetic Hut (see Figures 186–191). The expedition also conducted scientific work in which prominent features in the landscape that are clearly and easily identifiable were used. These consist of a network of reference points which the expedition established for the purpose of mapping Snow Hill Island. These reference points are located along a mountain ridge following the western coast on the north part of Snow Hill Island (see Figure 196).

4.5.2. Condition, risk assessment and recommendations

The Magnetic Hut remains
The remains of the Magnetic Hut (features 001, 002 and 003, Appendix 3) are situated on a hill, in this report named ‘the Magnetic Hut hill,’ which is located 100 metres west of the Winter Station of the first Swedish Antarctic expedition (feature 020, Appendix 3). The hill measures approximately 38 metres on a north–south axis and 23 metres east–west. The hill rises some 3–5 metres from the surrounding landscape and is made up of fine moraine gravel in its uppermost part, about 1 metre, and permafrost and ice in its lower part. On the eastern and northern sides of the hill, there is a riverbed with a number of water streams, approximately 65 metres wide (feature 065, Appendix 3).

We defined five features on the Magnetic Hut hill, three of them material remains of the Magnetic Hut, built and used for the purpose of measuring earth magnetism by the first Swedish Antarctic expedition (features 001–003, Appendix 3) and two of them prominent material imprints of erosion (004–005, Appendix 3, described under conditions below).

The remains of the Magnetic Hut building consist of an area with fragments of firebricks and other artefacts (feature 001, Appendix 3), approximately 6 metres in diameter. One brick is intact. Some brick fragments have pieces of cement. There are no traces of information regarding which company manufactured the firebricks. Other artefacts are pieces of building material – wallboards, floor tiles and fragments of glass (windows, bottles, glasses). Approximately 7 metres to
the south of the artefact scatter, there are two circular depressions in
the moraine, about 25 cm deep and 100 x 130 cm wide, and surrond-
ded by low mounds of moraine (features 002 and 003, Appendix 3).

The bricks are likely to be remains of a fundament for scientifc in-
struments, once located inside of the hut. The cement and firebricks
suggest that it was similar to fundamentals for scientifc instruments
at Sorgfjorden, Svalbard, from the same period. Research conducted
by the IAA has shown that there used to be more firebricks on the
site. Capdevila moved these bricks in the 1990s and placed them
outside of the Winter Station, close to its south-eastern corner (fea-
ture 018, Appendix 3). According to Fontana, the blue glass frag -
ments come from bottles which a company from the San Telmo area
of Buenos Aires sold to the Swedish expedition in 1901.

The depressions are most likely the remains of anchor points for
a wire that supported the Magnetic Hut. The hole contained a
Deadman, connected to the Magnetic Hut with a wire. Two wires
are visible in a historic photo of the Magnetic Hut (Figure 166).
It is likely that the hut had two more wires on the northern side of
the building. If so, the remains of the anchor points for those wires
have disappeared due to erosion from the river (see conditions be-
low). Inside of the Winter Station (feature 020, Appendix 3) there
is a Deadman hanging on the wall (see Figure 160). According to
Pablo Fontana, Capdevila placed it there after moving the remains
of the Magnetic Hut from the Magnetic Hut hill in the 1990s.

The artefacts in the cluster of things remaining from the Magnetic
Hut building are highly fragmented and clearly represent only a
fraction of the materials that once made up the building and the
scientifc equipment inside it. The depressions remaining from the
Deadman anchor points that once served to support the building,
are in good shape, clearly visible and interpretable. The entire area
of the Magnetic Hut hill is, however, criss-crossed with a web of
cracks (feature 004, Appendix 3). Along the northern and eastern
sides of the hill towards the meltwater river, there is a system with
deep, broad and expanding cracks, creating slabs of moraine hang-
ing out towards the river (see Figures 186 and 188, features num-
bered 004 and 005 in Appendix 3).

The remains of the frst Swedish Antarctic expedition on the
Magnetic Hut hill (features 001–003) are under threat from fal-
ing into the river because of erosion. During the two weeks we
worked at the site, we witnessed how the river eroded the eastern
and northern side of the hill at a rapid pace, partly also flowing
Figures 194-196. Above: Mountain top and basalt rock once used as a reference point when mapping Snow Hill Island. Below: Cairn on a ridge overlooking the Winter Station built as a reference point. Photos by Dag Avango.
Figure 197. Triangulation network for mapping the landscape by Kurt Molin, from Nordenskjöld and Bodman, 1905-08, vol.I, L5 (PDM). Three reference points have been detected and documented, here marked with a circle.
under the hill. This meltwater erosion is likely to be one of the main causes of the erosion process, but thawing permafrost can also contribute to the erosion. From air photographs of the 1980s and early 2000s, it is clearly visible that the Magnetic Hut hill extended far longer towards the north than it does today. Feature 001, the Magnetic Hut artefact scatter, is the feature under most severe threat from erosion and it is obvious that parts of it have already fallen into the river.

The recommendation is to monitor the Magnetic Hut hill by revisiting and re-making drone-based photogrammetric mapping, creating a record of where the most significant erosion is taking place, carefully documenting all remaining artefacts in situ, but leaving the artefacts in place. Beyond documentation, it is unlikely that it would be possible to stop erosion in the long term, unless radical measures are taken to construct barriers leading off the river in another direction. Such a measure would eventually be subject to erosion too, but, more importantly, would alter the landscape in a way that would be difficult to harmonise with the ambitions of the Antarctic Treaty environmental protocol.

**Natural reference points for triangulation and mapping**

The expedition team at the Winter Station conducted a thorough mapping of the inland area of the northern part of Snow Hill Island. For this purpose, they established a network of reference points. CHAQ2020 surveyed much of this inland area and identified several of the reference points, located along a mountain ridge following the western coast on the north part of Snow Hill Island.

Three of the reference points have been identified. One of the reference points is the top of a mountain located in the inland of the northern ice-free section of Snow Hill Island (feature 069, Appendix 3). The reference point is marked as such in the triangulation network map produced during the expedition (see Figures 182 and 185). The geographical location is Lat. -64.346690, Long. -56.933149. Another reference point is a basalt rock, approximately 5 metres high and 10 metres long, located on a ridge running along the western coast of the northern ice-free section of Snow Hill Island (feature 070, Appendix 3). The rock is also marked as a reference point in the triangulation network map (see Figure 197). The geographical location: Lat. -64.351736, Long. -56.956287.
There are no remains from the expedition at these sites, not even a cairn, most likely because the peak and the basalt rock are prominent enough for use as reference points.

There are no risks pertaining to these sites.

Beyond the documentation conducted by CHAQ2020, there is no need for further action in terms of documentation and conservation. To enhance the understanding of the scientific activities of the first Swedish Antarctic expedition, it would, however, be beneficial to include the reference point network as a component included in HSM 38, the Winter Station at Snow Hill.

The cairn as a reference point or triangulation and mapping
A cairn is placed at the edge of a ridge leading up from the east to a prominent basalt mountain top along the west coast of the northern part of Snow Hill Island (feature 071, Appendix 3). The cairn is located 880 metres from the Winter Station as the bird flies, and is clearly visible from the station. Its diameter is approximately 1 metre and is made up of rocks occurring naturally in its vicinity (see Figure 196). The cairn is also marked as a reference point in the map produced by the expedition (see Figure 197).

The cairn is collapsed due to the passage of time and the Antarctic environment.

However, the cairn is not at any particular risk of further deterioration due to environmental factors. The risk of being altered by tourists is minimal, as cruise ship tourists are very unlikely to make it up to the site and find it. There is, however, a risk that scientists and/or logistics personnel can find the site and be tempted to alter the cairn by adding or removing stones.

The recommendation is that the cairn is included in HSM 38, with strict regulations on visitors’ behaviour, forbidding any alteration of the cairn. The cairn should not be reconstructed but should be left as it is, giving witness to the passage of time.
4.6. The landscape of waste

4.6.1. General description

The first Swedish Antarctic expedition conducted activities in and around the Winter Station – scientific research but also regular household work and the routines of an everyday life which also occur on expeditions in the Polar regions. These everyday activities resulted in the wear and tear of everything, including buildings, building materials, clothes, equipment and scientific instruments. In the area immediately to the east of the Winter Station, there are artefacts that are likely to have been dumped there on different occasions by the Swedish expedition and by expeditions that have visited the site later. The artefacts appear in two clusters, named below as depot 1 and depot 2.

4.6.2. Condition, risk assessment and recommendations

Depot 1
Waste depot 1 (feature 052, Appendix 3) consists of a cluster of artefacts, located in a riverbed approximately 20 metres east of the Winter Station hill (see Figure 198). The upper end of the riverbed appears at the foot of an elevation, located between two wider riverbeds (features 008 to the west and 058 to the east, Appendix 3). The source of the water that has created the three riverbeds is meltwater or rain water periodically flowing down the mountainside located immediately to the east. It is clear that the source of

Figures 198-199. The landscape of waste with the two main depots east of the Winter Station hill. Some of the artefacts have eroded out from the bed of the meltwater creek. Photos by Dag Avango.
the middle riverbed, in which the depot is located, is water that is flowing out from under the elevation. The riverbed with the depot runs in a south to north direction and connects with the eastern riverbed some 15 metres downstream. The artefacts are all located on the floor of the riverbed or sticking out of the soil along its sides, from the point from where it appears below the elevation and along its uppermost 10 metres. Depot 1 consists of the following types of artefacts:
- Glass shards from broken bottles, some of brown and green glass, some of a deep blue glass
- Pipes of transparent glass, most likely test tubes
- Pieces of wooden boards of different shapes and dimensions
- Pieces of tar paper
- Pieces of thick cloth fabric
- Pieces of rusted iron such as nails, parts of pipe, fittings, sheets and barrel parts
- Pieces of metal wire
- Capsules of late twentieth-century design

The artefacts of the depot are clearly made up of items remaining from different time periods. Some of them are, no doubt, remains from the first Swedish Antarctic expedition, in particular the blue glass shards. These are of the same type that we found among the remains of the Magnetic Hut (feature 001, Appendix 3 see below) and at depot 2 (feature 042, Appendix 3). Research conducted by the IAA has determined that these glass shards emanate from bottles which Otto Nordenskjöld’s team acquired in the San Telmo district of Buenos Aires before departure to Antarctica in 1901. Another artefact that is likely to remain from the Swedish expedition are the broken test tubes. IAA members have found other artefacts from the Swedish expedition in the same riverbed in previous years, one example being a leather shoe. Other artefacts, in particular the capsule, are clearly of a later date.

All artefacts are fragmented. Metal pieces are rusted and fragile. The cloth pieces are fragile. Some of the artefact fragments were jammed in hardened mud at the time of our visit, while others were laying loose on the ground.

The visible artefacts are subject to air, precipitation and wind which will increase the speed of decay. Occasional extreme winds may disperse them across the landscape. The most significant threat, however, is the meltwater streams that have created the riverbed and exposed the artefacts. Next time meltwater is pouring down the mountainside and under the elevation, more artefacts are likely to be exposed while the artefacts that are already exposed will likely be flushed downstream, possibly all the way to the sea.

Condition Class: CC 3. Strong symptoms
Urgency Class: UC 3. Short term
The recommendation is to conduct an archaeological excavation in order to rescue artefacts that are already exposed, to find and rescue artefacts that are still likely to be buried under the soil, and to make a thorough documentation of the artefacts on site. The found artefacts should be conserved, registered and stored together with other artefacts from the first Swedish Antarctic expedition in the attic of the Winter Station hut.

Depot 2
Waste depot 2 (feature 042, Appendix 3) consists of a cluster of artefacts placed at an elevation located south-east of the Winter Station hill (see Figure 198). The artefacts consist of the following:
- Glass shards, transparent
- Glass shards, deep blue
- Glass shards, purple
- Pieces of metal
- Piece of rope
- Pieces of tube-formed transparent glass

Many, if not all of the artefacts in the cluster, are likely to be remains from the first Swedish Antarctic Expedition – possibly a dump for broken and obsolete items. The clearest examples are the remains of test tubes and the deep blue glass shards, which IAA members have identified as emanating from San Telmo, Buenos Aires, supplied to the Swedish expedition in 1901.

The artefacts are rusty, fragmented pieces of metal.

The visible artefacts are subject to air, precipitation and wind which will increase the speed of decay. Occasional extreme winds may disperse them across the landscape. The most significant threat, however, is the fact that this is an area to which tourists may go astray during visits. Therefore, there is a risk that they will become subject to souvenir picking. The risk will grow if Antarctic tourism continues to grow in the coming decades.

The recommendation is to conduct an archaeological excavation in order to rescue artefacts that are already exposed, to find and rescue artefacts that are still likely to be buried under the soil, to make a thorough documentation of the artefacts on site, and to conserve, register and store the found artefacts together with other artefacts from the first Swedish Antarctic expedition on the attic of the Winter Station hut.
4.7. The landscape of Argentinian area management and conservation

4.7.1. General description
In December 1953, by the 50th anniversary of the rescue by the Argentine Navy’s ship *Uruguay*, the Navy sent an expedition to Snow Hill Island. The overarching objective was of supporting Argentina’s claim to the Antarctic Peninsula. This expedition took possession of the Winter Station in January 1954, and made a brief documentation of the state of the hut and the remaining artefacts. In addition, the expedition members built two installations on the island: a hut - the Betbeder Hut - and a sea marker named Cincuentenario. The practical purpose of the hut was to serve as a refuge for scientists and military personnel working in the area, while the sea marker would support navigation. Both objects also had a geopolitical function, however. They were representations of Argentinian management of the area, an exercising of sovereignty, and, in this sense, they had a geopolitical function in relation to Great Britain and Chile which claimed the same area.

The historic monument as well as the landscape have been transformed by conservation and commemoration (see Figures 200–204). Commemorative plaques have been placed. Remains from the expedition have been identified, collected and displayed with information signs and occasionally with protective fencing. New trails for visitors have been tracked and marked up. The majority of these features of area management are described in Appendix 3. Here, some prominent constructions will be described and assessed: a storage shed close to the Winter Station built in the 1990s, a refuge from 1954 located on the northwestern corner of Snow Hill Island, and a sea marker, or blind lighthouse, also built by the Argentine military in 1954, located on the east coast of the northern ice-free section of the island. The lighthouse was restored in January 2016 by a DNA-IAA and Argentine Army group led by Pablo Fontana.

4.7.2. Condition, risk assessment and recommendations

The storage shed
In the times of the first Swedish Antarctic expedition, several small sheds were erected north of the Winter Station. On the plateau of the hill there were an astronomical observatory and a shed, or large box, for temperature recorders. At the slope of hill, there were two larger sheds, probably one for storage and another for the expedition’s dogs. Today, no traces from these sheds exist. At the approximate location of the old storage shed, and with similar measurements, a new shed for storage was built in the 1990s. The shed is used to store staple commodities, canned food, tools, gasoline, and other utensils.
The shed measures approximately 2 x 2 metres, 2.20 metres in height, with a pulpet roof (see feature 9, Appendix 3). The entrance door is located on the east facade facing the mountains and two small windows to the north and the west. The construction is made of planks which are then covered with tarred paper and laths.

The condition of the shed is good but the ground it stands on is drifting. Reinforcement of the near terrain has been done with stones, but the building sags precariously.

There’s an obvious risk that the building will actually collapse.

The recommendation is to monitor the condition, to carry out continuous repair and renovation of the tarred paper surfaces, and to plan for lifting and levelling the shed and reinforcing the foundation as a proximate goal.

**Condition Class:**
CC 3. Strong symptoms

**Urgency Class:**
UC 2. Short term

**Recommendation Class:**
RC 3. Major intervention
Figures 205–208. The storage shed was built in the 1990s to complement and later substitute storage in the Winter Station. Part of the material is reused from the Magnetic Hut remains (see the felt and copper nails). Photos by Gunnar Almevik.

The refuge Betbeder
The refuge is a wooden hut, located near the north-western corner of Snow Hill Island. Its name is the Betbeder Hut, built in 1954 by the Argentine military (see Figures 209–210). The hut is located on a valley floor some 150 metres from the shoreline. The geographical location is Lat -64.334833, Long -56.894722. Pablo Fontana surveyed the hut in 2016 and 2020. In 2020, waste was removed from the semi-destroyed hut, and minor conservation actions were initiated.

