INTERNATIONAL COUNCIL ON MONUMENTS AND SITES
CONSEIL INTERNATIONAL DES MONUMENTS ET DES SITES
CONSEJO INTERNACIONAL DE MONUMENTOS Y SITIOS
МЕЖДУНАРОДНЫЙ СОВЕТ ПО ВОПРОСАМ ПАМЯТНИКОВ И ДОСТОПРИМЕЧАТЕЛЬНЫХ МЕСТ

HISTORICAL POLAR BASES – PRESERVATION AND MANAGEMENT

This publication is compiled and edited for

the International Polar Heritage Committee of ICOMOS by :

SUSAN BARR – President IPHC

and

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MONUMENTS AND SITES
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MONUMENTOS Y SITIOS
XVII

The International Polar Heritage Committee (IPHC) is a special international scientific committee within ICOMOS. It specialises in polar (Arctic and Antarctic) heritage.

The IPHC consists of representatives appointed by ICOMOS National Committees and other experts from countries with an active polar interest. It is a non-political organisation.

ICOMOS is a non-governmental organisation of professional cultural heritage workers, which serves as an advisory body to UNESCO on world heritage matters.

The objectives of the IPHC are to:

- Promote international co-operation in the protection and conservation of non-indigenous heritage in the Arctic and Antarctic;
- Consult and co-operate with Arctic indigenous peoples regarding heritage of cross-cultural significance
- Provide a forum for interchange of experience, ideas, knowledge, and the results of research between administrators, archaeologists, conservators, historians, legislators and other professionals
- Promote international studies and projects
- Expand technical co-operation by fostering links with specialised institutions.

The International Polar Heritage Committee would like to express our thanks to:

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Front cover: The US first IPY station 1882–83, Point Barrow, Alaska. (Ray 1885)

Back cover: The remains of the first IPY station at Point Barrow, Alaska. Photo: Susan Barr 2007

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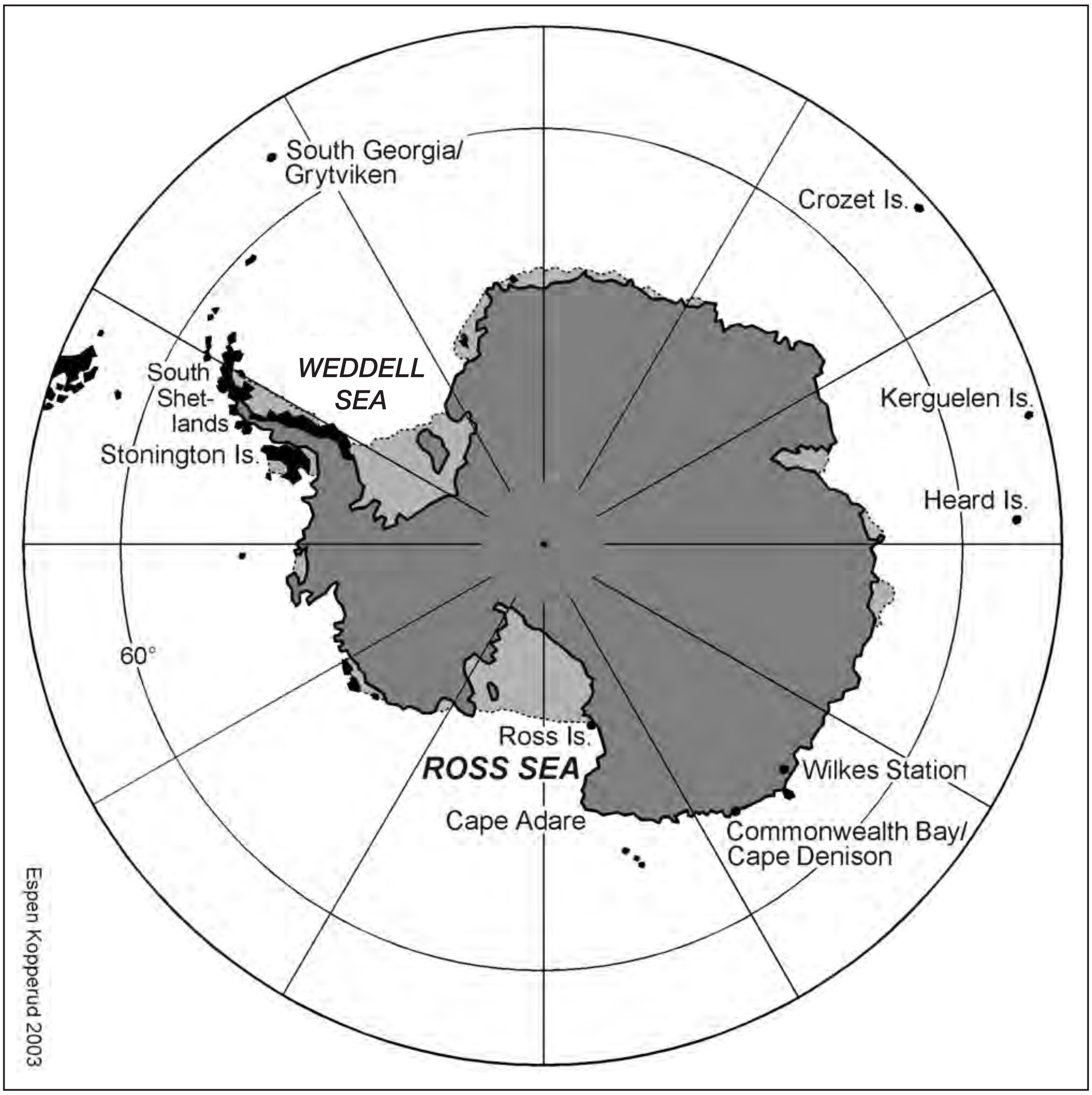
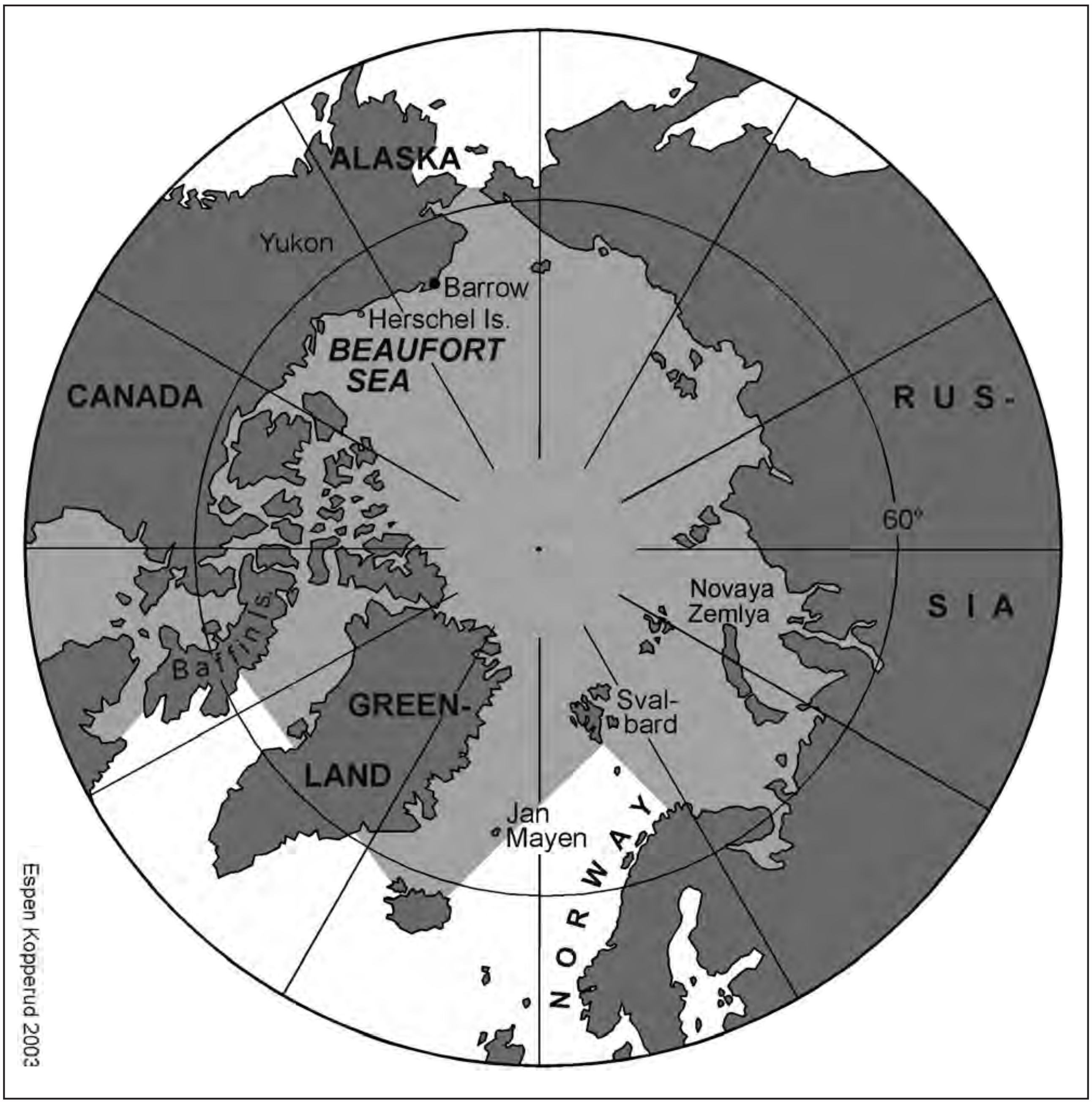
PREFACE

The conference on which this publication is based was authorised as project no. 135 of the 4th International Polar Year.