The sea marker
The sea marker, or blind lighthouse, was built by the Argentine Navy in 1953, in the same expedition that took possession of the
Winter Station for Argentina (feature 067, Appendix 3). It is located on the east coast of the northern ice-free section of Snow Hill Island, on a bluff where it is visible from the sea at a great distance (Figure 196). The sea marker has the shape of a tripod with a flat top built of steel bars. At its foot the three long sides measure approximately 2 metres each. The structure is approximately 6 metres high and is fixed in the ground with three stone chests framed by wooden boards. The structure is painted black and yellow. It has two black and yellow signboards, each divided into three sections (from the top: yellow-black-yellow), one facing the south-east and one the north-east. The geographical location is: Lat -64.358888, Long -56.935833. In 2016, a team led by Pablo Fontana restored the lighthouse by painting the structure and installing new signboards. Maintenance were also done in 2020.
Figure 211. Orthophoto of the sea marker and its surrounding landscape and coast line. Orthophoto by Dag Avango.
The sea marker is in very good condition. Pablo Fontana and Manuel Mamani repainted parts of the structure during the CHAQ2020 visit. IAA members conduct such maintenance work on a regular basis.

The eastern coastline of Snow Hill Island is very steep and subject to erosion. The sea marker stands at a distance of some 90 metres from the edge of the cliff. Without further knowledge about the speed of the coastal erosion, it is difficult to assess the risk of losing the marker to the sea.

The sea marker not only fills a practical role for navigation, but is also a historical source on the strategies of states competing for sovereignty in pre-treaty Antarctica. It constitutes also a monument to the rescue of the Swedish Expedition because its name “Cincuentenario” refers to the 50th anniversary of the rescue. Since the sea marker pre-dates the Antarctic Treaty, it could be proposed as an intermediary HSM until further consideration of its possible heritage values has been made.
5. THE HOPE BAY HUT (HSM 39)

5.1. Object information

Name: The Hope Bay Hut / Cabaña de Bahía Esperanza
Location: Hope Bay, Esperanza Base of Argentina
Hoppets Bukt / Hope Bay / Esperanza, Antarctic Peninsula
Geoposition: 63°24’S 56°59’W
Status: Argentinian national monument since 2010 according to law 266219
HSM no. 39 according to ATS, amendment Rec. VII-9
Proposing parties: Argentina and the United Kingdom
Parties undertaking management: Argentina and Sweden
Operative management: Dirección Nacional del Antártico - Instituto Antártico Argentino

5.2. Summary

The stone hut in Esperanza was built in February 1903 by the geoscientist Johan Olof Gunnar Andersson, Toralf Grunden and Samuel Duse to hibernate in during the Antarctic winter. The hut is named “Cabaña de Bahía Esperanza” in Castellano or, more commonly, “Choza de los Suecos”. The hut is located in the south part of the Argentinian Base Esperanza on the Antarctic Peninsula, about 20 metres from the shoreline to the Weddell Sea and close to the natural port of San Martin (HSM 40). The name of the location, Hoppets vik in Swedish, concurrently Hope Bay and Bahía Esperanza, was denominated by the Swedish expeditioners to express their sentiments as they were waiting for their mother ship Antarctic to come for their rescue. The dry-stone wall construction is made of metamorphic stones and chippings, about 1.7 metres in height, comprising one main room measuring from the exterior about 4 x 4 metres and a south-side antechamber of 3 x 2 metres with a small door facing east. The construction is fairly well preserved but has undergone a comprehensive restoration in the 1990s with concrete, reinforcing bars and epoxy glue that is harming rather than safeguarding. The most urgent treatment is to remove the roofing of iron bars and grid. There is a high risk that it will fall and take at least the top of the wall down.
5.3. Sources and management information

Daily life in 1903, with the building of the stone hut, the investigations, the mending of equipment, the acquisition and preparation of food, the social relations and the hygienic situation, is described in 1905 by Samuel Duse in the biography Bland sälar och pingviner, and also by Gunnar Andersson in 1904 in the second volume of Antarctic. In these biographies, there are a few contemporary photographs of the site, a map of Hope Bay and a ground plane drawing of the stone hut.

The hut has been maintained, first by the Argentine military and later by the Argentine Antarctic Institute. The first physical act of musealisation was the
construction of a reinforced concrete counterfort on the northeast corner with a plaque of unknown inscription, crowned by the flag of Sweden and Argentina. Today, only traces remain. The IAA holds a photograph from this period, some time in the 1960s (see Figure 224).

The work carried out in the hut of Hope Bay began with two survey campaigns in the summers of 1989/90 and 1991/92 by a DNA–IAA team coordinated by Ricardo Capdevila. A comprehensive restoration was performed in 1992–1993. The reconstruction works began with the demolition of the concrete column that had been installed in one of the corners in the 1960s. The tasks continued at the end of 1993. By this time, the antechamber had fallen down as well as parts of the walls in the main construction. The stones were reused in a manner of “anastolysis”; they were lifted up in the place where they had fallen down. New stones that were brought to the construction were marked in the exterior with an orange dot about two centimetres in diameter. The visual impact was strong when newly restored, but today the paint of the dots has eroded. New stones in the interior were instead marked with steel wires. As well as restoring the stone walls, a new roofing was constructed. According to the report, there were no remains of the inner tent or the old roofing with the sledge and canvas. The reconstruction was made with iron bars fixed into the wall with concrete. On top of the concrete and iron bars, a canvas was glued with epoxy and stretched with ropes tied to sticks in the outer ground. Another addition to the site was a fence of bollards and chains in yellow paint placed about two metres from the stone walls to prevent tourists to approach the hut.

The Argentine Law 26.621 of 2010 declared the hut in Hope Bay as a “national historical place,” Wennersgaard’s grave in Paulet as a “historical grave,” and the cairn in the summit of Paulet as “good of historical interest.”

5.4. The Hope Bay hut

5.4.1. General description

The dry stack stone wall hut is located on flat terrain with a small hill in the south. The distance to the sea is about 20 metres. Less than 10 metres from the hut on the east side passes the main road between Port St. Martin and Base Esperanza. The same road also leads to a big warehouse and eventually to a mechanic workshop and carpentry. Consequently, there is frequent traffic by large vehicles. The construction of dry stack stones is laid out in the south–north direction with an angle of about 25° to the east. The entrance is located on the east side of the antechamber. It is notable that the Winter Station on Snow Hill Island was laid out in the same manner. The stone hut is fenced with chains between metal bollards which are 80 cm high and painted in yellow. The fence area measures 8 x 9 metres and is a distance of 2 metres from the hut. Centred on the east side is a sign about 1.80 metres high, with the text: “In this bastion 3 men survived, on each piece of stone there still are supplications, prayers, faith and
Figure 216. Orthophoto by Dag Arango.
Figure 220. Ground plane, elevation of east facade and a section through the passage between the antechamber and the main room. Measured drawing by Gunnar Almevik.
hope, embedded in their hope, until ship Uruguay rescued them. This [sic] three men were Andersson, Duse and Grunden. Bahía Esperanza 1903."

The first stones were placed on the 15th of February 1903. Less than one month later, the refuge was ready. Samuel Duse described in his biography how stones were collected from the nearby area, and how larger stones were fixed with smaller stones, chippings and a mixture of sand and clay. The sand mixture can still be found in the lower parts of the construction. Originally, a tent was erected in the main room and a sledge placed on the coping functioned as a truss to mount the roofing of canvas. A hearth was built in the passage between the main room, and in the antechamber they had a “water closet” and a meat cellar (see Figure 202).

The main construction measures 4.2 x 4.4 metres in the foundation, about 1.7 metres high and tapering to the crest. The west-side wall has a slight concave shape. The interior space measures 3 x 3 metres at floor level. The wall is thickest in the east and south sides, about 0.9 metres, and is thinner on the north and west sides, about 0.6 metres. In the lower parts, there are larger stones than are found higher up. The stones are commonly long but with moderate height. The larger stones are supported by smaller stones and chippings. In the lower parts and deep in the wall are traces of sand and clay.

The antechamber measures 2 x 3 metres, giving the hut a total length of 6.4 metres. The height of the walls is slightly lower than that of the main construction at 1.5 metres. The outer walls are 60 cm thick but with a thickening in the middle of the south wall. This could be a trace of a distinction between the meat cellar close to the entrance and the toilet to the west, as depicted in a ground plan drawing by Samuel Duse (see Figure 215, b and c). The toilet is placed in the
Figures 225–201. Doorway of wooden boxes from the outside (225) and from the inside (229). Original features are the hearth (228) and the toilet (230), and reminders of care can be seen in the fading orange dots which distinguished repair stones from authentic stones (226) and the base of the first commemorating information sign. Photos by Gunnar Almevik.
southwest corner, about 0.6 x 0.6 metres, and is demarcated by a fat stone placed high like a threshold. The main construction and the antechamber are connected through a narrow passage measuring 0.6 metres wide and 1.2 metres high. The vault is constructed by a wide and fat stone. In the passage is the small heath. It consists of a fat stone, 0.5 x 0.5 metres, placed 0.4 metres above the ground extending to 1.2 metres.

The layout and design of the hut was consciously chosen to endure the local climate: the protected location in the landscape but still with access to resources, the orientation at a low angle towards the cold and strong southern winds, the lower antechamber oriented towards the south, and the curved crowning of the walls of the main construction for a streamline shape against the wind. These interacting features designed to endure the local climate do not attract attention, especially in the present condition without the convex curved crowning of the wall. Furthermore, the east window is clogged by stones and the doorway is covered by boards. Indeed, these features relate to a conscious design for the local climate. The place for the doorway and window towards the east is surely intentional as this side accumulates the least snow. The door was probably opened inwards which is common in dwellings where snow may block the passages.

5.4.2. Condition, risk assessment and recommendations

5.4.2.1. Structures

The dry stack wall

The hut is largely original and the changes and additions are traceable. However, some original features of the construction, like the roof construction and the meat cellar, have been lost by deterioration and restoration. There are traces of a window marked by flat stones in perpendicular positions running all through the wall. The original measurements were about 20–30 cm high and 30–40 cm wide, and about 1.5 metres from the ground in the middle of the east-side wall. This window was probably clogged during the restoration of 1992–1993.

The condition of the walls is fairly good. There are two piles of stones that have fallen from the wall in the west side of the hut: one in the north corner, and the other in the connecting corner of the main construction and the antechamber. The collapse may be caused by the harmful roofing construction but possibly also by landslide and sag of the foundation stones.

The condition analysis made before the restoration in 1992–1993 pointed at the masses of congealed snow that filled up the hut with the risk that the walls would be pushed out. Today, only a small
Figures 231–232. View of the stone hut’s location, close to the sea and the transportation road between harbour San Martín and Base Esperanza. Photos by Gunnar Almevik.
piece of ice exists in the corner of the main construction. One risk has been replaced by another. In February 2020, just one week after our inspection, a temperature record was measured in Esperanza showing 18.3°C. The ground is destabilised by the melting of permafrost, and streams of water pour beside the walls on the slope down to the sea. It is possible that the collapse of stones on the west side is also stressed by landslide. There is a risk that the hut is damaged by transformation of the ground. Considering that the road to the port and the big warehouse has frequent heavy traffic passing close to the hut, the vibration and compression of the ground may enhance the damage of the nearby hut.

The recommendation is to monitor the condition of the stone hut. Vibration and potential damage would decrease if heavy transportation took the road further away instead. The general recommendation is to put back into place the stones that fall down. The stones that have fallen down could be placed on the crowning to give back the form of the original convex curvature. A possibility that could be considered is to re-establish the sight of the window at the east wall of the main construction.

Roofing
No traces of the tent or the original roofing exist in the present condition. The present roofing was made during the restoration in 1992–1993. On top of the main construction rests four transverse 15 mm iron bars to hold a 4 mm iron grid of 25 x 25 cm squares. The iron is fixed to the crest with concrete. Traces of canvas exist, layered with epoxy glue in conjunction with the concrete. Epoxy glue has poured down the inner walls. The iron bars and grid are degraded and hang down. The concrete is ruptured and stones from the wall are pulled out and have fallen down inside the hut. Some stones have got stuck in the grid. To stay in the main construction under the iron bar and grid roofing is a danger.

There is an obvious risk that the iron bars and grid will fall down and take at least the top of the wall down.

The most urgent action is to cut down the iron bars covering the room. The recommendation is to cut these bars to the level of the wall, remove all loose material of concrete, epoxy and iron, and leave the rest be. To remove all traces of the bars with the concrete and epoxy glue is not recommended as this would result in the loss of a large part of the original wall. The stones that have fallen down could be placed on the crowning to give back the form of the original convex curvature.
Figures 233–236. The reconstructed roofing from the 1990s made with modern materials like the iron grid and bars fixed with epoxy and concrete, creating a hazard to the original dry stack walls. Photos by Gunnar Almevik.

Ground
The ground in the main construction has a congealed mass of snow on the east side. Feathers in the soil reveal that the space has previously been accessed by penguins. Iron bars are placed in the ground in the east part, possibly with a function to fix ropes to the canvas roofing of the 1992–1993 restoration.

The iron bars stuck into the ground cause a risk to both humans and animals.

The iron bars stuck into the ground should be removed for the safety of humans and animals.

Urgency Class: UC 1. Intermediate term
Recommendation Class: RC 1. Preventive conservation
Condition Class: CC 1. Minor symptoms
5.4.2.2. Ancillary components

**Doorway**

The doorway is constructed by three wooden boxes, two on high at each side of the doorway and a third placed on top like a vault. The boxes are filled with concrete. The door of boards has no hinges and is nailed to the boxes. Possibly, the door was never intended as a passage. To enter the hut, one needs a ladder. In the antechamber stood a thick door with iron hinges, possibly from the first intervention with the concrete counterfort.

The absence of a doorway makes inspection difficult and the use of ladders for climbing the walls poses a risk for both the surveyor and the construction.

The existing door (the separate door seems very heavy for the construction) should be mounted with hinges to function as a possible doorway. The door ought to be opened inwards. Arrangements and/or information is needed to prevent visitors from entering the hut.
6. THE PAULET ISLAND STONE HUT, GRAVE AND CAIRN (HSM 41)

6.1. Object information

Name: Paulet Island stone hut, grave and cairn / Larsen stone hut
Location: Paulet Island
Geoposition: 63°34'28.3"S 55°47'07.1"W
Status: Historic Site and Monument (HSM) no. 41 according to the Antarctic Treaty since 1972, Rec. VII-9 Measure 5 (1997)
Proposing Parties: Argentina and the United Kingdom
Parties undertaking management: Argentina, Sweden and Norway
Operative management by: Dirección Nacional del Antártico - Instituto Antártico Argentino
Site Guidelines: Site guideline no. 8, adopted by resolution 2 (2006), ATCM XXIX - CEP IX, Edinburgh

6.2. Sources and management information

The island was mapped during the British expedition in 1839–1843 led by James Clark Ross and named after Lord George Paulet. The ship Antarctic became stuck in the ice in February 1903 and on the 12th it was wrecked. The crew of 20 people walked about 40 kilometres and 16 days before reaching Paulet Island, where they built a stone hut to hibernate in during the coming winter. They also built a cairn on the highest point to attract the attention of passing ships. During the winter of 1903, the sailor Ole Christian Wennersgaard died and his grave is also part of the Paulet Island historic site. Life on the island is described by Carl Skottsberg and Carl Larsen in Antarctic (1904). In December 1953, for the 50th anniversary of the rescue, the Argentine Navy visited, documented and placed a sign at the hut. Later, DNA-IAA undertook investigations and placed galvanised net fences by the hut. The grandson of Carl Larsen placed a brass plate with a briefer history and the names of the 20 survivors.

The cairn is located at the top of the island, more precisely in the highest part of the volcanic cone, on its southern edge at 351 metres high, having been surveyed by Ricardo Capdevila and the IAA geodesist Andrés Zakrjsek on the 29th of January 1995, which also surveyed the remains of the shelter and the tomb. The cairn is a tower of approximately one and a half metres in diameter, with a current height of 2.1 metres, which is made up of rocks of regular size brought from lower levels (Capdevila 1996).
Figures 238–242. This page: Photos, probably by Carl Anton Larsen, of the sinking ship Antarctic, from Nordenskjöld’s archive, UGOT (PDM). Opposite page, above: A colored photo by Carl Anton Larsen of the crew on their rescue journey on the ice heading for Paulet Island, from Nordenskjöld’s archive, UGOT. Ground plan drawing by Carl Skottsberg of the stone hut, ‘Paulet hyddan’, from Nordenskjöld et al, 1904, page 468, vol. II. The letters refer to the following: a. aisle, b. beds, c. windows, d. veneer walls, e. insulation with guano, f. doors, g. kitchen, h. hearth. Opposite page, below, photos by Gösta Bodman of the rescue in November 1903, from Nordenskjöld et al 1904, pages 457 and 495, vol. II (PDM). To the right, Wennersgaard’s grave and in fond is the rescue ship Uruguay.
6.3. The Paulet Island hut, grave and cairn

6.3.1. General description

Paulet Island is located in the Archipelago north of the Antarctic Peninsula, and southeast of Dundee Island in the Weddell Sea. This small volcanic island is 1.6 square kilometres and the highest point is 362 metres above sea level. The stone hut is located about 150 metres from the north shore, laid out about 45° southwest to northeast. The hut has a main dormitory measuring about 10 x 7.3 metres, and a smaller annexed kitchen of 6.7 x 3.6 metres. The inner space of the dormitory is about 6 x 5.5 metres. The walls were originally 1.2 metres high and 2.4 metres high at the gable ends. The inner wall between the dormitory and kitchen is fairly well preserved. The entrance is located on the northwest kitchen wall. Yet another doorway is centred between the kitchen and dormitory. The door frames still exist. The kitchen originally had two windows with glassed sashes, of which there are no traces as the southwest kitchen gable wall has fallen down. The original roofing used two boat hooks as a ridge and tent poles as rafters, all covered with boat sails and seal skins. The roofing does not exist but some wooden material is preserved inside the hut. A stack of modern net fences is located on the northwest side of the hut with a brass plate. As the island holds a large Adélie penguin colony, the wildlife is on and about the monument and the soil is covered with guano. The rusty net fences are a danger to the wildlife. The DNA-IAA removed part of the fences in 2004 and plan to remove the rest in 2021.

The sailor Ole Christian Wennersgaard’s grave is located about 500 metres northeast of the hut. The grave is marked by a stone formation and a wooden burial cross. The cairn is located on the volcano on the southwest part of the island. The cairn is about one metre high and is square shaped.
Figures 246–250. The stone hut remains. Photos below by Patricia Ortúzar, DNA (CC BY-NC-ND).
Figures 251–254. Net fences with commemorative plaques. One is in Swedish, celebrating the centenary anniversary. Photos below by Patricia Ortúzar, DNA (CC BY-NC-ND).
7. THE WOODEN POLE AND CAIRN AT PENGUIN BAY (HSM 60)

7.1. Object information

Name: The wooden pole and cairn (I) and Corvette Uruguay Monument (II)  
Location: Penguin Bay, Seymour-Marambio Island  
Geoposition: (I) 64°17'45.1"S 56°41'31.2"W, (II)  
Status: Historic Site and Monument (HSM) no 60 according to the Antarctic Treaty since 1990  
Original proposing parties: Argentina and Sweden  
Parties undertaking management: Argentina and Sweden  
Operative management by: Dirección Nacional del Antártico – Instituto Antártico Argentino

7.2. Sources and management information

The island was mapped during the British expedition in 1839–1843 led by James Clark Ross. The cairn in Penguin Bay on Marambio Island was raised in 1902, before the expeditioners parted in groups and the Winter Station on Snow Hill Island was built. The place name originates from the Swedish expedition. A small group led by Nordenskjöld arrived at Marambio from Antarctica in a small boat. They brought a 4-metre long pole, which they painted, and added two laths and a pennant. A photograph by Ekelöf shows that the pole stood in the cairn and was also stabilised with ropes from the top to the ground. According to Nordenskjöld, they also left a depot of victuals, some tools and bullets. The depot was to be used in case the Swedish Expedition was forced to retreat. The place was visited several times by the expeditioners who stayed on the nearby Snow Hill Island to slay penguins and collect eggs. The establishing of the cairn and depot as well as the later visits are described in the biography of Nordenskjöld (1904). On the 10th of November 1903, the Argentinian rescue ship Uruguay arrived at Penguin Bay where they raised a wooden plaque with the text: “10.XI.1903 Uruguay (Argentine Navy) in its journey to give assistance to the Swedish Antarctic expedition.” In January 1990, when the site was listed as a HSM, a monument in cast concrete was erected by Argentina at the location of the wooden plaque. The place is regularly visited and cared for and the IAA conducted documentation of the site and reparation of the cast concrete memorial in 2018.

7.3. The cairn and the wooden pole

7.3.1 General description

Penguin Bay is located on the south-eastern coast of Seymour-Marambio-Marambio Island. The bay is wide and with an open landscape and meltwater delta surrounded by mountains. The cairn is located on a mountain about 40 metres from the sea. The stones in the cairn have fallen down and make a vaguely distinguishable assemblage of cultural remains. A 0.4 metre high wooden pole, about 5 cm in diameter, discloses its original function. Historian Pablo Fontana identified the remains of Nordenskjöld’s depot in 2016 and it was added to the HSM 60 in 2016.

The wooden plaque is located down the slope of the same hill further from the coastline. The original wooden plaque is still standing about 1.2 metres high and anchored in a cairn. The post is 75 x 65 mm in cross section and the plaque is made of one single board measuring 0.8 x 0.3 metres and 28 mm thick. The text is carved out in the wood and the board’s surface is painted in yellow. Just beside the wooden plaque there is a thick cast concrete pillar of 0.8 x 0.9 metres and with a leaning top of 0.7 metres high in the front and 0.8 metres in the back with two brass plaques dating to 1989.
Figures 261–262. Screenshots from the photogrammetric documentation of the wooden pole and cairn (above) and the commemorative monument and sign (below) in Penguin Bay, Seymour-Marambio Island. Scanning by Gunnar Almevik and post processing by Jonathan Westin. Visit antarctica.dh.gu.se/seymour.html for the interactive point clouds.
In the area by the wooden plaque there are parts of wooden crates scattered and half buried in the soil. The crates are probably remains from various depots of different expeditions (Nordenskjöld’s, the rescuers’, and later expeditions).

7.3.2. Condition, risk assessment and recommendations

The bay holds an Adélie penguin colony. The penguins and their nests can be found on and about the monument. The soul is covered with guano. The original cairn is heavily deteriorated. The wooden pole

The conservation of wildlife and the preservation and accessibility of the historic site are somehow conflicting. It is not possible to visit this site during breeding season without disturbing the penguins.

Biologists of the DNA-IAA visit the place several times every summer, take pictures and inform DNA-IAA about the condition of the site. The recommendation is to continue monitoring. Possibly, the wooden plaque by the concrete monument will need mending and repainting.
Figures 264–265. Remains from depositions of utensils originating from many different expeditions, half buried in the soil and covered with guano. Photos by Gunnar Almevik.
8. LARSEN CAIRN ON SEYMOUR-MARAMBIO ISLAND (HSM 94)

8.1. Object information

Name: Larsen Cairn  
Location: Seymour-Marambio Island  
Geoposition: 64°14'13.6"S 56°35'07.5"W  
Status: Historic Site and Monument (HSM) no. 94 according to the Antarctic Treaty since 2019  
Original proposing parties: Argentina, Norway, Sweden and the United Kingdom  
Parties undertaking management: Argentina, Norway, Sweden and the United Kingdom  
Operative management by: Dirección Nacional del Antártico - Instituto Antártico Argentino

8.2. Sources and management information

The cairn was erected in 1893 by the captain Carl Anton Larsen during the Norwegian South Polar Expedition of 1892–1893 with the ship Jason. The same Carl Anton Larsen was also captain on the ship Antarctic during the first Swedish South Polar expedition ten years later. Originally, there was a wooden pole in the cairn with an inscription by Larsen with the ship’s name and the date. The cairn was detected and visited by José María Sobral and Gunnar Andersson during an excursion in October 1903 where they also wrote their names and the date on the pole. Just weeks later, the cairn was spotted by the Argentinian rescue ship Uruguay. Members of the crew ascended to the cairn and left a written message in a tin box: “Les soussignés, de l’Expédition Argentine de Secours, commandant Cap. Julian Irizar, ent reconnu cette station le 7 Novembre, 1903 en trouvant seulement un point indique Avec des pierres et au milieu une canne en bois avec le signature de Andersson et Sobral; faite une enquête complete Et minutieux dessous et auteur de Pierre ent y trouve aucun, Ecrit José Gorrochategui -- Doctor Felipe Fliess – Lieutenant.” The cairn and this note in the tin box were found by the British Army in 1945 during “Operation Tabarin”. The note and photographs from the operation are archived at the Scott Polar Research Institute in Cambridge.
In 2016 Pablo Fontana, leading a search group of the DNA-IAA, found and identified the cairn, and initiated a process for preservation. The cairn was listed as a HSM, approved at the ATCM in Prague 2019, ATCM XLII, measure 12. There is an IAA report from the summer campaign 2015/16 by Pablo Fontana presenting the history and cultural significance of the cairn. The IAA has put up a rope fence around the cairn and a sign. According to the approval details to HSM 94, the monument should be managed by Argentina, Norway, Sweden and the United Kingdom.
8.3. Larsen Cairn

8.3.1. General description

The cairn is located on a hill 40 metres above sea level, 40 metres from the coast, and two kilometres from the Argentinian Base Marambio on the east side of the island. The stones in the cairn are assembled in an area of approximately 1.5 x 1.5 metres raising about 0.70 metres above the ground. The main stones are all of similar size, about 0.4–0.5 metres in width. There are no traces of the original wooden pole. It was described by the British Army as a round wooden pole of 2 metres high and 5 centimetres in diameter. The fence is made of six iron bars and a climbing rope. A wooden sign is mounted on two of the bars of the fence. The bars are painted orange. The bars and rope were installed in 2016 by the IAA, led by Pablo Fontana.
8.3.2. Condition, risk assessment and recommendations

The cairn seems to be more or less the same as it was in the photographs from 1945. The difference is the missing wooden pole, and the new fencing. The orange paint on the bars make the site easy to spot for visitors walking from Base Marambio. The wooden plaque’s carved out letters are, however, only vaguely visible.

There is no penguin colony or other wildlife affecting the monument or accessibility for visitors. The stones in the cairn lay stable. There are no signs of land drift or erosion on the site.

The recommendation is to regularly visit the place and observe eventual changes. The IAA plan to install a steel plaque on the wooden plaque in the summer 2021. The plaque will contain informational text.

Condition Class: CC 1. Minor symptoms

Urgency Class: UC 0. Long term

Recommendation Class: RC 1. Maintenance
9. REFERENCES AND ENDNOTES

9.1. References


Lithographisches Inst. des Generalstabs.


9.2. Endnotes
[5] The initiative was led by historians Aant Elzinga, Lisbeth Lewander, Torgny Nordin and Urban Wråkberg and also involved Bengt Grisell, Marie Nisser and Dag Avango from KTH-Royal Institute of Technology. One of the aims of the expedition, envisioned by Grisell was to find the shipwreck of the Antarctic and salvage it (Grisell had previously been involved in the salvaging of the Wasa ship).
[7] The expedition leader was Dag Avango (KTH-Royal Institute of Technology). Other participants were Louwrens Hacquebord and Ulf Gustafsson (Arctic Centre, University of Groningen), and Gustav Rosness (National Heritage Board of Norway).
[8] SPRS director Björn Dahlbäck was involved. From KTH, Dag Avango, Sweden’s representative in the IPHC, was in charge.
[9] According to this model, the Norwegian Polar Institute (NP) deals with all issues pertaining to Antarctica (similar to what the Swedish Polar Research Secretariat does in Sweden). Matters pertaining to Antarctic heritage, NP delegates to the Norwegian Heritage Board/Riksantikvarien which has in-house competence on heritage sites in the polar areas. The Heritage Board assess and make recommendations to the NP, which in turn recommends actions to the Norwegian Ministry of Foreign Affairs, which represents Norway in the ATCM.
[10] The meeting participants were Lars Amreus and Knut Weibull (RAÄ), Björn Dahlbäck and Ulf Jonsell (SPRS) and Dag Avango (KTH/IPHC).
[11] CHAQ involves Lize-Marié van der Watt (PI), Kati Lindström (KTH) and Dag Avango (LTU).
[12] From RAÄ Stefan Nilsson, but also Leif Gren, took the initiatives.
[13] Meeting participants from Sweden were Dag Avango (LTU), Lize-Marié van der Watt (KTH) and Justiina Dahl (SPRS). Argentinian participants were Rodolfo Sanchez and Patricia Ortúzar (DNA), and Pablo Fontana (IAA).
APPENDIX 1
FIELDWORK DATA SETS

Scale measure drawings
- Triangulation map (I-II) and renovation of the Winter Station area, 20200113, scale 1:500
- Ground plane of the Winter Station, 20200118, original and renovation, scale 1:20
- Attic of the Winter Station, 20200120, original and renovation, scale 1:20
- South facade of the Winter Station, 20200115, original and renovation, scale 1:20
- West facade of the Winter Station, 20200115, original and renovation, scale 1:20
- North facade of the Winter Station, 20200115, original and renovation, scale 1:20
- East facade of the Winter Station, 20200119, original and renovation, scale 1:20
- Cross section elevation of the Winter Station (I-II), original and renovation, 20200121, scale 1:20
- Longitudinal section elevation of the Winter Station, original and renovation, 20200121, scale 1:20
- Outer door of the Winter Station, 20200120, original and renovation, scale 1:2 and 1:10
- Inner door of the Winter Station, 20200120, original and renovation, scale 1:2 and 1:10
- Small window of the Winter Station, 20200123, original and renovation, scale 1:5
- Large window of the Winter Station, 20200118, original and renovation, scale 1:5
- Timber frame construction detail of the Winter Station, 20200122, original and renovation, scale 1:5
- Ground plane, elevation and section of Hope Bay Hut, 20200129, original and renovation, scale 1:50
- Door to the Hope Bay Hut, 20200130, original and renovation, scale 1:10
**Terrestrial photogrammetric triangulation**
- Winter Station hill, Snow Hill Island, 20200113, Fujifilm X-T2 and Agisoft Metashape, 4430 images.
- Winter Station exterior, Snow Hill Island, 20200113, Fujifilm X-T2 and Agisoft Metashape, 2319 images.
- Winter Station interior, Snow Hill Island, 20200116, Fujifilm X-T2 and Agisoft Metashape, 1950 images.
- Magnetic Hut remains, Snow Hill Island, 20200116, Fujifilm X-T2 and Agisoft Metashape.
- Hope Bay hut interior (652 images) and exterior (639), Esperanza, 20200131, Fujifilm X-T2 and Agisoft Metashape.
- Hope Bay hut, Esperanza, 20200128, iPhone XR and Agisoft Metashape, 1896 images.
- Penguin Bay Cairn, Marambio, 2020.02.05, Fujifilm X-T2 and Agisoft Metashape, 793 images.
- Larsen's Cairn, Marambio, 2020.02.06, Fujifilm X-T2 and Agisoft Metashape, 602 images.

**Drone-based photogrammetric triangulation**
- Winter Station hill and immediate landscape, Snow Hill Island, 20200113, DJI Mavic 2 Pro, Agisoft Metashape.
- Erosion, Snow Hill Island, 20200116, DJI Mavic 2 Pro, Agisoft Metashape.