The Antarctic Region

(dark grey)	land
(light grey)	ice
(white)	sea



The Arctic Region

land

ice

sea

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INTRODUCTION

This second publication from the ICOMOS International Polar Heritage Committee (IPHC) is the result of a conference held at the Barrow Arctic Science Consortium in Barrow, Alaska 24-27 September 2007. The conference, entitled "Protection and Preservation of Historic Scientific Bases in the Polar Regions", was part of the extensive scientific programme gathered under the auspices of the 4^{th} International Polar Year (IPY) 2007-09.

The 1st IPY took place in 1882-83, followed by the 2^{nd} in 1932-33 and the 3^{rd}, actually called the International Geophysical Year (IGY), in 1957-58. These scientific events were a manifestation of the will in the scientific community to nurture and extend international cooperation over and above short-term national advancement. In a similar vein the IPHC itself was established in November 2000 to advance international cooperation within the mixed scientific disciplines of polar heritage conservation. The first three IPYs have left us tangible remains of bases and activities in the polar regions. In addition to this, science has been a noteworthy part of many expeditions to the Arctic and Antarctic, encompassing a range of disciplines stretching from cartographical mapping and investigations of natural resources to studies of geophysical phenomena and climate change. The drive to bring back scientific evidence was, for example, one of the unfortunate factors that led Robert F. Scott's South Pole party to their deaths in 1912, and Roald Amundsen's successful attempt to lead the first expedition to navigate the length of the North-West Passage in one and the same vessel also produced a major ethnographical record of Inuit lifestyle in the region at the start of the 20^{th} century.

The many historical bases that are now scattered around the polar regions have suffered various fates. From the 1st IPY there are remains ranging from scattered pieces of equipment and building parts to complete and well-preserved buildings. From both earlier and later scientific bases there is also a wide range of remains that are often the magnets that draw today's polar tourists from site to site through the southernmost and northernmost regions of the planet.

The new conference centre at the Barrow Arctic Science Consortium. Photo: Susan Barr 2007

In connection with the 4th IPY, it was natural for the IPHC to focus on the status of historical scientific bases in the polar regions today. The conference in Barrow not only promoted presentations dealing with sites ranging from the historic huts of Antarctica to the remains of German meteorological bases in the Arctic from the 2nd World War, it also gave the opportunity for conservation experts from both polar regions to discuss topics such as management, conservation techniques, accessibility and the recording and dissemination of data and information. Included in this was the unique opportunity for the conference participants to discuss directly via a video-telephone link with conservators working at New Zealand's Scott Base in Antarctica on artefacts from Scott's and Shackleton's huts. This reflected one of the main objectives of the International Polar Heritage Committee (IPHC) which is to *promote international co-operation in the protection and conservation of non-indigenous heritage in the Arctic and Antarctic.*

The old US Naval Arctic Research Laboratory facility in Barrow, now an open research centre. Photo: Susan Barr 2007

Barrow was chosen as the location for this 4th IPY conference because it was the site of a 1st IPY station and therefore very appropriate to the conference theme. In addition it has excellent facilities for scientists to work and for conferences to be held. The IPHC is indebted to our members in Barrow and staff of the Barrow Arctic Science Consortium, as well as others in Barrow who assisted us during the conference period. We are happy to record that conference participants were able to repay some of the helpfulness by holding outreach talks at various schools in Barrow and neighbouring communities. We hope that this publication will enable our conference results to reach out even further to interested readers both within the international heritage conservation community and otherwise.

Susan Barr
President IPHC

MANAGEMENT OF IPY STATIONS IN THE NORWEGIAN ARCTIC

Susan Barr

Introduction

The original idea for an extensive and internationally coordinated polar year was the visionary plan of one man – naval lieutenant Karl Weyprecht from the double monarchy Austria-Hungary. He was one of the two leaders of the Austro-Hungarian North Pole Expedition 1872-74 which never reached the North Pole, but instead discovered, mapped and named parts of the archipelago of Franz Josef Land. During this strenuous expedition it became clear to him that all the time, energy, resources and loss of life that polar expeditions traditionally represented, did not produce results that warranted the expenditure. So far the race for national honour had been most in focus. Now he felt the time had come for science to be moved into the foreground. To produce useful and epoch-making scientific results, more or less haphazard observations from one expedition in one area had to be replaced by comparable, simultaneous observations of the same phenomena observed at the same time from stations scattered all around the Arctic. Only then could the separate lists of facts be analysed to produce answers to scientific questions about "why ?".

This inspired idea resulted in the first International Polar Year (1882-83), although Weyprecht himself unfortunately died before it happened – of tuberculosis in 1881. Eleven nations joined in this huge scientific experiment, establishing 12 stations in the Arctic and two in the south – Cape Horn and South Georgia. In addition 44 existing meteorological stations worldwide agreed to make special observations to tie in with the polar year programme.

Fifty years later the project was repeated. The emphasis was still on meteorological, geomagnetic and auroral observations in the polar regions, but this time (1932-33) there was to be a more global approach and more upper air observations were to be taken. Twenty-seven stations around the Arctic were particularly involved in the programme, but the pioneering aspect was not as strong as during the first IPY and many of the stations already existed. Forty-four countries agreed to participate this time on a global basis.

The Austro-Hungarian IPY station on Jan Mayen, photographed by Charles Rabot in 1892

The third IPY, actually called the International Geophysical Year (IGY) since it was much more than only polar, took place 25 years later (1957-58) and heralded the modern scientific invasion of Antarctica. In order to cover the opposite seasons in both polar regions adequately, the "year" actually lasted for 18 months. The geophysical programme was more complicated than in the previous polar years and space technology had made its entrance. The programme was in addition even more global and many thousands of scientists and support personnel from 67 countries participated. For practical reasons, I will include the IGY within the expression "IPYs" when talking about all four.

Fifty years on again, we are now in the 4th IPY, this time lasting for two years, from March 2007-March 2009, in order to include full field seasons in both polar regions.

IPY stations in the Norwegian Arctic

The conception of International Polar Years was, as mentioned above, an Austrian idea. The Austro-Hungarian first IPY expedition chose the island of Jan Mayen (71˚N, 8.5˚W) for its 13-month stay with 14 men. Their station was specially designed and erected as prefabricated units, and functioned perfectly during the entire period. The Austrians returned to the island for the 2nd IPY, this time with only three men and a completely different practical situation. A Norwegian meteorological station had been established on the island in 1921, manned by three men, and the Austrian expedition was able to use the reserve station which was situated close to the Norwegian station for use in case of fire in the main hut. In addition they erected a small hut for earth-magnetism measurements. They kept their own household, but were able to use the telegraph facility at the meteorological station. For the IGY the normal programme of the Norwegian meteorological station was incorporated and slightly extended. There were now 10 men engaged at the station for a year at a time, including a radio-sonde team.

The archipelago of Svalbard, which lies between 74˚ and 81˚N, was used as base for Swedish IPY expeditions. In 1882 the 1st IPY expedition took over a house at Kapp Thordsen that had been erected for mining purposes in 1872 on the initiative of the Finnish-Swedish arctic scientist Adolf Erik Nordenskiöld. The house was extended, and a number of small observation huts were erected nearby. Twelve men spent the polar year here in good comfort. For the 2nd IPY there was, similar to the situation on Jan Mayen, a much smaller expedition of three men in a small hut on the mountain above the Norwegian mining settlement of Longyearbyen. The hut on Nordenskiöld-fjellet was built especially for the purpose. In addition four men stayed at the Swedish mining settlement of Sveagruvan to carry out observations, and one in Longyearbyen. For the IGY a large station consisting of 11 larger and smaller buildings was erected on Nordaustlandet (North-East Land) in the northeast of the archipelago. The station was primarily Swedish, but with also Finnish and Swiss participation. During the winter 1957-58 there were eight Swedes, three Finns and two Swiss at the Kinnvika base, while additional scientists participated during the summer season. Also during the IGY a Polish station was established at Hornsund, on the west coast of Spitsbergen, the main island in the Svalbard archipelago. The Polish arctic scientist Stanislaw Siedlecki described the station as "a typical research laboratory, and also a normal house with the same customs as are typical for every Polish home"[1]. This station has remained in Polish hands and, apart from a break in the 1960s, has gradually been developed into the modern research station it is today. Management of this station will therefore not be included in this paper.