**Drone-based orthophotography**

**Snow Hill Island**
- Winter Station hill and immediate surrounding landscape from 10, 30, 50 and 140-metre elevation, DJI Phantom 4 pro.
- Coastal zone from 30-metre elevation, in sections from the location of the CHAQ2020 tent camp 100 m south of the Winter Station hill, to the edge of the glacier 1 km south of the Winter Station hill, DJI Phantom 4 pro.
- Coastal zone from 140-metre elevation, in sections from the location of the CHAQ2020 tent camp 100 m south of the Winter Station hill, to the edge of the glacier 1 km south of the Winter Station hill, DJI Phantom 4 pro.
- Coastal zone from 180-metre elevation, in sections, from the northern end of the moraine-covered glacier 1 km south of the Winter Station hill, to the inland ice south of a mountaintop, 3 km south of the Winter Station hill (named ‘the Station Peak’ in maps by the expedition), DJI Phantom 4 pro.
- Coastal zone surrounding the sea marker (feature xx, Appendix 3) on the western coast of Snow Hill Island, from 50-metre elevation, DJI Phantom 4 pro.
Hope Bay
- Entire area of the Argentinian research station Esperanza, with the stone hut close to its north-eastern end, from 140-metre elevation, DJI phantom pro

Drone-based video
- Winter Station hill and immediate landscape in sunset, Snow Hill Island, 20200112, DJI Mavic 2 Pro
- Winter Station hill and immediate landscape, Snow Hill Island, 20200113, DJI Mavic 2 Pro
- Winter Station hill and coastline, Snow Hill Island, 20200118, DJI Mavic 2 Pro
- Winter Station hill and coastline, Snow Hill Island, 20200120, DJI Mavic 2 Pro

Laser scanning
- Hope Bay hut, Esperanza, 20200122, Faro Focus m70, 26 scan positions (41-66)
- Hope Bay hut, Esperanza, 20200124, Faro Focus m70, 21 scan positions (77-98)
- The Winter Station interiors, Snow Hill Island, Faro Focus m70, 30 scan positions.
- The Winter Station exteriors (including hill), Snow Hill Island, Faro Focus m70, 54 scan positions

Structured-light scanning
- Three conservation objects, Snow Hill Island, 20200120, Einscan 2x Pro Plus

Photography
- Snow Hill Island, folder with xx images, Fujifilm TX1, Gunnar Almevik
- Hope Bay, folder with xx images, Fujifilm TX1, Gunnar Almevik
- Marambio, Penguin Bay, xx images, Fujifilm TX1, Gunnar Almevik
- Marambio, Larsen Cairn, xx images, Fujifilm TX1, Gunnar Almevik
- Snow Hill Island, folder with 580 images, NIKON D800, Dag Avango
- Hope Bay, folder with 55 images, NIKON D800, Dag Avango
- Marambio, Penguin Bay, 43 images, NIKON D800, Dag Avango
- Marambio, Larsen Cairn, 12 images, NIKON D800, Dag Avango
APPENDIX 2
CLIMATE MONITORING

*Temperature and relative humidity inside the Winter Station*

Madge Tech, RHTemp1000, -40 °C to +80 °C
Read off with Madge Tech 4 software, https://www.madgetech.com/software/madgetech-4-software/
- No. 1. Inside the hut, Nordenskjöld’s room, R20393
- No. 2. Inside the hut, attic, R20388

*Earth temperature by the Winter Station hill*

Madge Tech, Temp 1000, -40 °C to +80 °C
- No. 3. Wooden tube, R17067, 30 cm
- No. 4. Wooden tube, R16753, 50 cm
- No. 5. Wooden tube, R16758, 100 cm
- No. 6. PVC tube East, R13901, 56 cm
- No. 8. PVC tube South, R13913, 131 cm
- No. 9. PVC tube North, R11776, 65 cm
APPENDIX 3
FEATURES AT SNOW HILL ISLAND

1. Introduction
The historical remains of the first Swedish Antarctic expedition of 1901–1903 at Snow Hill Island/Cerro Nevado are concentrated in three areas (see map in Figure 1). In this appendix we label them A) the Magnetic Hut hill, B) the Winter Station hill and C) the northern inland area. The features listed in this appendix are not only material remains from the expedition itself, but from all activities related to remains of the expedition that have taken place since it left the island in 1903. In other words, the report also lists material imprints and remains from the efforts of the DNA-IAA to conserve and restore the remains, narrate and commemorate them, and direct visitors in the area. Some features also emanate from the camps of the DNA-IAA and from other related activities of theirs. Finally, the list of features also includes a number of environmental features that are crucial to mention for the understanding of erosion processes taking place in the area.

2. Features of the Magnetic Hut hill
The magnetic Hut hill is located on the north-western coast of Snow Hill Island, 100 metres west of the Winter Station of the first Swedish Antarctic expedition (feature 20). The hill measures approximately 38 metres on a north-south axis and 23 metres east-west. The hill rises some 3–5 metres from the surrounding landscape and is made up of fine moraine gravel in its uppermost part (about 1 metre) and permafrost and ice in its lower part.[1] On the eastern side and part of the northern side of the hill, there is a riverbed with a number of water streams, approximately 65 metres wide. While CHAQ2020 visited the site, the intensity of the water flow in the river varied from day to day depending on air temperature and cloud cover. We defined five features on the Magnetic Hut hill, three of them material remains of the first Swedish Antarctic expedition (features 1–3) and two of them prominent material imprints of erosion (4–5).
Figure 1. Map of the winter station site by Gunnar Almevik.
The remains of the first Swedish Antarctic expedition on the hill (1–3) are under threat from falling into the river because of erosion. During the two weeks we worked at the site, we witnessed how the river eroded the eastern side of the hill at a rapid pace, partly also flowing under the hill. This meltwater erosion is likely to be one of the main causes of the erosion process, but thawing permafrost can also contribute to the erosion. From air photographs from the 1980s, it is clearly visible that the Magnetic Hut hill extended far longer towards the north than it does today (Figures 2 and 3).

**Feature 1. Area with fragments of firebricks and other artefacts**

Area with fragments of firebricks and other artefacts, approx. 6 m in diameter. One brick is intact. Some brick fragments have pieces of cement. There are no traces of information regarding which company manufactured the firebricks. Other artefacts are pieces of building material – wallboards, floor tiles and fragments of glass (windows, bottles, glasses). Some pieces of glass are dark blue.

The feature is the material remains of a hut for geomagnetic measurements, which the first Swedish Antarctic expedition built at the site. The bricks are likely to be remains of a fundament for scientific instruments, located inside of that hut. The cement and firebricks suggest that it was similar to fundaments for scientific instruments at Sorgfjorden, Svalbard, from the same period.[2] According to Pablo Fontana, there used to be more firebricks on the site. Capdevila moved these bricks in the 1990s and placed them outside of the Winter Station, close to its south-eastern corner (feature 18). According to Pablo Fontana, the blue glass fragments come from bottles which a company from the Telmo area of Buenos Aires sold to the Swedish expedition in 1901.

The feature is under severe threat from erosion from the river and it is obvious that parts of it have already fallen into the river. The erosion front (5) of the river (65) follows the eastern side of the feature and there are cracks in the moraine, causing large flakes of moraine to hang out towards the river. The loss of a major part of the hill since the 1980s has mostly taken place along this eastern side, which is visible from an aerial photograph from this time.
Feature 2. Circular depression in the moraine

Circular depression in the moraine, 25 cm deep and 100 x 130 cm wide, surrounded by a low mound made up of a mix of fine moraine and fist-sized rocks. The outer measurement of the mound is 160 x 210 cm. The depression is located approximately 7 metres south-east of feature 1 (Figure 4).

Figure 4. Feature 2. depression in morain, remain of anchor point for wire stabilizing the magnetic hut. It is located close to the eroding north-eastern side of the Magnetic Hut hill. Photo: Dag Avango.

The depression is most likely the remains of an anchor point for a wire that supported the Magnetic Hut (1). The hole contained a Deadman, connected to the Magnetic Hut with a wire. Two wires are visible in a historic photo of the Magnetic Hut (Figure 6). The anchor point for the other wire (feature 3) is

Figures 5 and 6. Left: anchor point for wire on display inside the winter station (wooden boards in the upper parts of the wall), previously used as anchor point for wires stabilizing the magnetic hut. Right: image of the magnetic hut in which the wires stabilizing it are visible. Photo: Dag Avango and the Nordenskjöld expedition, UGOT (PDM).
situated a few metres away. It is likely that the hut had two more wires on the northern side of the building. If so, the remains of the anchor points for those wires have disappeared due to erosion from the river (65). Inside of the Winter Station (20) there is a Deadman hanging on the wall (Figure 6). According to Pablo Fontana, Capdevila placed it there after moving the remains of the Magnetic Hut from the Magnetic Hut hill in the 1990s (Figure 5).

**Figure 7.** Feature 3, depression in moraine, remain of anchor point for wire stabilizing the Magnetic Hut. Photo: Dag Avango.

**Feature 3. Circular depression in the moraine**

Circular depression in the moraine, 25 cm deep and 100 x 110 cm wide, surrounded by a low mound made up of a mix of fine moraine and rocks of 10–20 cm diameter. The outer measurement of the mound is 180 x 180 cm. The depression is located approximately 7 metres south-east of feature 1 (Figure 7).

The depression is most likely the remains of an anchor point for a wire that supported the Magnetic Hut (1). The hole contained a Deadman, connected to the Magnetic Hut with a wire. Two wires are visible in a historic photo of the Magnetic Hut (Figure 6). The anchor point for the other wire (feature 2) is situated a few metres away, also on the south side of the Magnetic Hut remains. It is likely that the hut had two more wires on the northern side of the building. If so, the remains of the anchor points for those wires have disappeared due to erosion from the river (65).

Inside of the Winter Station (20) there is a Deadman hanging on the wall. According to Pablo Fontana, Capdevila placed it there after moving the remains of the Magnetic Hut from the Magnetic Hut hill in the 1990s (see Figure 7 above).
Feature 4. Systems of cracks in the moraine

System of cracks in the fine moraine of the Magnetic Hut hill, where features 1, 2 and 3 are located. The crack is approximately 30 metres long, running from the eastern side of the Magnetic Hut hill in a bow shape to its northern end, surrounding an area approximately 10 x 30 m. Another system of cracks runs along the northern side of the Magnetic Hut hill, following the erosion front (5) towards the river (65). The cracks raise the question of how long it will take before all remains from the first Swedish Antarctic expedition on the Magnetic Hut hill will have disappeared.


Feature 5. Erosion front

Erosion front along the northern side of the Magnetic Hut hill, where features 1–4 are located. The erosion front is situated along the part of the Magnetic Hut hill facing the river (65). On the upper part of the front, large chunks of moraine are sliding down into the river. On the lower part, there is a gap of some 2–3 dm between the hill and the riverbed. The river flows through this gap on warmer days (Figures 10 and 11). At the lower section of the erosion front, ice is visible, with the appearance of being solid ice making up the core of the Magnetic Hut hill.

The erosion front is an obvious result of the flow of the river (65). While CHAQ2020 visited the site over a period of two weeks, we witnessed how the river on warm days grew in size considerably and started to flow in under the Magnetic Hill, with big chunks of moraine falling into the river as a consequence. On colder days the river flow decreased but still flowed along the erosion front, with soil falling into it.
3. Features at the Winter Station hill

The Winter Station hill is located on the north-western coast of Snow Hill Island, 100 metres east of the Magnetic Hut hill. On the top of the hill are the remains of the first Swedish Antarctic expedition (feature 20). On and around the hill, there are a number of features resulting from the history of this station. The hill measures approximately 115 metres along its length (SW-NE) and 40 metres at its widest point (NW-SE). The hill rises some 10 metres from the surrounding landscape and is made up of fine moraine gravel, in permafrost from 60 cm – 1 metre below ground.[3] Along the north-western side of the hill, there is a river-bed (65) made up of a number of water streams, approximately 65 metres wide. While CHAQ2020 visited the site, the intensity of the water flow in the river varied from day to day depending on air temperature and cloud cover.

We defined 58 features on the Winter Station hill (Figure 1). A few of those are material remains of the first Swedish Antarctic expedition, but most of them remain from activities that have taken place at the site after the expedition, up to the present/recent past. A number of features are material imprints of erosion.

Comparisons between the size of the hill as it appears in historic photographs and its size when CHAQ2020 visited the site show that parts of it have eroded away. This erosion has been going on since at least the 1980s. At this time the chief of the museum of the Argentine Antarctic Institute, Ricardo Capdevila, initiated work to stop the erosion of the hill in order to save the Winter Station from collapse. The material imprints of his work are visible on and around the entire hill, dominating the visual appearance of the hill and the experience of the Winter Station.

Feature 6. Depression in the hill side

Depression in the hillside on the northern side of the river (65), at the eastern end of the Winter Station hill. The depression is 6 metres long and 3 metres wide (Figures 12).
The location of the depression suggests that it is a result of erosion from the river. Supporting this interpretation is the fact that landslides can have this shape. Speaking against this interpretation is the fact that there are no traces of moraine below the depression. Another interpretation is that it is the remains of excavations of moraine for building purposes at the Winter Station hill, e.g. the ramp (41) or the reinforcements for the hill (38).

According to Pablo Fontana, the depression was probably not at this place three years ago. He knows of no digging at the site and does not believe in that interpretation, because the geologist working with Capdevila’s team recommended picking up soil to the north of the Winter Station hill. The depression is on the southern side of the Winter Station area. Fontana thinks it is a natural feature.

**Feature 7. Erosion front**

Erosion front along the western and north-western side of the Winter Station hill. The front stretches over 150 metres. At its highest part, in the south-west, the erosion front is 1 metre high and at its lowest part in the north it is 10 cm. The river (65) flows along the entire front (Figures 13 and 14).

![Depression in the hill side, south of the Winter Station (feature 6). Photo: Dag Avango.](image)

During the 14 days when CHAQ2020 visited the area, it was clear that on cold days the water did not flow along the erosion front. On warm days, however, it flows along the entire front, and is particularly heavy in the south-west. According to Pablo Fontana, the erosion along this front increased when the glacier that used to be on the water along the coast disappeared. The river was smaller before, according to Fontana. The biggest changes have taken place from the 1980s up to the present day.
**Feature 8. River bed**

Riverbed, running down the mountain east of the Winter Station hill and passing through the depression just east of the hill, turning north where it eventually reaches the sea. The riverbed was dried up when CHAQ2020 visited the site. The shapes of the riverbed reveal that a substantial amount of meltwater runs down through it during the springtime melting season. The entire floor of the small valley east of the Winter Station is filled with fine sediments (Figure 15). The amount of meltwater that seems to be passing through the valley east of the Winter Station hill is likely to be a major factor in the erosion process at the hill. The meltwater stream is also likely to be one of the main reasons for Ricardo Capdevila’s initiative to build stone walls along the foot of the eastern side of the Winter Station hill. According to Pablo Fontana, the riverbed used to be smaller. Fontana has seen the change himself, but this also becomes clear from the fact that, until 2008, DNA personnel had their camps on the hill east of the Winter Station hill, on the spot where the river nowadays cuts through the hill in the melting season.

![Figures 13 and 14. Erosion front on the western side of the Winter Station hill, on warm days subject to rapid erosion from the melt water river. Photos: Dag Avango.](image)

![Figure 15. River bed from meltwater creek on the eastern side of the Winter Station hill (feature 8). Photos: Dag Avango.](image)
**Feature 9. Shed**

Shed, made of wood, with boards fixed on a frame of beams. Façade of boards covered by tarred paper. The shed is placed below the Winter Station hill, on its lowest end in the north. Much of the wood is old and has copper nails. The building has a door in the east and windows in the north, south and west. The shed is placed on three aluminium boards (see description in 64), which in turn rests on an elevated terrace (10) (Figure 16).

The DNA-IAA use the building to store various things which the organisation can use for its work at the site, as well as for emergency needs. Along the walls to the east, south and west, there are wooden shelves with two or three levels, with water bottles (pet), cleaning equipment and soaps. There are also various foodstuffs – pasta, maize, conserves, flour, condensed milk, canned fruits, instant soups, muesli, nuts, coffee, spices and substantial amounts of toilet paper. There are also tools, spare parts and fuel for cooking.

At the back side of the shed, the DNA stores larger tools and ladders. Among the things there is a wooden sign with text about the heritage site, including its HSM number. According to Pablo Fontana, the house is a reconstruction of a hut which the first Swedish Antarctic expedition built for their needs. According to Capdevila, it was the toilet. However, it does not stand in the original place of that building. The original used to stand on the upper part of the hill, in a part of the hill that has now eroded away. Neither does it have the same measurements and proportions. According to Fontana, Ricardo Capdevila built the shed in 1996–1997, replacing the original building. Fontana also noted that in the original building, the door was placed in the north, not in the east as it is now, and the windows are also different – the original had one round window. As building

![Figure 16. Shed built by IAA staff led by Capdevila from materials (wood and nails) from lab buildings of the First Swedish Antarctic Expedition. Photo: Dag Avango.](image-url)
materials, Capdevila used historic materials from several sources, including from the Magnetic Hut (1). This is supported by the fact that there are copper nails in its wall, which the Nordenskjöld expedition used in the walls of the Magnetic Hut instead of iron nails, which are magnetic.

When Pablo Fontana took charge of the site, he removed old foodstuffs from the shed (it was full of it). He also removed newer boxes, tin cans and wires from the DNA camps of the last 15 years, and took them back to Marambio. Fontana also gave some order to the stuff in the hut.

**Feature 10. Foundation**

Foundation of fine moraine surrounded by walls of local stones and partly covered by aluminium boards (for description of the boards (see feature 64). Along the southern side, the wall surrounding the foundation has an arrow shape pointing south. A likely explanation for this shape is the function to steer eroding soil from the top of the hill to the sides of the building instead of displacing it (Figure 17). According to Pablo Fontana, Ricardo Capdevila built the stone wall and the foundation in accordance with instructions from the glaciologist of the IAA, Yevgeny Yermolin, who advised him.

**Feature 11. Aluminium board**

Retaining wall made of an aluminium board intended to stop fine moraine from creeping down the hill upon which the Winter Station stands and displacing the shed (feature 9). For a description of the aluminium board, see feature 64. According to Pablo Fontana, Ricardo Capdevila built the stone wall and the foundation in accordance with instructions from the glaciologist of the IAA, Yevgeny Yermolin, who advised him.