It can be mentioned in addition, that a Norwegian station was established in Dronning Maud Land, Antarctica for the IGY. This station was in use 1956-60, before it was turned over to South Africa for their use. "Norway Station" has long since disappeared under the ice.

The cultural heritage regime in the Norwegian Arctic

Before 1974 very little attention was paid to cultural heritage management in the Norwegian Arctic territories of Svalbard and Jan Mayen. The main reason for this was the fact that these areas were not particularly exposed to human impact apart from in specific, limited areas. In 1974 the first regulations were passed which automatically protected all fixed and moveable heritage that pre-dated 1900. This date was chosen fairly randomly, and it was replaced in Svalbard by the cut-off year 1945 (pre-dating 1946) with the new Svalbard Environmental Law which came into effect in 2002. Jan Mayen is still awaiting updating of its cultural heritage

[1] Swerpel 1985:52.

The IGY station at Kinnvika was erected with sufficient space between buildings to prevent any fires spreading, which would have been disastrous. Photo: Susan Barr 1985

regulations, and this is planned to take effect in 2008 in connection with the island being given protected status.

Svalbard's cultural heritage is managed by the Governor of Svalbard, with the Directorate for Cultural Heritage as supervising institution. For Jan Mayen, the Directorate has the direct responsibility for the cultural heritage management. The Directorate is part of the Ministry of the Environment, which is an advantage for the Norwegian arctic heritage since nature and cultural heritage are so intertwined in the polar regions.

Common for these, and other arctic regions, is the fact that the cultural monuments and sites are very international – they have their origins in many countries in addition to the current nationality – and good management thus requires an understanding of the implications of having custody over the heritage of other nations.

Management of IPY stations on Jan Mayen

Jan Mayen is an arctic island which has been part of the Kingdom of Norway since 1930. The cultural heritage regulations from 1974 put the year 1900 as the limit for automatic protection of cultural heritage. The 1st Polar Year station, known as Østerrikeren (The Austrian), was therefore protected from 1974, whilst the 2nd IPY station was not. As it turned out, this made very little difference. A new, updated law has been drawn up by the Norwegian Directorate for Cultural Heritage and is expected to be adopted in the course of 2008. This follows the Environmental Law for Svalbard with pre-1946 as the cut-off date for automatic protection.

In fact there is little left of both IPY stations today to manage and protect. The 2nd IPY station, which was the reserve hut of the Norwegian meteorological station, was destroyed in September 1940 when the personnel of the meteorological station were evacuated to Britain and the station was put out of action to prevent a German takeover. Mainland Norway had been occupied by a German invasion force in April that year. From the 1960s there were occasional calls to "clean up" the site of the destroyed station, but only dangerous materials such as batteries and ammunition from the Norwegian garrison which held the island from 1941 were removed. Probably anything that was regarded as a souvenir disappeared too. Today the ruins of the meteorological station are treated as protected, and will be once the new law is adopted.

When "Østerrikeren" was legally protected by the regulations of 1974, it was already somewhat late. The large station was left in good order in 1883 and from 1906 it was used by occasional wintering trappers from Norway, even though it was described by a visiting ship in 1900 as already in a bad state of repair. By 1926 the buildings were considered unusable, although the 2nd Austrian IPY expedition in 1932 noted that the main building was not too bad. The final thrust came in 1940-45 when the Norwegian garrison on Jan Mayen used the remains of "Østerrikeren" to build various observation posts, canon positions and defence trenches.

So today the two IPY stations on Jan Mayen consist of ruins of building foundations with assorted materials and remains of which many are from later periods. Nevertheless, they still contain a certain amount of original information about siting, building materials, the natural process of deterioration in such an area, and the impact of human activity on cultural heritage. In addition they represent the invaluable experience of historical remains that can be viewed in situ.

Management of these sites in later years has first and foremost been to secure them legal protection, and this will hopefully be in place for both in the course of 2008. The sites have been reasonably protected by

The remains of these buildings at "Østerrik-eren" nearest the sea have been destroyed by wave erosion in the last few years. Photo by the IPY expedition 1882-83 from Barr 2003.

The remains of "Østerrikeren" can be seen near the base of the slope in centre picture. To the left the eroded edge of the site. Photo: Susan Barr 2007

the fact that Jan Mayen has been a difficult place to visit and tourism has been very restricted. This is changing as international arctic cruise activity develops, but the new protection regime will provide a strong measure of control and sanction. A greater threat for "Østerrikeren" right now is the increasing erosion of the coastal side of the site as less sea ice and more wind and wave action eat away at the loose lava sand. A couple of the outbuildings that are clearly seen on a photograph from 1883 have been washed away in the last few years and this natural process is impossible to curb. The main area of the station is luckily less exposed and should survive for some time to come.

Management of IPY stations in Svalbard

This high arctic archipelago, of which Spitsbergen is the largest island, has been Norwegian since the Treaty of Spitsbergen was ratified in 1925. With the new Environmental Law for Svalbard from 2002, which raised the cut-off year for automatic protection to pre-1946, the 1st and 2nd IPY stations in Svalbard are protected, while the IGY station at Kinnvika is not.

The 1st IPY Swedish base at Kapp Thordsen on Spitsbergen is a large house by the usual standard of 19th century buildings in Svalbard. As with most of the remaining historical buildings in the archipelago it is a timber frame and panelled construction with the roof waterproofed by tarred felt. After 1883 it was used by trappers and occasional other visitors, without any particular maintenance. A hundred years after the IPY, in 1982, it was still in basically good condition, but one of the corner walls between the main section and an additional wing had collapsed and there was decay of part of the roof. This author was responsible at the time for Svalbard's cultural heritage and organised a successful restoration of the walls and roof, leaving the building in a solid condition once again. In later years the gradual sliding of damp earth and turf from the slope behind has pressed against the back wall of the house and caused rotting and deterioration of the lower boards of the wall and the wooden box foundation pillars. Maintenance and restoration work has been carried out in several rounds by the Governor of Svalbard's cultural heritage section. This has consisted of replacement of rotten timber, but in as limited an extent as possible. Where only parts of a board have been rotten, new parts have been added by lasking to the existing whole wood. The building has a high priority status on the plan for cultural heritage sites and monuments in Svalbard and will be maintained in good condition also for the future.

The Swedish base in 1932-33 was a much smaller building and was manned for the 2nd Polar Year by three men. It was built on Nordenskiöld-toppen, the highest mountain (1050 m) around Longyearbyen. The cabin's construction was unusual for Svalbard: it was composed of walls and roof of galvanized sheet iron with insulation mats between the inner and outer walls. Fifteen tons of equipment had to be hauled up the mountain

The IPY base at Kapp Thordsen, "Svenskhuset", in 1982 just before restoration work began. Photo: Susan Barr

"Svenskhuset" with new roofing and the walls restored. Photo: Susan Barr 1987

The main building and living accommodation at the Kinnvika station. Photo: Susan Barr 2006

by dogsleds in order to establish the station. The building still stands today and is used as an emergency shelter. It experiences extreme winter conditions and occasionally suffers snow and ice damage, but apart from normal maintenance, it has not been given any special priority as a cultural heritage monument. Its use today ensures that it is kept in reasonably good condition and its protected status ensures that it is not purposefully destroyed or changed.

From a management point of view the 1957-58 IGY station at Kinnvika is currently the most interesting. This author has for some years been concerned with the fact that the station is a prime – but unprotected – example of classic historical scientific arctic bases. It has remained almost unused since the end of the IGY activities, apart from the fact that the station area has been "cleaned up" with the removal of most of the non-fixed heritage objects such as antenna masts, oil drums and tracked terrain vehicles (one was later returned). In connection with the 4th IPY, there have been renewed scientific activities at Kinnvika and this gave the impetus to initiate the process which will afford protection by decree to the entire station complex and its surroundings. The Governor of Svalbard has announced the start of this process, meaning that the entire station must be treated as already protected whilst the process is run. Once this is in place, a management plan will have to be drawn up to tackle the maintenance of the 11 buildings. The buildings are solidly built and have withstood the harsh climate well, but there is a problem of fungal growth and some rotting, particularly in the large main building which has mostly been kept boarded up through the years. The authorities see it as an advantage if the building could be restored and used carefully in the future.

The 4th IPY in Svalbard

The current IPY 2007-09 has produced a flurry of extra scientific activity in the established research bases of Ny-Ålesund and Hornsund in Svalbard. It has been mentioned above that the Polish station at Hornsund was established for the 3rd IPY, or IGY, and has been considerably developed since. This historical scientific base has therefore never been considered for special heritage protection.

Ny-Ålesund is another matter. It was established as a coal-mining settlement at the beginning of the 20th century and continued to be developed as such until a large explosion in the mine in 1962 stopped all activity. It was not politically feasible at the time to abandon the settlement, and science and research gradually took over. The settlement has been designated by the Norwegian government as the main research centre in Svalbard and so far nine countries have permanent bases in the settlement, including China, Japan, the UK, South Korea and Germany, while several other countries have ongoing research activities. The impetus of the 4th IPY has considerably increased the amount of scientific projects and activities.

Ny-Ålesund is not protected as a scientific base, but 29 of the buildings in the settlement are automatically protected by law since they pre-date 1946. They are all connected to the previous coal-mining activity. Ny-Ålesund is thus the largest collection of protected buildings in Svalbard. Because of the steadily increasing research activities, the buildings are under pressure to be developed for modern standards and usages. It has been in the interests of all concerned to reach agreement on the heritage values of each of the protected buildings and the degree of protection to be accorded to the interiors as well as the exteriors. After a successful joint process, the heritage management authorities and the Ny-Ålesund management are in the finishing stages of completing the management plan for each of the 29 protected buildings as well as for the settlement as a whole. The plan places each of the protected buildings in one of four categories, which indicate whether the interior and exterior must be kept unchanged, the interior may be carefully adapted for light use, the interior may be carefully adapted for year-round activity, or the interior may be freely adapted. In all cases the exteriors are to be kept as authentic as possible.

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Ny-Ålesund in Svalbard, an historic coal-mining settlement turned international research centre and the site of much 4th IPY activity. Photo: Susan Barr 2007

Conclusion

The four International Polar Years created a large number of specially-constructed scientific bases. Many of these have disappeared or have left only faint traces. The Norwegian Arctic is relatively rich in IPY bases and has a strict management policy which affords both protection and maintenance where the latter is still feasible. The state of the bases today ranges from archaeological remains to a complex station of 11 buildings. In addition to the management aspect, the bases also provide both interesting objects to experience, but not least also material for studies of types, functions and the development of such scientific bases through the 125 years between the 1st and 4th International Polar Years.

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German Meteorological Stations in Northwest Svalbard

Cornelia Lüdecke

The Mitra Peninsula in north-western Spitsbergen (Svalbard) contains the densest site of historical German meteorological stations in the high Arctic. These are described below.

German Geophysical Observatory (1911-1914)

In the northwest corner of Svalbard, Virgohamna has become a well-known site from various attempts to fly to the North Pole. The Swede Salomon August Andrée (1854-1897) tried with a balloon in 1896 and 1897 and the American Walter Wellman (1858-1934) was also unsuccessful in using the recent invention of airships in 1906, 1907 and 1908. These adventurous expeditions attracted a lot of polar tourists to watch the prep arations and launches, and also initiated some discussions about meteorological conditions for the planned flights (Eckholm 1898).

One of the inventors of airships, Graf Ferdinand von Zeppelin (1838-1917) had the idea of using his zeppelin for exploring the Arctic by air, with the idea that there still might be a lot of islands to discover (Miethe und Hergesell 1911). Working together with the leading German aerologist Hugo Hergesell (1859-1938) and Prince Heinrich von Preußen (1862-1929), Zeppelin organised the Zeppelin Study Expedition to the west coast of Spitsbergen in 1910 to carry out a feasibility study. They tested anchoring manned balloons and looked out for a good starting point for zeppelins. In the end, Hergesell advised the establishment of an aerological station for the investigation of the meteorological conditions of the upper air (Hergesell 1914). Not least, too little was known about the development of fog or icing on the top of the zeppelin in the first 1000 m above ground, where flights should take place.

The following year, Hergesell equipped the first permanent manned geophysical observatory, at Hotellneset close to Longyear City (today by the Longyearbyen airport), where the Germans could use a house from the Norwegian Arctic Coal Co. (Remp und Wagner 1914). When the four staff members of the observatory were to be relieved by the next group, the ice-covered Isfjord did not allow any access to Longyear City. Due to this the new observatory was built at Ebeltofthamna on the Mitra Peninsula close to the mouth of the Krossfjorden. This meteorological station was in action with annual new personnel for two consecutive years (1912-1914) until the outbreak of World War I (Wegener 1914, Dege 1962). Today nothing other than a roll of

Roll of piano wire for captive balloon ascents at the site of the German geophysical observatory at Ebeltofthamna in 2000. Photo: Cornelia Lüdecke piano wire for captive balloon ascents reminds us of this important era (Fig. 1). It is said that in 1915 the huts were removed to Ny-Ålesund, the coal-mining settlement nearby, a usual thing to do in a region where no trees are growing.

German marine weather stations (1941-1943)

When Germany was operating in high northern latitudes during World War II, meteorological information was crucial, but foreign weather data was no longer available. Thus all information about weather conditions west and north of Germany had to be gathered by German meteorologists. Weather flights to the Far North started from Banak and Trondheim in Norway (Kington and Selinger 2006). The next step was the establishment of a weather station in Svalbard in the end of summer 1941. It was named *Knospe* after the expedition leader Hans-Robert Knoespel (died 1944) and built for six people at Signehamna (Lilliehöökfjord close to Lilliehöök glacier) (Selinger 2001). In winter the prefabricated construction of the accommodation hut (6 m x 8.35 m) was perfectly hidden under a snow cover (Fig. 2). The main task of the meteorologists had been the release of radio-sondes to measure the meteorological conditions of the upper air and the transmission of the data to the nearest German receiver at Tromsø. For filling the balloons they had a lot of bottles with hydrogen, but later, when these were used up, they produced the gas at the station themselves.

Station *Knospe* in October 1941 (Selinger 2001:70).

However, just in case of discovery during summer, the group set up some tents as a summer station hidden in the mountains of the Mitra Peninsula. Further provisions and rubber boats for a fast escape in case of emergency were placed at various locations towards the open sea.

Before the next wintering group of meteorologists came, an automatic station WFL 21 *Gustav* was installed close to the landing site during summer 1942 to bridge the gap of the unmanned station by transmitting meteorological surface data to Tromsø (Fig. 3) (Selinger 2001).

During the next year station *Knospe* was occupied by a new group of meteorologists led by Franz Nusser (1902-1987), which worked under the cover name *Nussbaum* (1942-1943). When the winter station of *Nussbaum* was discovered by the Norwegians just by chance in summer 1943, it was totally destroyed and only debris reminds us of the scientific work done there. Nowadays the *Nussbaum* site is characterised by barrels for liquid fuel, generators, various tools, and equipment of the accommodation hut (Fig. 4) (Lüdecke 2001).The summer station of 1943, now consisting of a living hut (3.75 m x 2.65 m) and a radio transmission hut, experienced the same fate, but due to its remote location the debris is still in place. Today you can still identify the four corners of the hut, a destroyed weather screen, and the equipment for hydrogen production for the radio-sonde ascents. The rusty buckets are still there filled with caustic soda and aluminium gravel (Fig. 5).

Additionally there are various sites of rubbish originating from two years of occupation. The little radio transmission hut (3.60 m x 1.95 m) had been built on a small artificial plateau at the slope just below the site

Batteries of the destroyed automatic weather station WFL 21 *Gustav* at Signehamna in 2006. Photo: Maria Ufer.

Site of the marine weather station *Nussbaum* in 2000. Photo: Urban Wråkberg.

Chemical remnants at the summer station of *Nussbaum* in 2000. Photo: Urban Wråkberg.

of the living hut. Technical equipment for radio transmission, a registering meteorological instrument, rubbish, and artefacts used for living are scattered around and tell us a lively story of its occupation.

Further actions to do

The more remote emergency depots, other equipment and rubber boats were sited in the landscape in their time, the more untouched the debris still in place is today. The remains of the German marine weather stations provide us still with a very good insight into details of how they were organised and how they worked with a wide distribution of activities.

Architectural plans and sketches of the stations as well as lists of equipment and historical pictures are available in archives, personal collections and in Franz Selinger's publication (Selinger 2001). The Mitra Peninsula is an outstanding place for the reconstruction of meteorological activities at *Knospe* / *Nussbaum*. There is even still new material available concerning the geophysical observatory at Ebeltofthamna (Steinhagen DACH 2007). Both places are close to each other and related, because staff members of both stations explored their surroundings on the inner Mitra Peninsula. In addition, since 1998 Germany is maintaining a modern research station close by at Ny-Ålesund, Kongsfjorden.

The historical sites at Ebeltofthamna and Signehamna are highlights easily accessed by tourist cruises in Svalbard. Proper information on the importance of these scientific stations and the extraordinary spirit of the place are missing. A thorough archaeological investigation of these places as well as of two other marine weather stations further to the north (*Kreuzritter*) and north-east (*Haudegen*) in combination with socio-cultural and historical information has to be done, to preserve them as German polar heritage (Lüdecke 2005).

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Bio-deterioration in buildings in Svalbard (Spitsbergen)

Johan Mattsson and Anne-Cathrine Flyen

Introduction

Bio-deterioration in wooden buildings is normally restricted by the physical conditions: mainly sufficient access of water and favourable temperature (Domsch et al., 1980, Rayner & Boddy, 1988). When the conditions for growth are present, it is only a matter of time before the decay is so extensive that repair or even replacement has to be done. Based on both long field experience and laboratory tests, knowledge of where the critical constructions in a building are is well established. Furthermore, the rate of bio-deterioration in different constructions with regard to decay (Mattsson 1995) and mould growth (Samson et al., 2002, Mattsson 2004) is relatively well known.