![Figure 17. Arrow shaped foundation for stopping movement of soil from the northern slope of the Winter Station hill towards the shed (feature 10). Behind it is an aluminium board, filling the same function (feature 11). Photo: Dag Avango.](image-url)
**Feature 12. Stone wall**

Wall of stones, between 10 and 20 cm high, running along the lower end of the north-western side of the Winter Station hill, from the shed (9) to the large support structure for the hillside. In its southern half, the wall is about 50 cm wide; in its northern part, it is about 2 metres wide. At the southern end of the wall, it branches off and ends in a stone field covering the hillside, intersected by aluminium boards (Figure 18).

According to Pablo Fontana, Ricardo Capdevila led the establishment of this wall and the system of stone fields and aluminium boards. In the 1990s, Capdevila saw that the hill was eroding away and wanted to stop it. He had the boards placed there and filled the spaces between them with stone, and thereafter filled moraine on top of them and covered them with a metal net. Capdevila’s team could not finish the work, however. This is why the fields of stone in the hillsides, intersected by aluminium boards, but without moraine filling and metal net, are there. They are parts of Capdevila’s support structure that he and his team did not have time to finish.

**Figure 18.** Stone wall, feature 12, following the lower part of the western side of the northern part of the winter station hill. The wall was built for several functions - as a delimitation of a no-go zone on the Winter Station hill side, as a barrier holding back erosion and as the lower section of larger stone chests to be built in the future (of the feature 38 type). Photo: Dag Avango.

Building this system involved moving large amounts of stones and moraine. Capdevila and his team did this with the help of a four-wheel drive with a trailer, which Fred Goldberg gave him. The work of building the system stopped in 2015 because the four-wheel drive was out of action and because Rodolfo Sánchez, then the new director of the IAA, stopped the work. He had the opinion that a new analysis should be carried out to investigate what the ideal method of stop-
ping erosion at the Winter Station hill would be. Yevgeny Yermolin performed this analysis and concluded that the method Capdevila and his team were carrying out was a good solution. Sánchez ordered this work to be continued in the Antarctic summer of 2019, but with the emergence of the CHAQ2020 expedition, this plan was changed. Instead, the Swedish team should explore the site and evaluate the methods that had been used. Future work at the Winter Station hill should also be guided by their recommendations.

Feature 13. Stone wall

Wall of stones, placed along the lower part of the eastern side of the Winter Station hill. The wall runs between the shed (9) and a stone field supporting the central part of the east side of the Winter Station hill (17). The wall is approximately 70 metres long. The southernmost 20 metres of the wall are only around 50 cm wide, while the rest of the wall is wider (Figure 19). The function of the wall is to protect the eastern side of the Winter Station hill against erosion, from soil creeping down the wall, and from water in the meltwater creek (8). According to Pablo Fontana, the wall forms part of the structures which Ricardo Capdevila built in the 1990s for stopping erosion of the Winter Station hill.

Feature 14. Walls and areas of stone

System of walls and areas/fields of stone on the eastern side of the Winter Station hill connecting to the lower wall (13). Along the top of the hill, the stone walls support sections of standing aluminium boards (15 and 16). The eventual purpose of the system of walls is to be part of larger stone chests, of the same type as feature 38. According to Pablo Fontana, the particular formations of the walls and stone fields are designed to be optimal for the shape of the hill.

Figure 19. Stone wall, feature 13, following the lower part of the eastern side of the northern part of the Winter Station hill. The wall was built for several functions - as a delimitation of a no-go zone on the Winter Station hill side, as a barrier holding back erosion and as the lower section of larger stone chests to be built in the future (of the feature 38 type). Photo: Dag Avango.
**Feature 15. Aluminium boards**

Wall of aluminium boards, two sections, placed upright on their long side, along the northern section of the eastern side of the Winter Station hill (Figure x). The board wall is supported by wooden sticks knocked into the ground in pairs, one on the outer side, one on the inner. On the valley side, a stone wall 7 decimetres high gives additional support to the board wall (14). In the southern part of the feature, parts of the wall have fallen or are about to fall.

![Figure 20. System of stone walls and stone covered areas, feature 14, following on eastern side of the northern part of the Winter Station hill. The walls were built to become larger stone chests in the future (of the feature 38 type). Photo: Dag Avango.](image)

From feature 15 there is a wall (14) running at a 25-degree angle toward feature 16, the next retaining wall of aluminium. Capdevila's team placed the boards there during expeditions in the early 1990s to function as retaining walls to stop erosion of the Winter Station hill.

**Feature 16. Aluminium boards**

Wall of aluminium boards which are placed upright on their long side along the northern section of the eastern side of the Winter Station hill (Figure 22). To support the wall, there are wooden sticks hammered into the ground, a stone wall on the outer side of the boards, and steel wires (4.5 mm thick) tied in the aluminium panels and anchored under the moraine surface of the top section of the Winter Station hill (Figure x). The board wall is 35 metres long and ends in the south at a firebrick pile (18). 25 metres from the northern end, a staircase to the Winter Station cuts through the wall. The northernmost section of the wall contains aluminium boards only. The next section to the north also contains a wooden board which is obviously older than the others. Capdevila's team placed the boards there during expeditions in the early 1990s to function as retaining walls to stop erosion of the Winter Station hill.
Feature 17. Stone wall

Wall of stone and field/area of stone located on the mid-section of the eastern side of the Winter Station hill (Figure 24). The stone field supports a wall of aluminium boards (16) along the top of the Winter Station hill. The northern end of that wall has collapsed along a section of 10 metres and the stones have fallen down in front of the structure. Capdevila's team constructed the structure during expeditions in the early 1990s to function as retaining walls to stop erosion of the Winter Station hill.

Feature 18. Pile of fire bricks

Pile of firebricks, placed on the edge of the eastern side of the Winter Station hill. The pile is 70 cm high and measures 55 x 41 cm (Figure 25). From the top of the pile, to a height of an additional 60 cm, there is a thin wooden board with a wooden sign board on it, which has the following text:
“Ladrillos refractarios del observatorio magnetico
Refactory bricks geomagnetic observatory.”

The firebrick pile is strikingly similar to the fundaments for scientific instruments which the Swedish-Russian arc of meridian expedition placed at Treurenburg Bay at Svalbard in the years preceding the Nordenskjöld expedition. According to Pablo Fontana, Capdevila moved the firebricks to this point from the site of the magnetic observatory (1). The reason for doing so was that Capdevila was already seeing the rapid erosion of the Magnetic Hut hill in the 1990s and realised that he had to move them or lose them to erosion. Some of the firebricks are placed as a doorstep to the Winter Station hut.

Figure 24. Wall of stone and stone filled area, on the eastern side of the Winter Station hill (feature 17). Photo: Dag Avango.

Figure 25. Pile of firebrick with a wooden sign board. The bricks used to be part of the Magnetic Hut, but were moved to this place by IAA staff. Photo: Dag Avango.
Feature 19. Staircase

Staircase of cement running up the Winter Station hill towards the Winter Station door from the valley east of the hill (Figure 26). The staircase is 400 cm long and 45 cm wide. The stairs measure ca. 35 x 45 cm. Along the southern edge of the stairs there is a railing made of simple wooden boards, 230 cm long and 100 cm high. The railing is fixed into the cement of the staircase. According to Pablo Fontana, Ricardo Capdevila built the staircase between 1980–2000 with the purpose of making tourists approach the Winter Station hut along his desired route and preventing them from going up the hill at other points, thus reducing the erosion.

Figure 26. Staircase on the Winter Station hill, from the valley on its eastern side (feature 19). Photo: Dag Avango.

Feature 20. The Winter Station

See the description of the Winter Station of the first Swedish Antarctic expedition under heading 4 in the main report.

Figure 27. The Winter Station, feature 20. Photo: Dag Avango.
Features 21–24. The memorial plaques

On the eastern slope of the Winter Station hill, there are four memorial plaques commemorating the first Swedish Antarctic expedition and events that relate to the remains of it at Snow Hill Island - features 21, 22, 23 and 24 (Figure 28).

![Image](image_url)

Figure 28. The memorial plaques, placed below the Winter Station hill, just to the north of the stairs leading up to the station door. Photo: Dag Avango.

Feature 21. Memorial plaque

Memorial plaque of metal placed on a wooden board, 12 cm thick, on a wooden post. The sign measures 36 x 26 cm. The post is 115 cm high. The text of the plaque is the following:

“ESTE LUGAR HA SIDO DECLARADO MONUMENTO HISTORICO NACIONAL POR EL GOBIERNO DE LA REPUBLICA ARGENTINA POR DECRETO No 6058/65

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THIS PLACE HAS BEEN DECLARED A NATIONAL HISTORICAL MONUMENT BY THE GOVERNMENT OF THE ARGENTINE REPUBLIC BY DECRETE No 6058/65.” The same text follows in French and Russian.

Feature 22. Memorial plaque

Memorial plaque of metal placed on a wooden board, 2.1 cm thick. The sign measures 39 x 58 cm. The sign is placed on a wooden post 115 cm in height. The sign has the following text:

EXPEDICION POLAR SUECA 1902-1903 DE EMBAJADA DE SU-
Figures 29 and 30. Left: Memorial plaque celebrating the Argentinean governments declaration of the Winter Station as a national historic monument, feature 21. Right: Memorial plaque, erected on behalf of the Swedish embassy in Argentina and the DNA, commemorating the 100 year anniversary of the First Swedish Antarctic Expedition 1901–1903. Photos: Dag Avango.

ECIA EN LA REPUBLICA ARGENTINA Y LA DIRECCION NACIONAL DEL ANTARCTICO CONMEMORAN EL CENTENARIO DE LA EXPEDICION SCIENTIFICA DEL DOCTOR OTTO NORDENSKJOELD Y LE RINDEN HOMENAJE A LOS SEIS HOMBRES QUE INVERNARON DONS ANOS EN CERRO NEVADO EN 1902–1903.

SVENSKA POLAREXPEDITIONEN 1902–1903 MED ANLEDNING AV 100 ÅRSJUBILEET AV OTTO NORDENSKJOLDS VETENSKAPLIGA EXPEDITION HEDRAR SVERIGES AMBASSAD I ARGENTINA OCH ARGENTINAS DIRECCION NACIONAL ANTARCTICO DE SEX VETENSKAPSMÄN SOM ÖVERVINTRADE PÅ SNOW HILL ÅREN 1902 OCH 1903 OTTO NORDENSKJÖLD GÖSTA BODMAN ERIK EKELÖF JOSE MARIA SOBRAL OLA JONNASEN GUSTAF ÅKERLUNDH

DICIEMBRE 2003
Feature 23. Memorial plaque

Memorial plaque of metal placed on a wooden board, 2.5 cm thick. The sign measures 60 x 55 cm. The sign is placed on two wooden posts 115 cm in height. The sign has the following text:

“REFUGIO SUECIA AQUI INVERNO DEL DOCTOR OTTO NORDENSKJOLD
Y SUS QUATRO COMPANEROS ENTRE LOS QUE SE ENCONTRABA EL REPRESENTANTE ARGENTINO ALFEREZ DEL FREGATTA JOSE MARIA SOBRAL DURANTE 22 MESES DE LOS ANOS 1902/3 DECLARADO MONUMENTO HISTORICO NACIONAL DE LA REPUBLIC ARGENTINA.”

According to Pablo Fontana, Ricardo Capdevila moved the sign to this location from a former placement close to the north-eastern corner of the Winter Station (20).

Feature 24. Memorial plaque

Memorial plaque of metal placed on a wooden board, 2.5 cm thick. The sign measures 30 x 40 cm. The sign is placed on a wooden post 105 cm in height. The sign has the following text:

“EL ALFEREZ DE NAVIO DON JOSE MARIA SOBRAL INTEGRANTE DE LA EXPEDICION DEL DOCTOR OTTO NORDENSKJOLD ES EL PRIMO ARGENTINO QUE DESEMBARCA PARA INVERNAR EN EL CONTINENTE ANTARCTICO

Figures 31 and 32. Left: Memorial plaque, erected on behalf of the Swedish embassy in Argentina and the DNA, commemorating the 100 year anniversary of the First Swedish Antarctic Expedition 1901-1903. Photo: Dag Avango. Right: Plaque commemorating the declaration of the Winter Station as a historical monument of Argentina. Photos: Dag Avango.
LA ARMADA ARGENTINA
LE RINDE HOMENAJE AL
CONMEMORARSE EL 60 ANIVERSARIO
DE ESTE MEMORABLE EPISODIO
1902-12-11-1962.

The plaque commemorates the 1962 death of José María Sobral, 60 years after. According to Pablo Fontana, the sign used to be placed by the south-east corner of the Winter Station.

Figure 33. Plaque commemorating the Argentinean navy’s celebration of the 60 years anniversary of José María Sobral’s landing on the Antarctic continent, the first Argentinean to do so, on December 11 in 1902. The celebration took place in 1962. Photo: Dag Avango.

Feature 25. Pile of wooden building materials

Pile of wooden building materials placed on a moraine ridge north-east of the Winter Station hill (Figure 34). The pile consists of boards of different dimensions and types, as well as parts of wooden constructions. The character of the wood suggests that much of it is older material, probably emanating from the first Swedish Antarctic expedition’s activities at the site. Some of the objects may be of an earlier age. The pile roughly measures 250 x 200 cm and is 60 cm high. According to Pablo Fontana, the materials in the pile were in the process of spreading due to wind when he began his work at Snow Hill in 2016. He has secured it in the ground using wires. Fontana believes the material could come from the astronomic hut and/or the Magnetic Hut. Fontana is considering as-
Figure 34. Pile of wooden building materials, on a ridge immediately to the east of the winter station hill. Photo: Dag Avango.

Assigning museum object numbers to the building parts, identifying where each one of them comes from, and including them in the museum collection. Ricardo Capdevila must have put the pile at this place in the 1990s because it was not at the site in the 1980s.

Feature 26. Pile of coal

Pile of coal placed in the small valley on the eastern side of the Winter Station hill. The coal pile is surrounded by a wall of stone. On top of that, there is a rope fence hanging on wooden pins, 60 cm high. The structure measures 270 x 260 cm (Figure 35). The pieces of coal vary in size. There are also pieces of coal outside of the fenced area in the valley east of the Winter Station. Pieces of coal found there are thrown onto the pile.

Figure 35. Pile of coal, remains of the coal storage for the expedition. IAA/Museoantar built the fence and the stone wall surrounding it. Photo: Dag Avango.
Feature 27. Stone wall

Wall of stone running along the lower end of the southern part of the Winter Station hill. The wall runs from the coal pile (26) on the east side of the Winter Station hill to the ramp connecting the hill with the valley (41). The wall is around 60 cm wide and 10–30 cm high (Figure 36). The wall is part of the system of reinforcements built by Ricardo Capdevila’s team in the 1990s–2000s.

Feature 28. Arrow of wood

Arrow of wood, orange red on a yellow pole of bamboo. The arrow is part of a system of arrows in the area of the Winter Station. Their function is to encourage visitors to approach and depart the Winter Station (20) along a specific route to avoid erosion in erosion-sensitive areas. Pablo Fontana placed the arrow there in the field season of 2018–2019. The arrows are 30 cm long, 5–15 cm wide (standard size). The bamboo pole is 65 cm high.

Feature 29. Arrow of wood

Arrow of wood, orange red on a yellow pole of bamboo. The arrow is part of a system of arrows in the area of the Winter Station. Their function is to encourage visitors to approach and depart the Winter Station (20) along a specific route to avoid erosion in erosion-sensitive areas. Pablo Fontana placed the arrow there in the field season of 2018–2019. The arrows are of standard size (see feature 28).
**Feature 30. Arrow of wood**

Arrow of wood, orange red on a yellow pole of bamboo. The arrow is part of a system of arrows in the area of the Winter Station (see Figures 37 and 38 for the type). Their function is to encourage visitors to approach and depart the Winter Station (20) along a specific route to avoid erosion in erosion-sensitive areas. Pablo Fontana placed the arrow there in the field season of 2018–2019. The arrows are of standard size (see feature 28).

**Figures 37 and 38.** Left: Arrow of wood, part of a system of wooden arrows placed for the purpose of directing tourists in the desired direction. Right: Arrow of wood, part of a system of wooden arrows placed for the purpose of directing tourists in the desired direction. Photos: Dag Avango.

**Feature 31. Arrow of wood**

Arrow of wood, orange red on a yellow board hammered into the moraine. The arrow is part of a system of arrows in the area of the Winter Station. Their function is to encourage visitors to approach and depart the Winter Station (20) along a specific route to avoid erosion in erosion-sensitive areas. Pablo Fontana placed the arrow there in the field season of 2018–2019. The arrows are of standard size (see feature 28).