In situations where the physical conditions apparently are a significant restricting factor for bio-deterioration, it is expected that no decay would appear. This opinion has been the case for the built cultural heritage in Svalbard, where the polar climate seems to be an obvious guarantee for protection of wood against bio-deterioration.

However, by field work in cooperation with the Governor of Svalbard during 2003 and 2004, it has been shown that some of the cultural heritage in Svalbard is suffering from severe decay caused by brown-rot fungi (Mattsson 2003).

Svalbard

Svalbard (Spitsbergen) was an international "common ground" until 1925, when it became part of Norway. People from many countries have used this arctic archipelago in a variety of ways for over 400 years – there are no signs of any aboriginal occupation – and Svalbard's cultural sites and monuments are regarded as international heritage. It was a place for seasonal occupation, and most inhabitants based their livelihoods on the exploitation of natural resources, with fishing, hunting and mining as the principal activities. Permanent settlements were first established in the early 20th century, when Norway and Russia started to carry out large-scale coal mining

The environment is unrelentingly hostile; wind, water, rot and scavenging polar bears can wreak havoc on old buildings, and may erase them from the landscape very quickly.

Structures and sites and movable historical objects in Svalbard are protected and safeguarded as a part of Svalbard's cultural heritage and identity and as an element of a coherent system of environmental management. All kinds of man-made structures and sites dating from 1945 or earlier are protected by law and considered as cultural heritage.

Materials and methods

Buildings

Spread around the coast are many hunting cabins mostly dating from the beginning of 20th century. Originally they were built to last a year or two, but quite a lot of them still hang on. The buildings consist mainly of wooden materials and they are constructed in an unsophisticated way, with uninsulated walls and the floor beams directly on the soil. The walls and roof of the cabins are uninsulated, but covered by dense bitumen felt.

Five buildings were investigated. Four of them were old hunting cabins (*Gnålodden*, *Hyttevika*, *Konstantinowka* in the southern part of the island of Spitsbergen and *Laxebu* in the northwesten part of Spitsbergen close to the research settlement of Ny-Ålesund), while one was a former office building in Long-

Laxebu, May 2004. Photo: Johan Mattsson

yearbyen (*Transporten*), which had been standing empty and unheated for several years. All of the buildings are located close to the sea.

Monitoring device

Climatic conditions (temperature and relative humidity) were measured temporarily and to some extent for longer periods.

The microclimate was monitored for short periods in some selected areas in the buildings. In access, the monitoring of temperature and relative humidity was done with a Rotronic Hygrolog. The measurements were done twice every hour for eight months.

Survey

The survey was carried out during two periods; December 2003 and May 2004.

Sampling – materials and air

54 wooden samples and 69 tape lifts were taken for microscope analysis. Furthermore, sterile wood samples of spruce were placed both outdoors and inside the buildings for exposure during two summers.

Sampling of viable mould spores were done by a MicroBio (a version of Anderson one-stage sampler) that collected the fungal spores in 100 liters of air on an agar plate. In order to yield both fungi that grow at high water activity and species that grow on low water activity two media were used (MEA and DG 18). A total of 78 air samples was taken.

Analyses

The analysis of the samples was done in light microscope, up to x1000 magnifying. Samples of viable mould spores from the air were analysed by counting the number of colonies after 7 days of cultivation at 22 °C. The species were then identified by light microscope.

Results

Climate

Meteorological data (Statistics Norway) shows that the average temperature and precipitation through the last 30 years has been -6,7 ºC and 190 millimetres at Longyearbyen and -6,4 º Cand 385 millimetres at Ny-Ålesund.

Microclimate

The microclimate was monitored for short periods in May 2004 in some selected areas in the buildings. The temperature was correlated to the sun exposure, where the direct sun radiation raised the temperature from few degrees Celsius above zero up to 45 C.

Building survey

The survey consisted of a visual control of surfaces. Furthermore, there was a simple measurement of moisture content in wood and temperature on surfaces.

The survey showed that there were three sources for the moisture problems: high relative humidity/ condensation, leakages and water from the ground. The most extensive problem was caused by the humidity in the ground. Both due to melting of snow and permafrost, the floors and lower part of the walls were standing wet for long periods. Furthermore, it has been common to cover the lower part of the walls with soil in order to insulate and increase the temperature indoors. As long as the soil is frozen, it does not cause any moisture problems. However, during summer months, the upper part of the soil is thawing and the water is penetrating into the walls where fungal growth can occur.

Mould fungi

Both wood that had been exposed for several years and wooden samples that had been exposed outdoors for two summers showed a clear growth of mildew fungi, mainly *Aureobasidium pullulans*.

The air-tight constructions had caused problems with high relative humidity and condensation. The result was extensive mould fungi on several surfaces. The most common species that were found are in the genera *Cladosporium*. The extensive mould damages cause a discolouration and a poor indoor air climate in the buildings.

Decay fungi

The survey and sampling showed an extensive occurrence of wood-decay fungi in connection with the wooden constructions. In the 54 wooden samples, the species *Leucogyrophana mollis* was found in 34 cases. *Coniophora puteana* was found in two samples and a species in the family *Corticiaceae* in one sample. Soft-rot was found in 29 samples.

New wood samples that were placed on already decayed wood, were visibly attacked by *Coniophora puteana* within one year.

In an earlier analysis of samples from building materials taken at other places at Svalbard, we found

Left: Extensive growth of *Coniophora puteana* is caused by moisture from the ground.

Under: Mould growth on surfaces inside the hunting cabin. Both photos: Johan Mattsson

the occurrence of *Antrodia serialis*, *Columnicystis abietina*, *Cylindrobasidium evoluens*, *Dacrobolus sudans*, *Ditiola radicata*, *Gloeophyllum sepiarium* and *Hyphoderma setigerum*.

Discussion

Bio-deterioration

For access to cellulose, wood-decaying fungi need an excess of water and a favourable temperature for growth. The moisture content in wood has to be at least 20% and the temperature over +3-4 °C. Optimum temperatures are for most of the fungi species around 20-25 °C. At higher temperatures the activity declines and the lethal limit is normally at 40 °C or higher.

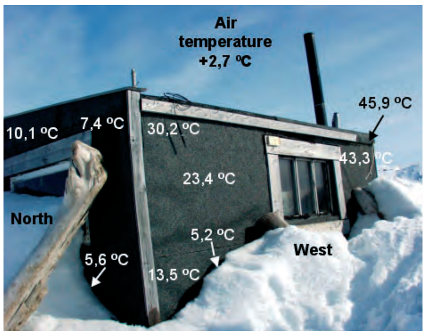
Due to low temperatures and dry conditions caused by low yearly precipitation in the Svalbard area, it is traditionally regarded to be an area of very low risk for bio-deterioration caused by fungi. For that reason, wood is expected to have a long service life in the buildings in this area.

Despite the tough climate conditions in Svalbard, it has been proven that bio-deterioration is an extensive problem in the old wooden buildings. This can be explained by the favourable conditions in the local microclimate in materials and constructions, which could be described as a “mycoclimate”. In this very restricted area fungal growth can occur during favourable conditions. The fungi are inactive during the winter, but in the summer they grow for long periods and cause extensive decay. The rate of bio-deterioration is surprisingly fast considering the fact that the buildings are in an extreme harsh climate and there is no heating. The growths of both mould fungi and wood-decaying fungi have been shown to be almost as fast as in the temperate climate in the southern part of Norway.

The problem with the bio-deterioration is both the decay of the building materials and a bad indoor air climate. This causes problems with the practical repair work, because replacement without improving the construction with regard to protection against further moisture problems, will lead to new damage in the short term. The aspect of climate change will also have a direct influence on the future bio-deterioration.

Local variation of damages

Every building had an individual pattern of the appearance and distribution of damage. This can be illustrated by showing the damage at *Transporten* and *Laxebu*.



Variation of temperature on north and west faced walls on Laxebu. Photo: Johan Mattsson

The former office building (*Transporten*) had several structural damages. The damage was most extensive at the lower part of the external walls, where the cladding and structural elements were decayed by brown-rot fungi. The building was originally constructed on pillars, so both the floor construction and the walls were protected from soil contact. However, later addition of soil up against the walls in order to gain a warmer floor and walls during winter time, created favourable growth conditions for bio-deterioration. The damage had developed through several years, mainly due to a combination of wet soil against the walls and lack of maintenance.

The damage at the hunting cabin (*Laxebu*) was also mainly in the floor construction and lower part of the walls. The reason for this was the contact with wet soil and melting snow during summer time. Wooden materials outdoors had some local decay inside the materials, where the microclimate had partly good growth conditions for brown-rot fungi. A leakage in the roof had led to a local, but extensive brown-rot damage caused by *Coniophora puteana* in the roof construction.

Furthermore, due to the use of dense bitumen felt on walls and roof, any water that enters the building can hardly be ventilated out again. Under such conditions, mould growth has been occurring on different surfaces. The mould damage causes a significant poor indoor air quality in the cabin – which could have practical and health implications for any visitors.

The covering of walls and roof with bitumen felt was a tradition in order to create an air-tight construction. This was done in order to achieve comfortable conditions for the user of the cabin through the few years the building was supposed to be in service. Due to the air-tight conditions and dark colour on the surfaces where the midnight sun can heat the building, conditions for bio-deterioration are much better then expected in the arctic climate.

Origin of the occurring fungi

The species that were found had not previously been reported to be growing in Svalbard. Moreover, their natural substrates are lacking in this area. At the same time these species are commonly found in temperate forest areas and in buildings on the mainland of Norway. As the amount of spores from wood-decaying fungi normally is of a low number in air sampling, we assume that the contamination probably mainly had occurred before transport and exposure in Svalbard.

The reason for a rapid contamination of wood-decaying fungi in new wood samples is because the samples in those cases were placed in direct connection with already established wood-decaying fungi.

Sampling of viable mould spores in the air showed a dominating occurrence of species in the genera *Cladosporium* and *Penicillium*. Spores from these genera are commonly found in air samples all over the world, also in the outdoor samples that were taken in Svalbard.

Sterile wood samples were placed outside and indoors at the investigated buildings. Already after one year of exposure outdoors in Svalbard, there was a clear growth of mildew fungi (mainly *Aureobasidium pullulans*). Samples with mould fungi inside the buildings were mainly caused by species in the genera *Cladosporium* and *Penicillium*.

This shows that ordinary mould species are growing on plants and in the soil in Svalbard, and that contamination and germination on materials outdoors occurs at site. The contamination of new materials indoors is more likely caused by local sources of already established damage on other materials.

Water sources

Growth of fungal attacks is dependent on a suitable combination of temperature and moisture content in the wood. The water is introduced by different means; leakage, thawing of the permafrost and snow, rain, fog, high relative humidity and condensation. Humidity from use of the buildings might also be a source. However, due to a very restricted use of the investigated buildings through many years, this source is of minor importance.

The pattern of the established fungal attacks that were found, showed that the external growth of mould fungi (= mildew fungi) is depending on the time of wetness (TOW) in the wood that is mainly caused by rain, and to some extent a high relative humidity.

Inside the buildings, the growth of mould fungi was caused either by condensation or water from the ground. The wood-decaying fungi were growing due either to leakage or to water from the ground.

Growth and decay occur surprisingly fast

Despite the general aspect of very unfavourable growth conditions in Svalbard, it has been shown that bio-deterioration can develop surprisingly rapidly. New establishment and growth of both mould fungi and wood-decaying fungi are proven to be happening in just one year. The estimate of rate of growth of damage is that it might occur at about the same rate as on the Norwegian mainland – where the general growth conditions normally are regarded to be significantly better.

The situation can be explained by several reasons. First of all, due to the midnight sun, there can be long periods (weeks and months) with good temperatures. Furthermore, the access of water during the periods of favourable temperatures in many cases is not a restricting factor – especially not in the lower part of the buildings, where the melting snow and thawing of permafrost has great influence on the water content in the wooden materials.

Preventive work

The mould fungi cause some discolouration of surfaces and might cause some degradation, mainly to easily available cellulose, i.e. paper, and other organic materials like textiles. Removal of mould fungi does not have to be done in order to save the building materials, even if the other materials inside the buildings might be damaged. If it is desired to secure an acceptable indoor air climate in the buildings, the mould fungi have to be removed.

Wood that is considerably decayed by fungi should be repaired or replaced in order to ensure a further long service life for the building.

Preventive work should be done in order to avoid further bio-deterioration. Because the buildings in Svalbard that were erected before 1946 are protected by law, the methods and extent of this work have to be considered in every single case.

It is not known in detail what preventive measures that might have the best effect against further bio-deterioration, but in general the following efforts should be considered:

- Stop leakages
- Removal of soil against the walls

More detailed monitoring has to be done:

- More thorough registration of established fungi.
- Use of sterile wood samples in order to find out how fast contamination and growth are.
- Continuous monitoring of temperature and humidity both before and after repair work and possible change of exposure to be done.
- Clarifying the effect of different measurements is of crucial importance in order to prevent further bio-deterioration. This has then to be discussed in order to figure out what measurements are acceptable.

Climate changes

Very local microclimate ("Mycoclimate") is of most importance for bio-deterioration of wood in Svalbard. Already with the existing conditions, bio-deterioration is proven to take place to some extent. Climate changes can cause higher average temperatures and longer periods with favourable growth temperature. It can also cause more humid conditions due to thawing of the permafrost, more precipitation and higher relative humidity.

What is the future for arctic building heritage?

The situation for the investigated buildings is severe with respect to the established bio-deterioration. If nothing is done, the consequences will be serious in few years. Both restricted and more extensive efforts can prolong the service life of both building materials and the buildings themselves. However, a principal discussion has to be taken in order to find out what extent the future work should have.

Conclusion

Bio-deterioration in Arctic regions has earlier been regarded to be almost a non-existing problem due to extremely low temperatures and dry conditions. The maintenance and administrative handling of the cultural heritage in this region has to some extent been influenced by this opinion.

However, our research has shown that the microclimate in both materials and constructions can be favourable for biological activity. This gives serious problems with both mould growth and decay caused by brown-rot fungi. The damage has been shown to be more extensive than earlier expected. Commonly found fungi are the same species as found in temperate regions.

The results imply a need for modification of both administrative routines regarding management and practical work with maintenance and repair work of culture heritage in Arctic areas. In case of any climate change, the warmer and wetter conditions will give even better growth conditions for fungi. This situation is of crucial importance for the future of the cultural heritage.

Hopefully future research and practical investigation can give important and useful information for understanding and executing the future management of the culture heritage in Svalbard.

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Northumberland House, Fort Conger and the Peary Huts in the Canadian High Arctic: current condition and assessment of wood deterioration taking place

Robert A. Blanchette, Benjamin W. Held and Joel A. Jurgens

Wooden structures built in 1852 during the Franklin rescue expedition on Beechey Island (74°43'N, 91°54' W) and by American expeditions led by Adolphus Greely (1881) called Fort Conger (one of the first International Polar Year stations) and Robert Peary (1900) on Ellesmere Island (81° 44' N, 64°44' W) are deteriorating. Since little to nothing is known about the agents and processes involved with wood degradation in the Arctic, an assessment of the biological and non-biological degradation processes found at the sites, evaluations of the current condition of the wood and environmental monitoring over a 2 year period is reported. Wind erosion and salt defibration of the wood were types of non-biological degradation found. In addition, advanced decay by wood-destroying soft rot fungi was evident in all structures. Molecular characterization of the fungi causing decay indicated that they are a unique group of polar fungi with the capacity to survive extreme environmental conditions and cause significant degradation. Warming trends in the Arctic will undoubtedly increase degradative actions by these organisms and accelerate decay of the historic woods. Information on the various agents causing wood deterioration and decay at these historic sites and a better understanding of how degradation processes take place in the Polar environment can be used in management plans to help preserve this Arctic cultural heritage.

Introduction

In 1852, Sir Edward Belcher led a squadron of five ships in search of the lost expedition of Sir John Franklin. During the expedition a wooden shore depot of supplies was erected on Beechey Island by the crew of the *North Star* under Commander W. J. S. Pullen. This building, called Northumberland House, represents some of the oldest introduced wood in the Canadian High Arctic. The building was still intact during a visit by the Captain Allen Young in the *Pandora* in 1875 (Young 1879) but deterioration has taken a significant toll on the structure and only ruins currently remain of the original building and contents. In addition to Northumberland

The remains of Northumberland House at Beechey Island built in 1852 by members of the Belcher squadron during a Franklin rescue expedition. Photo: R.A. Blanchette

House, graves from the Franklin expedition, monuments erected as memorials and several caches can be found on Beechey Island and add to the historic significance of the site (Phillips 1985).

A United States army expedition to the Arctic in 1881-1883 led by Adolphus Greely was part of an American contribution for the first International Polar Year activities. The expedition established Fort Conger at Lady Franklin Bay in northern Ellesmere Island. A very large wooden structure was built to house 26 members of the expedition during their exploration and scientific investigations. Unfortunately, relief ships carrying food supplies did not arrive and Greely was forced to abandon the Fort and head south in small boats. After an arduous journey and long periods of starvation at an improvised camp, only 6 survived and were rescued. Although the expedition ended in disaster, a large amount of scientific information was obtained and published (Greely 1886, 1888).

Fort Conger was a massive structure that was 18 m long, 5 m wide and had a 3 m high ceiling. It took enormous amounts of coal to heat the structure and was not well suited to the severe arctic environment. Robert Peary, who made many expeditions to the Arctic from 1890 to 1909, decided in 1900 to use Fort Conger as a wintering base. Robert Peary considered Fort Conger to be "a great barn of a structure … grotesque in its utter unfitness and unsuitableness for polar winter quarters" (Peary 1917) and his crew of Mathew Henson, Dr. T. S. Dedrick and several Inuit dismantled most of Fort Conger and erected several small wooden shelters. The igloo-sized shelters were 2.5 to 3 m long and 2 to 3 m wide and were built low into the ground (Dick 2001). The huts were connected by a series of canvas covered passageways that became covered with hardened snow. Instead of a wooden hut, Peary decided to build a tent dwelling for his own living quarters that was covered by mattresses from Greely's Fort. Snow and ice was used to cover the tent and mattresses, providing a solid layer of insulation. Subsequent expeditions by American, Norwegian, Danish, and British/Canadian expeditions in 1915, 1920, 1921, and 1935 also used the structures and supplies left at the site. Today, Peary's tent cannot be found but the wooden structures and many other materials still remain at the site. The huts and wooden artifacts, however, are in various states of deterioration.