**Feature 32. Wooden frame with plaque**

Wooden signboard with a metal plaque, commemorating the inauguration of the Winter Station as a museum in 2005. The wooden signboard measures 105 x 145 cm and is 4.5 cm thick. It stands on wooden poles 150 cm above the ground. The metal sign measures 39 x 27 cm.

The text of the wooden signboard is the following: “MONUMANTO No38 DEL TRATADO ANTARCTICO.”
The text on the metal plaque is the following: “CABANA DE LA EXPEDICION SUECA 1901–1903 MUSEO INAUGURADO EL 12 DE ENERO DE 2005 PROGRAMA MUSEOANTAR DNA-IAA SWEDISH EXPEDITION HUT MUSEUM”
The sign stands at a prominent place along the approach route marked by red wooden arrows to the Winter Station. From its placement, it is also visible from the sea (Figures 39 and 40). According to Pablo Fontana, Ricardo Capdevila put up this sign. Museoantar was a programme of the DNA-IAA at the time. Capdevila was the leader of Museoantar. Capdevila had placed the sign out in the river (65). Pablo Fontana moved it to its current location to encourage people to walk along a particular route to the Winter Station, thus avoiding increased erosion of the hill. The date for the inauguration of the museum, the 12th of January 2005, only marks a date that officially confirms the transition of the Winter Station into a museum – a process that had begun years before.

Figures 39 and 40. Wooden frame with plaque commemorating the official opening of the Winter Station as a museum on January 12, 2005. Photo: Dag Avango.

**Feature 33. Fence**

Fence, about 70 m long, consisting of a climbing rope fixed upon bamboo pins and wooden boards, average 70 cm high, hammered into the moraine. The fence runs along the lower section of the western side of the Winter Station hill, from south to north a few metres from the bed of the river running through the area (65). At the endpoints of the fence there are wooden arrows (31 and 34). The function of the fence, as well as the arrows, is to make visitors to the site walk along a particular route to avoid additional erosion of the site. Pablo Fontana placed the fence and the arrows here in 2018–2019. His intention was to make tourists walk below/west of the fence as they approach the Winter Station hill.

**Feature 34. Arrow of wood**

Arrow of wood, orange red on a yellow stick of bamboo. The arrow is part of a system of arrows in the area of the Winter Station (see Figures 37 and 38 for the type). Their function is to encourage visitors to approach and depart the Winter...
Figures 41 and 42. Rope fence on bamboo pins along the lower section of the western side of the Winter Station hill. The rope is placed there to keep visitors away from the erosion sensitive hill slopes. Photo: Dag Avango.

Station (20) along a specific route to avoid erosion in erosion-sensitive areas. Pablo Fontana placed the arrow there in the field season of 2018–2019. The arrows are of standard size (see feature 28).

Feature 35. Aluminium boards
Wall of aluminium boards placed upright on their long side, along the western side of the hill on which the Winter Station stands. On the valley side of the board wall there is a row of nine steel rods and pipes hammered into the ground. On the hillside of the boards there is a field of stones covering a space delimited by another wall of aluminium boards higher up on the hillside (36). The board wall consists of three segments of aluminium boards (for a description of the boards, see 64). The boards were placed there during expeditions in the early 1990s under the leadership of Capdevila to function as retaining walls to stop erosion of the Winter Station hill. Capdevila’s idea was to fill up the spaces between the board walls with stones on top of which is a layer of finer moraine covered by a steel net (of Gunnebo type). An example of the construction, close to finalisation, is feature 38. The aluminium board walls of 35, 36 and 37 and the stone fields in between are all part of a similar reinforcement as feature 38, which Capdevila did not have time to finish.

Feature 36. Aluminium boards
Wall of aluminium boards placed upright on their long side, along the western side of the hill on which the Winter Station stands. The wall consists of three aluminium board sections (for details on the boards, see 64). Bamboo pins placed in pairs support the wall. There are steel wires tied to the bamboo pins, anchored under the moraine. On the hillside of the board wall, there is a layer of fine moraine, 1.5 metres wide and thereafter another wall of aluminium boards (37). Ricardo Capdevila’s teams built the system of boards and moraine fillings in the 1990s to stop erosion of the Winter Station hill.
Figure 43. Walls of aluminium boards, delimiting the edges of an unfinished stone chest on the west side of the winter station hill, built by IAA/Museoantar for the purpose of strengthening the hill against erosion. Photo: Dag Avango.

**Feature 37. Aluminium boards**

Wall of aluminium boards placed upright on their long side along the western side of the hill on which the Winter Station stands. Very thin wooden sticks placed in pairs support the wall on each side. On the hillside of the board wall there is a layer of fine moraine, followed by a stone wall at the top of the hill. Ricardo Capdevila’s teams built the system of boards and moraine fillings in the 1990s to stop erosion of the Winter Station hill.

**Feature 38. Reinforcement system for the Winter Station hill**

Area surrounded by walls of aluminium boards placed upright on their long side. Inside the area there are large stones which are covered by a layer of moraine followed by a steel net of Gunnebo type. Capdevila’s teams built the system in the 1990s to stop erosion of the Winter Station hill. Feature 38 shows what Capdevila and his team intended the system to look like once it was finished, but most likely with one exception – they did not want the metal net to be visible on top. They probably intended the net to be covered by moraine, thus creating a surface hard to distinguish from the surrounding terrain.

**Feature 39. Surface encircled by stones and filled with moraine**

Area delimited by a stone wall and filled with moraine, located along the western facade of the Winter Station. The area measures 11 metres along the station wall, 13 metres along the hillside, and 4 metres wide. The wall is 40 cm high. The purpose of the area is the same as the system of aluminium board walls and stones on the slopes of the Winter Station hill – to isolate the permafrost in the hill and stop erosion.
Feature 40. Stone wall

Stone wall running from the ramp (41) at the southern end of the east side of the Winter Station hill in a bow around the southern end of the hill and back along the west side of the hill up to the south-west corner of the reinforcements on the hillside (38). The wall is 45 metres long and is placed at the lower end of the steepest part of the Winter Station hill. The wall is a part of the larger system of walls, stone fields and aluminium boards placed at the hill in order to stop erosion. Ricardo Capdevila led this work, starting in the 1990s.

Figures 44 and 45. Reinforcement system for the Winter Station hill. Photo: Dag Avango.

Feature 41. Ramp / walkway

Ramp/walkway situated in the southern part of the eastern slope of the Winter Station hill. The ramp starts from the small valley east of the hill and leads to the southern end of its top. The ramp is 20 metres long and 4–5 metres wide. Along the southern side there are two walls of stone, one of which continues in a bow shape around the southern side of the Winter Station hill (40) and one leading north to the coal pile (27).

Figure 46. Surface encircled by stones and filled with moraine. Photo: Dag Avango.
There is no doubt that the ramp is a feature built by human hands. It is possible that this was the recommended walkway up the hill before Pablo Fontana put up a wooden arrow on top of it, pointing visitors towards the staircase (19). It is also possible that the ramp was constructed to make a road for a four-wheel drive which Capdevila used to bring up stones and moraine to the top of the Winter Station hill. According to Fontana, it was Fred Goldberg who donated this four-wheel drive to Capdevila. It is possible that Capdevila's team brought the material for building the ramp from a nearby hillside where there is a depression (6).

**Feature 42. Area with artefacts**

Area with artefacts, situated on a small hill on the opposite side of the small valley east of the Winter Station hill. The artefacts in the area consist of copper wire, ceramics and small pieces of glass, including the same blue glass that is
present in the remains of the Magnetic Hut (1), originating from San Telmo, Buenos Aires. There are also parts of test tubes of glass in the area. Some of the artefacts are laying on the surface, which make them attractive objects to visitors who may pick them up or even take them away. Pablo Fontana expressed the opinion that the site should be subject to rescue excavation, partly because of the risk of theft, partly because of the increased meltwater coming down the hillside in the springtime.

Feature 43. Fence of wooden logs

Fence of wooden logs, 25 cm thick, placed along the western side of the Winter Station hill. There are six logs. The northern section of the fence consists of two logs placed on poles. These poles are made up of vertically placed logs reaching a height of 75 cm. The remaining four logs are laying directly on the ground. According to Pablo Fontana, Ricardo Capdevila built this fence. The Argentinian air force had brought the logs for use at Base Marambio.
**Feature 44. Plastic tubes**

Plastic tubes drilled into the ground for the purpose of measuring the temperature of permafrost. There are three plastic tubes which CHAQ2020 named 44a, 44b and 44c. In each tube CHAQ2020 placed a temperature gauge with a data logger for measuring the temperature of the permafrost. The measuring devices hang in nylon wires, in full contact with the soil/ice below. The three tubes are situated in different places and the data loggers in them are at different depths, as given below.

**44a. Plastic tube east**

This plastic tube is situated on the slope opposite the small valley east of the Winter Station hill. The tube contains the following temperature data logger: R13901 at 56 cm depth.

**44b. Plastic tube north**

This plastic tube is situated on the northern side of the upper part of the Winter Station hill, just north of the flagpole (59). The tube contains the following temperature data logger: R11776 at 65 cm depth.

**44c. Plastic tube south**

This plastic tube is situated on the southern part of the western slope of the Winter Station hill, in the upper part of the reinforcement system of the hill (feature 38). The tube sits next to a standing wooden board. The tube contains the following temperature data logger: R13913 at 131 cm depth.

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**Figure 52.** Plastic tube 44a for measuring ground temperature. Photo: Dag Avango.
Feature 45. Collection of fossils

Oval-shaped ring of stones, 130 x 160 cm, situated some 3 metres from the northern gable wall of the Winter Station. Inside the ring of stones is a large number of fossils. Pablo Fontana does not know who constructed the feature, when it was constructed, or why.

Feature 46. Bracket for a grinding stone

Bracket for a grinding stone, sitting on the north-eastern support beam of the Winter Station hut. The feature is original and the grinding stone itself is inside of the Winter Station hut.
Figure 55. Collection of fossils by the northern gable wall of the hut. Photo: Dag Avango.

Figure 56. Bracket for grinding stone. Photo: Dag Avango.

Feature 47. Depression in the moraine
Depression in the moraine on the hill, on the opposite side of the valley east of the Winter Station hill. The depression is the remains of a cold box for meat, dug by personnel of the DNA at the site. Earlier expeditions of the DNA used this hill as a camping site.

Feature 48. Stone wall
Stone wall along the upper western side of the northern part of the Winter Station hill. The wall was probably built to function as a delimitation to keep visitors from adding to the erosion of the hillside.
Figure 57. Pit remaining from meat box placed there during maintenance work at the Winter Station in the 80-90’s by the DNA-IAA, prior to the regulations of placing tent camps on a longer distance from the building. Photo: Dag Avango.

Feature 49. Fence of rope on bamboo poles
Fence consisting of a rope – climbing/glacier-walking type – placed on 11 poles made of bamboo (see Figure 8). The fence is an average of 60 cm high. The construction date of the fence is unknown, but it was there in 2016 as the IAA (Pablo Fontana) conducted maintenance work on it.

Feature 50. Flag pole
Flagpole placed on the northern side of the top of the Winter Station hill. The pole is made of bamboo and is about 4 metres high. It is placed in a steel pipe, 80 cm high, which is drilled into the ground and fixed with stones. Members of the

Figure 58. Retaining wall of stone along the western side of the Winter Station. Photo: Dag Avango.
IAA/Museoantar under the leadership of Capdevila placed this flagpole there. The first Swedish Antarctic expedition also had a flagpole at the site, but theirs was fixed to the north gable wall of the Winter Station.

**Feature 51. Flag pole**

Flagpole on the eastern lower side of the Winter Station hill. The pole is made out of two bamboo poles tied together with steel wire. The flagpole is fixed to the ground in one of the stone walls built to stop erosion of the hill. The flagpole was placed there by the IAA Museoantar program, by Capdevila. It had an orange flag on top and functioned as a starting point for the trail which some tourists took to get towards the top of the mountain east of the Winter Station hill. The trail was marked by a rope on bamboo sticks. Pablo Fontana later removed this rope because it gave visitors an impression that it was a fixed rope, making ascent and descent of the mountain safe – which it was not.

**Feature 52. Assemblage of artefacts**

Assemblage of artefacts (depot 1 in the main report text), situated in a creek bed cut into fine-grained soil (dried out at the time of our visit). The upper end of the riverbed is situated at the foot of a smaller hill, located between two wider riverbeds (features 008 to the west and 058 to the east). The three riverbeds have been created by meltwater or rain water periodically flowing down the mountainside located immediately to the east. It is clear that the source of the middle riverbed, in which the depot is located, is water that is flowing out from under the smaller hill.

The riverbed with the depot runs in a south to north direction and connects with the eastern riverbed some 15 metres downstream. The artefacts are all located on the floor of the middle riverbed or sticking out of the soil along its sides, from

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**Figure 59.** Flag pole on the east side of the Winter Station hill. Photo: Dag Avango.
the point from where it appears below the elevation and along its uppermost 10 metres.

The assemblage consists of the following types of artefacts:
- Glass shards from broken bottles, some of brown and green glass, some of a deep blue glass
- Pipes of transparent glass, most likely test tubes
- Pieces of wooden boards of different shapes and dimensions
- Pieces of tar paper

**Figures 61-64.** The dried out riverbed with the artefact assemblage is the one running from the right to the left of the image. Photos: Dag Avango.
- Pieces of thick cloth fabric
- Pieces of rusted iron such as nails, parts of pipe, fittings, sheets and barrel parts
- Pieces of metal wire
- Capsules of late twentieth-century design

The artefacts of the depot are clearly made up of items remaining from different time periods. Some of them are likely to be remains from the first Swedish Antarctic expedition, in particular the blue glass shards. These are of the same type that we found among the remains of the Magnetic Hut (feature 001) and at feature 042 (named depot 2 in the main report). Research conducted by the IAA has determined that these glass shards emanate from bottles which Otto Nordenskjöld’s team acquired in the San Telmo district of Buenos Aires before departure to Antarctica in 1901. Another artefact that is likely to remain from the Swedish expedition is the broken test tubes. IAA members found other artefacts from the Swedish expedition in the same riverbed in previous years, one example being a leather shoe. Other artefacts, in particular the capsule, are clearly of a later date. During fieldwork in the Museoantar framework in the 1990s, the DNA had their camp on the hill overlooking this creek. Some of the artefacts probably emanate from these camps.

Figure 65. Wooden arrow, acting to direct tourists along a route leading to minimal disturbance of erosion sensitive spots. Photo: Dag Avango.

Feature 53. Arrow of wood

Arrow of wood, orange red on a square yellow pole of wood, situated on a small hill by the shore. The arrow is part of a system of arrows in the area. Their function is to encourage visitors to approach and depart the Winter Station (20) along a specific route to avoid erosion in erosion-sensitive areas. Pablo Fontana placed the arrows in the field season of 2018–2019. The arrows are 30 cm long and 5–15 cm wide (standard size).
**Figure 66.** Site where Sobral operated an anemometer during the first Swedish Antarctic Expedition. Photo: Dag Avango.

**Feature 54. Site where photograph of José María Sobral and an anemometer was taken**

Site where photograph of José María Sobral and an anemometer was taken in 1902, identified by Dag Avango and Gunnar Almevik.

**Figure 67.** Approximate position of point “e”, part of the expedition’s laboratory landscape, here marked by the scale in the center of the image. Photo: Dag Avango.

**Feature 55. Approximate position of point “e”**

Approximate position of point “e” in the map of the first Swedish Antarctic expedition, identified by Dag Avango and Gunnar Almevik.
Feature 56. **Approximate position of point “d”**

Approximate position of point “d”, marked out in one of the maps produced by the first Swedish Antarctic expedition. Identified by Avango and Almevik from a historic photo.

Feature 57. **Trail**

Trail leading between the depression east of the Winter Station hill and the top of the mountain range also east of the hill. The lower end of the trail begins near the signboard below the southern end of the Winter Station hill (feature 32). At the upper end there are metal anchors for a wire. Pablo Fontana removed this wire in recent years because tourists tended to believe that the wire made it safe to go to the hilltop.

Figure 68. Approximate position of point “e”, part of the expeditions laboratory landscape, here marked by the scale in the center of the image. Photo: Dag Avango.