Wood in the polar environment is not free from degradation and these important historic wooden structures in the Arctic have suffered serious deterioration. Many forms of degradation continue to attack and cause significant losses. This report provides needed information on the current condition of the historic woods and gives new details on the destructive degradative processes occurring in wood at these Arctic sites. This work was carried out under Scientific Research License numbers 0100501 and 0201102R-M from the Nunavut Research Institute and permits QQ-01-01 and QQ-02-04 from Quttinirpaaq National Park, Parks Canada.

Northumberland House

Large quantities of wood from the Northumberland House structure remain at Beechey Island and are protected as part of Canada's National Historic sites. Although only a partial wall of the building is still standing, large

Wall boards, posts and various wooden artifacts associated with Northumberland House. This wood at Beechey Island is some of the oldest wood introduced into the Arctic by European explorers. Extensive decay is present in the wood and decay fungi are actively causing degradation. Photo: R.A. Blanchette

An illustration of Fort Conger as it appeared in 1881 (from Greely 1886). The structure was built by a U.S. army expedition led by Adolphus Greely and served to house the men and act as a research station during the first International Polar Year.

numbers of the house posts and wall boards are on the ground within and around the location of the original structure. The structural wood present at the site is spruce, hard pine (most likely *Picea abies* and *Pinus sylvestris*) and oak. Some woods are affected by salt deterioration and have white defibrated surfaces. This type of non-biological degradation occurs in wood of historic huts at other polar locations and has been well described from the expedition huts located in the Ross Sea Region of Antarctica (Blanchette et al. 2002). It is caused by the corrosion of wood cells due to the chemical attack on lignin. Salts migrate into wood and accumulate resulting in the chemical degradation of the middle lamella between cells (the cementing material that holds cells together) and cells separate. Over time the cells on the wood surfaces become defibrated and detach. This process is relatively slow and gradually erodes the wood. Of greater importance is the destruction of wood by wood decay fungi. All woods have evidence of decay and many are affected with advanced stages of decay. There are several types of wood decay that occur throughout the world but only one form of degradation was found. This decay was characterized by cavities forming inside the secondary walls of wood cells and is commonly referred to as soft rot. Other types of wood decay, normally found in temperate regions of the world, were not found. Isolations from the decayed wood produced cultures that were identified by sequenc-

Little remains of the original Fort Conger due to dismantling by Peary and his expedition crew members in 1901 to make smaller dwellings for overwintering. Parts of the Fort's wooden floor, miscellaneous timbers and many artifacts are still at the site. Photo: R.A. Blanchette

Structures built by Peary and his crew using wood from Fort Conger. Few people know that these historic structures are still present on the shores of Lady Franklin Bay and relatively little information has been published about them. Hut used by Matthew Henson is on right and T. S. Dedrick's hut is at left.

Both photos: R.A. Blanchette

ing of the ITS region of rDNA. Many of the fungi obtained were *Cadophora* species that cause soft rot. Species of this genus have recently been found attacking wood in many locations in Antarctica and current information suggests that these decay fungi are indigenous to Polar Regions (Arenz et al. 2006, Blanchette et al. 2004). The wood from Northumberland House has been in the arctic environment for over 150 years. Decay fungi have slowly caused considerable degradation and strength losses to the historic wood over the past many decades. The fungi are still active in the woods and continue to cause decay when the moisture and temperature conditions are favorable for degradation to occur.

Fort Conger and the Peary Huts

The dismantling of Fort Conger by Peary and his crew left little of the original wooden structure at the site. Some foundation posts, beams and floor boards remain as well as many miscellaneous pieces of structural wood and wooden artifacts that are dispersed across a large area along the shore of Lady Franklin Bay. The largest section of floor remaining, approximately 4 x 2 meters, has floorboards raised 18 cm above the ground on sleepers running across the width. Many other artifacts made from metal, glass and other materials are also

The Dedrick hut at Fort Conger. All three hut structures used by the Peary expedition have had serious deterioration over the past decades and the degradation processes continue unabated. Outer boards of the hut's multi-layered wall construction have blown off, windows and doors are open and the roof has blown off one hut. Non-biological deterioration (wind erosion and salt corrosion) as well as decay by wood destroying fungi has severely affected the wood in the huts.

The remains inside the Dedrick hut showing stove and other materials that were left. The huts were build low into the ground which has resulted in moisture accumulation and very wet conditions inside the hut. Conditions are favorable for decay and soft rot fungi have caused extensive degradation in the wooden structure and wooden artifacts. Photo: R.A. Blanchette

at the site. In addition, human remains can be found among the old timbers. The source of these bones and how they came to be dispersed around the site is not clearly understood. Wood used in the construction of Fort Conger and the wood that is now part of the Peary huts was primarily white pine (*Pinus strobus*) and a hard pine (possibly southern yellow pine). There is also aspen (*Populus* sp.), birch (*Betula* sp.) and oak (*Quercus* sp) wood at the site.

The Peary huts, individually called the Henson, Dedrick or the Inuit hut, were made with an unusual construction consisting of many layers including paper on the inside of tongue-and-groove boards, tar paper, silt and gravel in a 15 cm space, another wall of wood and exterior tar paper (Phillips et al. 1978). These multi-layered "soil" insulated wooden walls were covered with mounds of earth and turf as well as snow and ice in the winter. The huts were built into the ground and the floor of the hut was approximately 40 cm below the ground surface. Additional details on hut construction can be found in an archaeological report by Phillips et al. (1978). Most of the outer wall boards are missing from the huts but a few locations still have the double wall construction sandwiching the soil and gravel. One of these boards on Dedrick's hut bears the inscription, CHIEF SIGNAL OFFICER/WASHINGTON DC USA, and is from the Greely Expedition. Windows and doors are open and the roof has blown off the Inuit hut. It can be found on the ground several meters away. One of the first photographs taken of the huts in 1935 (Shackleton 1938) suggests that the roof may have been off the hut since that time (Phillips et al. 1978).

The effects of serious wood deterioration are clearly evident on the hut woods. Wind has eroded the surfaces of the outer boards that remained on the structures producing a grooved appearance where early-wood cells of the annual rings have eroded faster than the more resilient latewood regions. The sand and ice blasting that affected the wood was tempered in places where the wood has some protection. Even paint, used to write an inscription, can protect the underlying wood. However, the historic inscription on the outer boards of the Dedrick hut originally from Greely's 1881 expedition, is becoming worn and unreadable due to its age and the severe wind erosion that occurs. Some wood throughout the site also has evidence of salt damage, but precipitation appears sufficient at the site to leech excessively high concentrations of salt from the wood and this form of deterioration is limited. Most significant is the degradation of wood taking place by wood-destroying fungi. Advanced decay is evident in all wood in ground contact and varying stages of decay are found in woods located above ground. Since the huts were built low into the ground, moisture easily accumulates inside and provides conditions that are ideal for decay to take place. Wood inside the huts is so decayed that it is soft to the touch. Although the decay can appear brown in color and look like a brown rot form of degradation, microscopic examination indicates that all of the decay found in all woods at the site is caused by soft rot fungi. The decay produced by soft rot fungi results in a distinct signature in the residual wood consisting of cavities formed inside the secondary walls of the wood cells. As the fungus continues its attack, the cavities enlarge and coalesce leaving large holes in the cell wall. In advanced stages of decay, most of the cellulolysic secondary wall is removed leaving only a weak skeleton of lignin in the remaining cells. Strength properties of the wood are greatly affected by the actions of the fungus. A major soft rot fungus found at the site was identified as species of the ascomycete, *Cadophora.* The decay fungi are still very active at the site and since plenty of moisture is present they continue to degrade the wood when temperatures rise above 0° C.