Figure 69. Trail from the Winter Station to the top of the mountain range east of it. Photo: Dag Avango.
**Feature 58. River bed**

Riverbed running from the mountain east of the Winter Station towards the depression separating this mountain from the Winter Station hill. As the angle of the slope flattens out, the riverbed turns north, running tightly along the eastern side of the mountain slope until it reaches the coastal plain and eventually enters the sea. The riverbed is about 50 cm wide in its upper parts and 5–10 metres in its lower part. When CHAQ2020 visited the site, the creek was dry. From its physical appearance, however, it is clear that during periods of the year, water comes down the mountain. IAA personnel have noticed that the depth of this riverbed has increased over several years. The CHAQ2020 expedition team members discussed the possibility of diverting the water from the stream running parallel with it towards the Winter Station hill (feature 8). To do so, a trench would need to be dug connecting it to the riverbed. In this way, the meltwater would not contribute to the erosion of the eastern side of the Winter Station hill.

![Figure 70. River bed running along the eastern side of the mountain east of the winter station hill. In the left side of the photo, the river bed leading to erosion on the Winter Station hill is visible. Photo: Dag Avango.](image)

**Feature 59. Wooden sign board**

Wooden sign with the following text:
“10 x 1 1903 ‘Uruguay’ (Armada Argentina) en su viaje de auxilio a la expedicion Antarctica Suecia.” The sign has the following dimensions: 80 cm wide, 30 cm high and 2.5 cm thick. The pole on which the sign sits is 120 cm in height. The sign is placed next to a fence with object number 43, on the flat upper surface of the Winter Station hill.
Feature 60. Concrete slab

Concrete slab situated underground on the northern side of the Winter Station. Only a smaller part of the concrete is visible, a section about 30 cm long and 10 cm wide. The slab is clearly larger underground, but to determine how large would require excavation. A possible explanation of the existence of this concrete is that the DNA-IAA may have reinforced the hill with concrete sometime between the 1980s and the early 2000s.

Feature 61. Concrete slab

Concrete slab situated underground at the south-eastern corner of the Winter Station. Only a small part of the concrete is visible, a section about 60 cm long and 20 cm wide. The slab is clearly larger underground, but to determine how large would require excavation. A possible explanation of the existence of this concrete is that the DNA-IAA may have reinforced the hill with concrete sometime between the 1980s and the early 2000s.
Feature 62. Deleted

Feature 63. Arrow of wood

Arrow of wood, orange red on a square yellow pole of wood, situated close to the main river running through the Winter Station area of Snow Hill Island. The arrow is part of a system of arrows in the area. Their function is to encourage visitors to approach and depart the Winter Station (20) along a specific route to avoid erosion in erosion-sensitive areas. Pablo Fontana placed the arrows in the field season of 2018–2019. The arrows are 30 cm long and 5–15 cm wide (standard size). This arrow stands on a bamboo pole which is 60cm in height.

Figure 74. Wooden arrow with the purpose to direct visitors along a desired route. Photo: Dag Avango.

Feature 64. Pile of aluminium boards

Pile of aluminium boards, each one measuring 366 x 63 cm. The boards have fittings along all sides, making it possible to connect and lock them to each other. This type of board is used in all the structures Ricardo Capdevila built on the long sides of the Winter Station hill in order to stop erosion. The same kind of boards are also placed under the shed (9). The boards are one of the most common building materials for Base Marambio.

According to Pablo Fontana, this is a type of building material that is specially made for building airfields quickly. The air force of the United States reportedly used such boards to construct airfields during its bombing of Vietnam in the 1960s and 1970s. Argentina ordered such boards to Base Marambio to be used for building the airfield there. However, they later opted not to use them because they melted the permafrost in the airfield. Instead, the air force – and the DNA – has started to use them for other purposes, such as building walkways and houses at Base Marambio and to stop permafrost erosion at Snow Hill.
Feature 65. River

The main river running through the Winter Station area. The river is fed with meltwater from the inland ice on top of Snow Hill Island. It starts as a number of smaller creeks down the steeper mountain slope of the island and appears as a broad but shallow river from a ravine some 100 metres north of the Winter Station. From there the riverbed becomes wider and the stream fans out into a number of smaller creeks criss-crossing the riverbed. The western side of the river causes heavy erosion on the Magnetic Hut hill (see erosion front, feature 5). Along the eastern side the river causes erosion of the Winter Station hill.

During CHAQ2020’s visit, the river was low on water in the early mornings and on days with much overcast and colder weather. In the daytime, however, particularly during sunny days and warm weather, the water flow grew in intensity and volume. In the mornings the water was clear enough to make it possible to think of as drinking water. In the afternoons, however, it always turned brownish and was unsuitable for drinking.
It is clear that the existence of this river is one of the reasons why the first Swedish Antarctic expedition placed its Winter Station at this site – to have access to drinking water. It is also clear that the river, in the context of an increasingly warmer climate, is today posing a major threat from erosion to both the Winter Station hill and the Magnetic Hut hill.

Feature 66. Anchor for wire

Anchor point for a wire which previously led up the mountain side from the Winter Station hill to the top of the mountains east of the Winter Station. It was the DNA-IAA expeditions under Capdevila that once placed the fence there to help tourists make it up the steep slope to the top for the view. In recent years, Pablo Fontana removed the fence because of the risk of accident to tourists.

![Figure 77. Anchor point for wire on the top of the mountain east of the Winter Station hill. Photo: Dag Avango.](image)

Feature 67. Sea marker

Sea marker at a site where the DNA erected a sea marker in 1952, in connection with Argentina taking possession of the Snow Hill Winter Station. The sea marker is located on the eastern coast of Snow Hill Island, a two-hour walk from the Winter Station at the western coast. The sea marker functions to support ship navigation at sea, as well as expeditions on land or ice. The sea marker also represents Argentinian activity and governance of the area. During CHAQ2020, Pablo Fontana and Manuel Mamani conducted maintenance of the sea marker by re-painting its base in yellow.

Feature 68. Wooden building material for sea marker

Wooden board in various dimensions, situated in a pile some 50 metres west of the sea marker (feature 67). The boards are remains of building material used in the con-
construction of the first sea marker built by Argentina on the eastern coast of Snow Hill Island in 1952. The wood was used for maintenance needs by DNA-IAA.

**Feature 69. Reference point 1**

Top of a mountain, located in the inland of the northern ice-free section of Snow Hill Island, marked on a map from the expedition as a reference point for mapping. Its geographical location is Lat. -64.346690, Long. -56.933149. There are no remains from the expedition at the site, not even a cairn. The most likely explanation is that the peak itself is prominent enough to be used as a reference point.
70. **Reference point 2**

Basalt rock, approximately 5 metres high and 10 metres long, located on a ridge running along the western coast of the northern ice-free section of Snow Hill Island. The rock is marked in a map from the expedition as a reference point for mapping. Its geographical location is Lat. -64.351736, Long. -56.956287. There are no remains from the expedition's mapping activities. The landscape feature is prominent though, and probably sufficed as a reference point for the mapping without adding a bolt or a cairn.

![Reference point 1](image1)

**Figure 80.** Reference point 1. Photo: Dag Avango.

71. **Reference point 3**

Cairn placed at the edge of a ridge leading up from the east to a prominent basalt mountaintop along the west coast of the northern part of Snow Hill Island. The cairn is located 880 metres from the Winter Station as the bird flies and is clearly visible from the station. Its diameter is approximately 1 metre and is made up of rocks occurring naturally in its vicinity. The cairn is marked as a reference point in a map produced by the expedition. The cairn is also visible on a photograph from the expedition, where a rod fixed in the cairn is visible.

![Reference point 2](image2)

**Figure 81.** Reference point 2. Photo: Dag Avango.
Endnotes:
[1] Russians article about the glaciology of Snow Hill

Figure 82. Reference point 3. Photo: Dag Avango.
APPENDIX 4
THE COLLECTION OF ARTEFACTS FROM SNOW HILL (HSM 38)

1. Recovery
The present collection is a material testimony of the scientific mission of this important expedition – one of the first expeditions of the Heroic Age in Antarctica – and the geological, geomagnetic and meteorologic surveys that they carried out.

Material objects used during the historical expedition have been discovered in connection with the restoration of the hut from the 1950s, but particularly through the conservation work carried out by Argentine Antarctic Institute (IAA) from the 1980s onwards. A variety of objects have been found, including clothing, footwear, kitchen utensils, tools, fragments of wood from boxes and barrels, glass fragments, nails, screws, and other. The objects from inside the building were systematically recovered during the 1979/80 and 1980/81 Antarctic summer campaigns, whereas outside the building, the artefacts have been surfacing sporadically throughout the years due to soil erosion at the garbage pits where they have laid buried.

After its rediscovery, the Snow Hill site has gone through several interventions, of which many have not been documented. First systematic recovery of the artefacts started at Snow Hill in parallel to the rescue and conservation works undertaken at the Swedish Refuge (as the hut is called in Argentina) in January and February 1980 by the team from DNA-IAA, headed by Lic. Santiago Comerci. Next year, he was joined by Dr. Ricardo Capdevila, also a researcher at the Argentine Antarctic Institute, just like Comerci. During December and January of the 1980/81 Antarctic summer campaign they continued with the recovery of the historical artefacts, whereas later campaigns concentrated foremost on the rescue of the hut itself. During this second campaign of 1980/81, the team rescued also objects from the sites that had been used as waste deposits by the original historical expedition.

As the ice was being eliminated from the interior of the building during these
rescue works, the salvaged artefacts were removed from the building together with the enclosing ice. The artefacts were placed in a transparent polyethylene bag which in its turn was introduced into a black polyethylene bag. Then the bags were exposed to sunlight. In such a way the ice removal process could be accelerated without subjecting the artefacts to heating or physical force.

Altogether 135 objects were recovered and catalogued during these two Antarctic summer campaigns, including the heating stove in the living room as well as Husqvarna cooking stove in the kitchen. Part of these 135 objects was transported to Buenos Aires where they were added to the museal collections of IAA, while the rest was stored in the hut itself.

The rescued objects can be divided into the following categories: metal and wooden tools as well as ammunition and locks (figures 1, 2, 3); clothing and footwear (figures 4 and 6), dishes and kitchen utensils (figure 5), scientific instruments (figure 7), cigarettes, candles, fragments of printed matter and hunting ammunition (figure 8) and parts of furniture (figure 9). The photos included below show only some of the salvaged artefacts. The full list and description of the artefacts can be found in Comerci 1996.

Figure 1. Tools recovered from Snow Hill by IAA, photographed in 1980/81. Photo: Historical Archives of IAA, AHF005946, (CC BY-NC-ND).

Figure 2. Artefacts recovered from Snow Hill by IAA, photographed in 1980/81. Photo: Historical Archives of IAA, AHF005956 (CC BY-NC-ND).
Figure 3. Artefacts recovered from Snow Hill by IAA, photographed in 1980/81. Photo: Historical Archives of IAA, AHF005942 (CC BY-NC-ND).

Figure 4. Socks and a boot recovered from Snow Hill by IAA, photographed in 1980/81. Photo: Historical Archives of IAA, AHF005966 (CC BY-NC-ND).

Figure 5. Kitchen utensils recovered from Snow Hill by IAA, photographed in 1980/81. Photo: Historical Archives of IAA, AHF005964 (CC BY-NC-ND).
Figure 6. Clothing recovered from Snow Hill by IAA, form 1980/81. Photo: Historical Archives of IAA, AHF005948 (CC BY-NC-ND).

Figure 7. Scientific equipment recovered from Snow Hill by IAA, photographed in 1980/81. Photo: Historical Archives of IAA, AHF005953 (CC BY-NC-ND).
The majority of the salvaged objects are preserved in situ, in the repository in the attic of the Snow Hill hut. Most of these have been recovered by DNA-IAA in 1980s. Between 2009 and 2011, these artefacts have been re-catalogued, conserved and rearranged by DNA-IAA in order to ensure their long-term preservation. The remaining part of the collection is located in the repository of IAA in Buenos Aires. At present, these objects are under conservation, although the conservation work has had to be momentarily suspended during the COVID-19 pandemic, since the access to the building has been temporarily restricted. A smaller collection of artefacts that were brought back by the Argentine Navy are on display in the National Naval Museum of Tigre (El Tigre, Buenos Aires Province) and in the museum ship corvette Uruguay (City of Buenos Aires).
2. Conservation of the in situ collection

2.1. Previous activities

Work with the collection began during the Antarctic summer campaign 2008/2009 in the framework of the Management of Historic Sites and Monuments Project of the Environmental Management Program of the DNA. This project was carried out under the supervision of specialists in archaeological heritage and cultural heritage conservation and resulted in a series of activities aiming at the preservation of the artefacts. The work was coordinated by Dra. Victoria Nuviala Antelo and was carried out during three consecutive summer campaigns. These activities were reported as information papers at ATCM XXXII-CEP XIII and ATCM XXXIV-CEP XIV (ATCM, 2010, 2011).

According to the reports from 2009/10 and 2010/11 Antarctic summer campaigns (Nuviala, Contissa 2010 and 2011), the first stage of the activities was dedicated to description, quantification and the analysis of the objects’ state of conservation, as well as their maintenance and storage. In the second stage, more profound intervention was undertaken with the objects that were deemed to be more vulnerable, in order to stabilize them for long-term preservation. All artefacts were stored in a part of attic that was designated as repository.

Figure 10. Enamelware plate. Inventory no CN-0049-IAAM, photo: Kati Lindström.
Figure 11. Short-legged boot. Inventory no: CN-0006-IAAM, photo: Kati Lindström.

Figure 12. Primus. Inventory no: CN-0050-IAAM, photo: Kati Lindström.
Figure 13. Primus. Inventory no: CN-0050-IAAM, photo: Kati Lindström.

Figure 14. Knife. Inventory no: CN-0042-IAAM, photo: Kati Lindström.
Figure 15. Salamander stove. Inventory no: CN-0034-IAAM, photo: Kati Lindström.
2.2. Antarctic summer campaign 2020

2.2.1. Approach and objectives

The conservation of the collection is based on international guidelines and recommendations concerning heritage conservation, such as those promoted by international organizations such as the International Council on Monuments and Sites (ICOMOS 1990) or International Council of Museums (ICOM 2006). It follows the Antarctic Treaty System regulations such as the Protocol on Environmental Protection to the Antarctic Treaty (1998), Guidelines for the Designation of Historic Sites and Monuments (ATCM XXXII - CEP XII, Res 3, 2009) and the Guidelines for the assessment of heritage sites in Antarctica (ATCM XLI - CEP XXI, Res 2, 2018). It is also carried out in accordance with the current international legislation for the protection of cultural heritage.

Following objectives were defined by IAA for Antarctic summer campaign 2019/20 concerning the historical artefact collection of the Nordenskjöld expedition:
- To incorporate recently discovered artefacts and fragments into the existing registry kept by DNA-IAA.
- Create favourable conditions for long-term preservation of the new objects as well as the collection in general.
- Continuous evaluation of the potential risks to the collection.

2.2.2. Fieldwork

Of the expedition members listed in chapter 3.3. of the present report, the work with artefacts was carried out by conservationist Valeria Contissa in collaboration with Dr. Kati Lindström and Dr. Pablo Fontana, as well as with assistance from the logistics personnel Captain Héctor Emanuel Mamani Ovejero.

2.2.3. Work process

To preserve collections means to reduce all possible losses, which in its turn means to manage the risks that the collection is subjected to (Michalski 2006). To this purpose, the campaign carried out a series of activities that allow for an integral management of the collection:

I. Risk assessment.
II. Work with newly found artefacts.
III. Mapping of the collection's general state of conservation.
IV. Assessment.
V. Preventive conservation.

I. Risk Assessment

The risks do not arise solely from the collection’s immediate context where they are stored or displayed, but also from the wider environment around that. For risk assessment, it is necessary to start from the wider site, proceed to the building and its characteristics and only then move to the interior of the building and analyse each room separately (Michalski 2006). This process is summarized in Figure 16.

Figure 16. The location of potential threats around the collection, adapted from Figure 5, “Nested layers around the collection”, Michalski 2006, p. 62.

More specifically, the analysis of the agents of deterioration was carried out according to the system of classification of the agents of deterioration, proposed by Canadian Conservation Institute (CCI), International Council of Museums (ICOM) and International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) (Marcon 2009; Michalski 2006, 2009a, 2009b; Stewart 2009; Strang, Kigawa 2009; Tétreault 2009; Tremain, 2009; Waller, Caro 2009).

The collection includes of a wide variety of materials, such as pieces of metal, wood, textiles, leather and others. Although all materials deteriorate inevitably with time, there exist certain agents of deterioration that can directly or indirectly accelerate this unavoidable process considerably. In what follows we will look at these affecting factors in more detail, according to the nested model of threats proposed above.
Layer 1: The island context

Climate change and changes in the terrain on which the hut is situated can impact the stability of the hut in future.

Layer 2: Hut

Extreme climate conditions, particularly high relative humidity (RH) and salt that exists in marine air, may accelerate the corrosive processes in metals. Annual average of the relative humidity in 2019 was 89%, measured at Marambio Base, at a distance of 37.3 km from the hut. Climatic conditions inside the hut have hitherto not been measured.

If the movement of the tourists is not controlled, it can result in vandalism or physical damage to the hut, as objects can be removed by ill-intentioned persons.

Fire can be a potential issue. If necessary precautions are not taken, a fire could break out as a result of negligence.

Although low temperatures are not favourable to the development of pests, the conditions can change in future due to climate change, making the environment more suitable for the development of harmful microorganisms.

Layer 3: Repository

The choice of the site for repository and its conditions are fundamental to guarantee security and favourable environment for the preservation of the collection.

Layer 4: Storage system

Absence of labelling, dissociation: potential loss of the information associated to the artefacts may result in serious problems. For this reason, it is important that all objects have a unique identifying code and an associated label.

Defective storage system can exert physical force: if the artefacts do not have adequate packaging or fitting, they are at risk of being broken or deformed.

Failing to mend the detected damage can increase the level of deterioration and lead to artefact loss.
Layer 5: Artefacts

All the above-mentioned factors impact the material of the artefacts to a bigger or smaller degree. Inspection of the state of conservation allows to assess the level of deterioration of the objects and to set up a conservation plan with clear priorities for interventions.

II Work with newly found artefacts

New artefacts, principally fragments, were found during the Antarctic summer campaigns of 2015/16 and 18/19 in an area of a historical “garbage dump”, located around 30 metres in the direction East-Northeast from the hut. These objects had been unearthed due to the action by melting water and wind that have been eroding the soil.

Discovered material includes several small-scale metal objects, such as nails, buttons and undefined fragments, footwear and leather fragments, as well as a big number of glass fragments, principally from glass bottles. A particular find among the textiles was a woollen sock that was almost intact and very similar to a sock that was already included in the collection.

Figure 17. Woollen sock. Inventory numbers: CN-0067-IAAM, photo: Valeria Contissa (CC BY-NC-ND).

Figure 18. Woollen sock. Inventory numbers: CN-0363-IAAM, photo: Kati Lindström.
The activities were focused on the treatment of the newly found artefacts. Although the full duration of the field stay was 11 days in total, two of these were dedicated to setting up and taking down the camp, and all the work around artefacts was carried out in the matter of 9 days. The team erected a large laboratory tent where we placed all elements necessary for working with the objects: their evaluation, inventory, cleaning, labelling, photography and the fabrication of storage systems.

The analysis of all new artefacts consisted in first identifying the object’s morphological and technological characteristics and at the same time evaluating its state of conservation. The obtained information was introduced into the existing database.

Another task related to the inventory was to merge the existing objects with the general catalogue of the Museum of Argentine Antarctic Institute (IAAM), by adding the code IAAM to the pre-existing catalogue entry “CN + No”, where CN stands for Cerro Nevado (Snow Hill) followed by the number of the entry. Thus, the final inventory numbers would be listed in the form of “CN + No + IAAM”, where CN stands for Cerro Nevado, followed by the entry number and then IAAM for the Museum of Argentine Antarctic Institute.

Additionally, a new category of “LOTES” (“lots”) was created for inventorying those unidentified fragments that have been found in great quantities. The fragments have been grouped according their similar qualities, so that they could be studied by specialists in archaeology at a future date. The lots were assigned inventory numbers in the form of “Lote + No + CN + IAAM”, where descriptive “lot” is followed by the entry number among lots, CN for Cerro Nevado and IAAM for the Museum of Argentine Antarctic Institute.

The materials collected during the Antarctic summer campaigns of 2015/16 and 2018/19 had been deposited in polypropylene boxes and polyethylene bags that had been left open in order to avoid the condensation of humidity. In total, it was 40 objects or fragments inventoried individually and 13 lots of fragments of different materials, mostly glass from bottles (Fig 19 and 20).

Figure 19. Glass fragments. Inventory number: Lote Nº 001 CN-IAAM, photo: Kati Lindström.
Compact sediment characteristic to the environment where the items were found, was stuck to many of the glass fragments (Figures 21 and 22).

Figure 20. Glass fragments. Inventory number: Lote Nº 006 CN-IAAM, photo: Kati Lindström.

Figure 21. Glass fragment, possibly from a window. Inventory number: CN-0348-IAAM, photo: Kati Lindström.

Figure 22. Nail made of ferrous metal, with a rectangular section. Inventory number: CN-0352-IAAM, photo: Kati Lindström.
Since textiles are more hygroscopic than other materials, their identification and interpretation posed the biggest difficulties, as can be seen from the following Figures 23 and 24. Therefore, it was deemed necessary to intervene in some of them by humid cleaning, in order to be able to properly analyse them.

Humid cleaning was performed on two textile pieces with inventory numbers CN-0338-IAAM and CN-0339-IAAM, two gloves that could not be studied because of the very sticky and compact sediment. In both cases it was necessary to soak them into distilled water in controlled manner with the purpose of removing the sediment. The procedure was carried out with utmost caution and utilizing semi-rigid supports for handling the soaked textiles. The sediment that was removed mechanically before soaking was collected and labelled for a possible future analysis.

Once the sediment was entirely removed, the gloves were left to dry at the ambient temperature. By now their forms and colours were much better distinguishable. Figures 25 and 26 show how the glove with the inventory number 339 revealed its original black colour that was entirely indiscernible before the procedure.
Figures 25 and 26. During the cleaning process. Inventory number: CN-0339-IAAM, photos: Valeria Contissa (CC BY-NC-ND).
It was necessary to apply a stabilizing treatment to artefacts that were in a more vulnerable condition. This was carried out with minimal intervention and keeping in mind the reversibility of the treatment, in order not to compromise the authenticity of the heritage artefacts.

In order to increase the structural stability of the textiles that demonstrated fragility and tear, supports were provided for weakened fibres. This is a reversible treatment, using an open fabric such as tulle cloth of the same colour, which is then attached to the artefact with stitches without knots. Figure 28.
The campaign also performed general mapping of the state of conservation in the rest of the already inventoried collection. This analysis demonstrated that those metallic artefacts that have not been intervened yet suffer from active corrosion. It was also confirmed that the two metallic stoves, the salamander stove in the living room and the kitchen stove, are in an unstable condition. Small sample
was taken from a fragment that was loose on the top of the salamander stove, in order to perform a laboratory analysis of the corrosive substances and determine the adequate treatment for its stabilization in long term.

III Mapping the general state of conservation of the collection

Field work included also assessing the general state of conservation of the already existing collection that had been treated during previous campaigns.

<table>
<thead>
<tr>
<th>State of conservation</th>
<th>Good</th>
<th>Fair</th>
<th>Bad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive deterioration</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Active deterioration</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

**Figure 30.** Chart for evaluating general state of conservation.

Legend to the assessment chart:

- **Good**
  - No significant deterioration.
  - Can be exhibited and stored.

- **Fair**
  - Moderate deterioration.
  - Exhibition to evaluate. Needs a support for its storage.

- **Bad**
  - Signs of serious deterioration.
  - Cannot be exhibited and requires a special support structure for its storage.

- **Active deterioration**
  - Deterioration is aggravating.

- **Inactive deterioration**
  - Deterioration has stopped, but there are visible traces of a previous issue.

**Figure 31.** Percentages showing the share of objects pertaining to each category of intervention priority.
IV. Assessment

As can be seen from the Figure 31, the collection includes objects with varied needs for treatment. In order to be able to determine which objects require more attention due to their vulnerability and its projected change, a range of damage categories was defined as shown in Figure 30.

The assessment revealed that the majority of the collection (around 60%) is in a stable condition and does not need any direct intervention for its long-term preservation. Of the rest, 32.9% of the artefacts that consist mostly of textile fragments, leather, wood and metal pieces of small size (such as nails and screws of varying calibres), show normal wear. Some of them display moderate active deterioration with signs of progressing damage. Others feature signs of past damage without ongoing deterioration. In both cases it is necessary to intervene directly or indirectly in order to stabilise them, for example, by improving their supports or encasing.

The remaining 4.65% (altogether 15 objects) consists mainly of corroding metals in varied sizes. They are in a state of high vulnerability, featuring active corrosion. This group of objects should be prioritised in planning next interventions to the collection.

All objects of the collection require preventive conservation measures.

V. Preventive conservation

Preventive conservation measures are to be preferred to any other type of intervention. “Preventive conservation” refers to “all measures and actions aimed at avoiding and minimizing future deterioration or loss. They are carried out within the context or on the surroundings of an item, but more often a group of items, whatever their age and condition. These measures and actions are indirect – they do not interfere with the materials and structures of the items. They do not modify their appearance.” (ICOM-CC 2008) In short, all actions taken are aimed at reducing the possible damage to the artefacts.

With the purpose of avoiding future damage and mitigating the impact of the
agents of deterioration outlined above, a series of preventive conservation strategies was implemented at all nested layers of context.

The island context

As detailed in Chapter 3.3 of the report, the behaviour of the terrain and the climatic conditions are being studied in the area of the hut and its vicinities. These studies would provide necessary data for devising mitigation measures that help to avoid or reduce future damage to the hut.

The Hut

The implementation of the Code of Conduct and the regulations for tourism stipulated in the Site Guidelines for Visitors for Snow Hill Hut (ATCM 2019) promotes responsible and conscious use of the site, preventing damage to the hut and the artefacts.

Activities carried out during the summer campaign 2019/2020:

• Two sensors were placed in the hut to monitor the temperature and humidity in the building, both on the ground floor and in the attic (see Appendix 2 of this report for technical specifications).

• The two powder fire extinguishers (ABC type) were renewed. To prevent fire accidents, fire extinguishers are replaced yearly by the personnel of the IAA (as reported in the Activity Report for Antarctic Summer Campaign 2017/18, see Fontana 2018), along with the removal of flammable material such as containers for combustibles or portable stoves.

• Collecting samples for microbiological analysis. While there is no evidence of biodeterioration at the present moment, we cannot exclude the possibility that the structure contains microorganisms in a latent state which can then potentially cause damage at a later stage, especially considering the rising temperatures due to climate change. 8 samples of ca 3mm each (chips of wood) were taken in different areas of the hut to assess this potential damage.

These samples would be processed and analysed through different methods: observation with optical and electronic microscopes as well as culture in growth medium. These analyses would be performed at LEMIT (Laboratory for Multidisciplinary Training in Technical Research) in the city of La Plata, Buenos Aires province.
The analysis of the samples will also show whether there is any active or inactive deterioration, and, accordingly, whether there is any need for taking any action for preventive conservation in order to avoid future damage to the hut and the collection.

An additional measure of preventive conservation in the hut was the installation of a protective sheet on the floor of the living room. The movement of tourists inside the hut causes progressive wear in the original wooden floor. To avoid such deterioration, a transparent plastic sheet had been placed on the floor previously, but was already in a poor condition due to use (Figure 34). The sheet was replaced with a new one of a more resistant material. The new cover is also significantly narrower (width 70 cm), allowing the wood to keep its hygroscopic function, absorbing and releasing humidity in the air (Figure 35).
Figure 34. Previous floor protection. Photo: Valeria Contissa (CC BY-NC-ND).

Figure 35. New floor protection. Photo: Valeria Contissa (CC BY-NC-ND).
Repository

Repository was planned and established during the Antarctic summer campaign of 2009/10 when a wooden shelf was built in the Northern section of the attic for storing the encasing boxes. A similar shelf was built during this summer campaign in the opposite wall, facing the existing one. Here several new boxes were stored, along with the old ones that were redistributed from their previous positions.

Tar paper rolls. Five rolls with tar paper lie on the attic along the southern wall. These have been stored here because this was the material used for covering the hut (Figure 36).

![Figure 36. Tar paper rolls before cloth removal. Photo: Kati Lindström.]

The rolls were covered with sackcloth which was dirty and stained. Removing the sackcloth covers in order to assess the state of the rolls (Figure 37), we discovered a second packaging in paper with the original paper etiquette featuring the brand. The paper etiquettes showed multiple stains which could be fungi.

![Figure 37. Removal of the cloth. Photo: Kati Lindström.]

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Samples for microbiological analysis were taken from this paper packaging. (Figure 38) Paper cover was also removed from the rolls and both packaging materials were disposed of (Figure 39). It will be evaluated whether there is a need to remove the rolls from the attic.

Attic floor. A synthetic cover had been extended across the attic floor during the earlier campaigns in order to relieve the pressure exerted by the weight of some of the artefacts that were stored on the floor since this space functions as a repository of the collection and storage for some objects necessary for the maintenance of the hut. The majority of this plastic cover was removed upon suggestions from the Swedish technical experts, in order to avoid condensation of humidity between the wood and plastic (Figure 39).

In addition, temporary protection was installed over a broken floor board in the attic, above the kitchen. One of the boards around the chimney hole had broken in and is extremely vulnerable. In order to prevent further damage, alveolar polycarbonate sheet (an extremely light and rigid material) was placed above the damaged board, with a warning sign “NO PISAR – DO NOT STEP” (Figure 40).
Storage system

New encasings were confectioned for the 40 recently found artefacts. The storage system was confectioned taking into account the material characteristics of the objects. Secondary support structures were made from materials that are chemically stable and that simultaneously function to dampen the impact of external conditions: polypropylene boxes with polyethylene foam fitting inside and cotton padding (as an absorbent against physical impact), as well as cotton textile and Tyvek® (as absorbents for ambient humidity).
Artefacts

A priority order was decided for the interventions that will be performed during future campaigns.

### 8.3. Plan for future conservation activities

- Labelling the objects: all artefacts need to have legible etiquettes that allow for their identification and archiving of all the associated information.
- Improvement of the storage system.
- Treatment of the objects with highest priority according to Chapter 2.2.3 section IV.
- Laboratory analyses of the samples collected during the conservation work.
- 3D-modelling of the objects with the purpose of preventive conservation and public outreach.
- Study of new objects.

### 8.4. Acknowledgements

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8.5. References


ATCM (2018). Guidelines for the assessment of heritage sites in Antarctica. Resolution 2, ATCM XLI - CEP XXI.


APPENDIX 5.

THE ANTARCTIC BOAT

General description

At the Argentinian Base Marambio, Seymour–Marambio Island, a part of a wooden boat originating from the first Swedish South Polar expedition is stored. The remains of the boat were found on the 29th of January 1997 by Dr Rodolfo del Valle’s group of IAA geologists on the north coast of Snow Hill Island (Capdevila 2000). In January 1998 the remains were moved along the north side of the hut. The two bands were recovered as well as part of the keel and some frames of the boat. One of the boat’s bands was installed on permanent display at the Marambio Base in February 2020, having remained in the ex-museum of the base between 2004 and 2018. The other band of the boat, along with the rest of the parts, was transported in the 2003/4 campaign to the IAA’s repository of historical objects in Buenos Aires, where it is currently located. During the fieldwork of CHAQ2020 the boat part was documented. A suitable location inside the base was discussed with the directory. A data logger to measure relative humidity, temperature and light was set up.

The boat is built of oak which is an untypical material for boats that are lifted and carried by larger ships. Due to its lighter weight, pine is the normal choice for boats which need to be hoisted onboard for embarkation. The Swedish boat builder Fredrik Leijonhufvud passes expert opinion that small Swedish pilot boats were almost always built in oak. Used as a material, oak has a longstanding link to royal property and shipbuilding. The use of copper rods also indicates a more costly construction. The narrow clicker planks and thin ribs are modern methods. Thus, it is not a boat built on local tradition, but rather on a shipyard that manufactures recreational boats, service boats, lifeboats and so on. Eventually, oak was preferred to endure the Antarctic climate and collisions with ice.

The historic photos depict two types of rowing boats; one thicker construction with a symmetrical pointed bow and stern (Figures 263–264), and another lighter construction with a flat stern (Figure 262). The remains are of the thicker boat construction.
In 1901, Otto Nordenskjöld led the first Swedish South Polar expedition with a multidisciplinary team of researchers in geology, geography, biology and medicine. The original plan was to hibernate in Antarctica and stay for one year to survey the land, measure the climate, and collect samples, but their ship was wrecked and the expedition came to last more than two years.

Today, the remains from this expedition are protected as cultural heritage according to the Antarctic Treaty and they have been maintained by Argentinian efforts. Among five protected cultural environments, the wooden research station on Snow Hill Island stands out. Sweden joined the Antarctic Treaty in 1984 but has not actively engaged in the management of cultural heritage there until the CHAQ2020 expedition in 2020.

The fieldwork presented in this report was carried out in Antarctica with the purposes of documenting and assessing the condition of the remains and providing a knowledge base for policy and decision-making concerning Swedish cultural heritage in Antarctica.