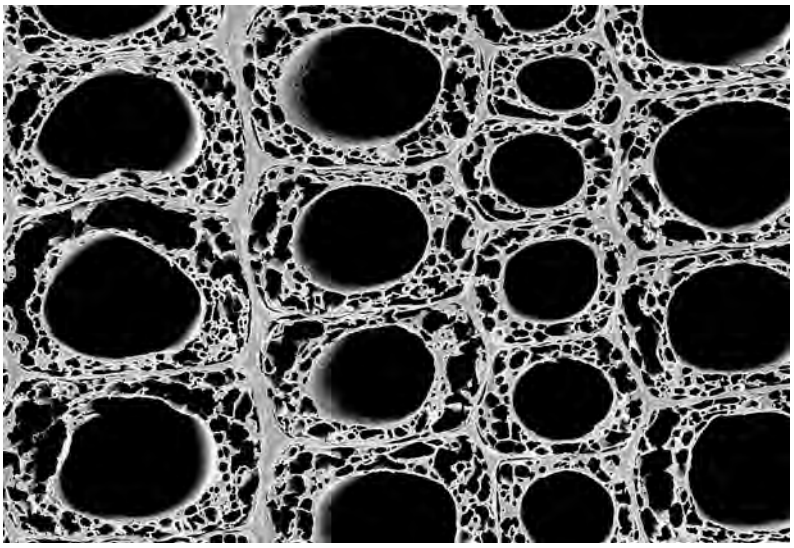
Environmental monitoring of temperature and relative humidity was done inside Henson's hut and the Dedrick hut over a two year period. Conditions suitable for decay were found for long periods of time during the summer months. Moisture levels appeared conducive for decay and temperatures were above freezing for 1810 to 2185 hours per year. During the first International Polar Year, Greely's expedition members monitored temperature and found in 1881 and 1882 that there were 1588 and 1691 hours respectively above 0° C (Greely 1888). In comparison to environmental data recently obtained in our investigations, there was approximately 2000 hours per year above 0° C or about 500 more hours per year than when the huts were built. Although only 2 years of data are being compared and more monitoring needs to be done to determine if this is an ongoing trend, any increase in temperature will allow additional time for fungi to grow and metabolize their substrate resulting in greater amounts of decay. Fungi are well adapted to respond quickly to environmental change and apparently can utilize increases in temperature to their advantage to grow longer and have increased decay rates (Gange et al. 2007). Warming trends in the Arctic will undoubtedly have a continued detrimental effect on historic woods by providing more time for these unusual wood destroying fungi to actively cause decay.

Defibration of wood surfaces was found on some woods at Beechey Island and at Fort Conger. Salt accumulation is responsible for causing a chemical attack on wood that results in the separation and detachment of wood cells. Loose surface wood fibers are eroded off exposing new cells to the corrosive action of the salts. Both photos: R.A. Blanchette

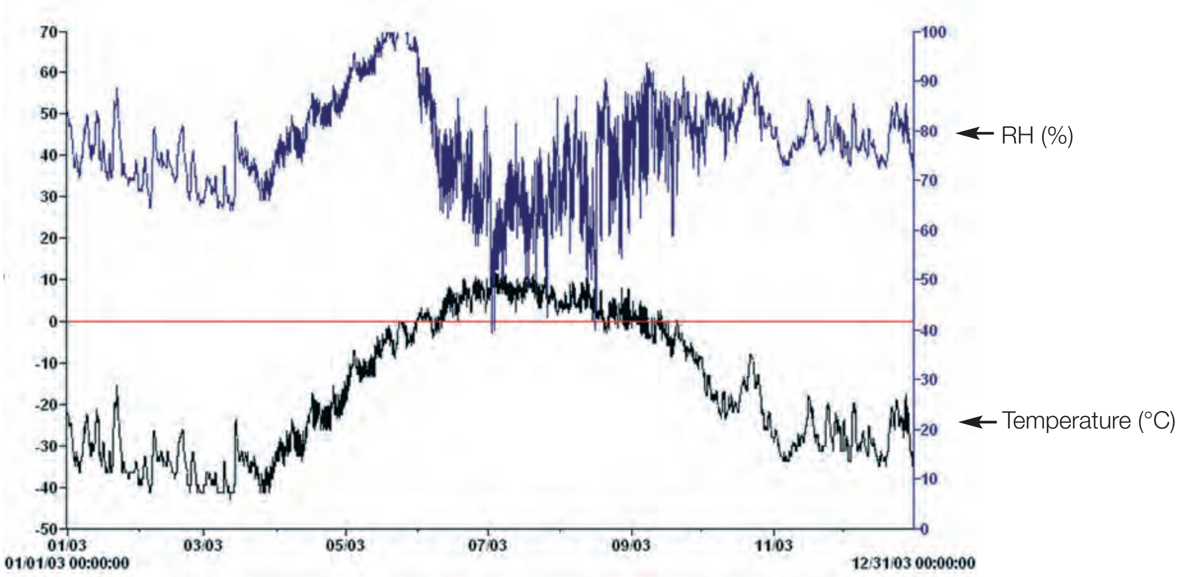
The effects of wind erosion on outer boards of Dedrick's hut cause deep grooves in the wood. The less dense earlywood cells of the wood are eroded faster than the latewood cells resulting in a grooved appearance. An inscription, "CHIEF SIGNAL OFFICER/WASHINGTON DC USA" placed on this reused wood during the Greely expedition (1881) has partially resisted the effects of the wind.

Conservation of historic wood in the Arctic

Great concern for the preservation of historic arctic sites and for the artifacts they contain has been expressed in recent years (Barr 2004, Chaplin 2004, Hett 1985). However, the extreme climate and inaccessible location make preservation efforts exceedingly difficult. In addition, sites such as Fort Conger and the Peary huts are not well known and little has been published about them. Consequently, public interest in protecting this important polar heritage is very limited. Understanding the types of deterioration taking place at these arctic sites and understanding the mechanisms of degradation is a first step in developing successful conservation plans. Recently, research on the historic expedition huts of the Ross Sea Region of Antarctic has been carried out (Farrell et al. this volume) and the Antarctic Heritage Trust has assembled detailed plans to preserve the huts



Effects of wood decay by soft rot fungi in pine timber from Fort Conger. Cross section of wood cells shows the destructive attack by the fungus causing many cavities inside the wood cell walls. Wood strength is severely compromised in advanced stages of decay. Photo: Benjamin Held



Environmental monitoring within Henson's hut shows temperatures above 0° C and relative humidity is suitable for decay to take place over an extended period of time in the summer months. Comparisons made with data taken during the Greely expedition in 1881 and 1882 indicate that the duration of time for decay fungi to be active (hours above 0° C) has increased by approximately 500 hours / year in recent times.

and obtain funds to carry out the work. A similar scenario is needed for historic huts in the Arctic if these monuments of polar heritage are to be saved. Serious deterioration has occurred at Northumberland House and in the remains of Fort Conger and the Peary huts. Of major concern is the serious wood decay taking place in the historic woods. This is no easy task to control especially since we know very little about these unusual polar microbes. More investigation is needed to better understand these decay fungi and their degradative processes so control methods can be realized. In the meantime, focus should be on general repairs to secure the Peary huts and altering microenvironmental conditions by improving drainage and reducing moisture in and around the huts. Since moisture is essential for decay to take place, reducing moisture in the woods will help to limit decay. Increased study and documentation of the wooden remains of Northumberland House and Fort Conger are also essential since decay is in advanced stages and degradation is continuing. Warming trends in the Arctic appear to be extending the time in which decay can take place and undoubtedly are accelerating decay rates so that these historic woods are being destroyed more rapidly.

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Antarctic scientific bases: Environmental and cultural heritage perspectives 1983-2008

Ricardo Roura

Introduction

Following the entry into force of the 1991 Protocol of Environmental Protection to the Antarctic Treaty (hereafter the Protocol), Antarctic Treaty Parties have had to take action on their abandoned or under-used scientific bases, while protecting those that have historic value. The Protocol and other Antarctic Treaty instruments protect sites of recognised historic value that have been designated as Historic Sites and Monuments (HSMs). Historic remains predating 1958 whose existence or present location is not known have also a degree of protection.[1] However, the remains of past activities that are not otherwise protected are subject to be removed under Protocol requirements to clean up past and present waste disposal sites on land and abandoned work-sites.[2]

In 1983 a new wave of designations of historic sites began, following a hiatus of eleven years. The sites and monuments designated since then included some abandoned scientific stations that had at some point generated environmental concerns.

Non-Governmental Organisations (NGOs) played a key role in the adoption of the Protocol by Antarctic Treaty Parties. To promote its views the international environmental organization Greenpeace International (hereafter GPI) started an Antarctic campaign in 1983 (Roura 2007). One of the approaches used was to conduct unofficial inspections of Antarctic sites and facilities.

This article examines the designation of Antarctic scientific bases as HSMs from the evolving and at times contrasting perspectives of protecting environmental and cultural values. This analysis has been made on the bases of comparing and contrasting the findings of GPI's unofficial inspections[3] with Antarctic Treaty System (ATS) documentation including official inspection reports. These were used to track the interplay of cultural and environment values for over two decades and how they are reflected in the designation and management of historic scientific bases in Antarctica.

1 Overview: Antarctic Historic Sites and Monuments

The Protocol and other Antarctic Treaty instruments protect sites or monuments that have been designated as HSMs.[4] Any Party may propose a site or monument of recognised historic value for listing as an HSM. The proposal for listing may be approved by the Antarctic Treaty Consultative Parties (ATCPs) by a measure adopted at an Antarctic Treaty Consultative Meeting (ATCM).[5] By ATCM XXX (2007) there were 78 listed sites and monuments numbered 1-82 (some have been de-listed or subsumed into other HSMs). Of these, approximately 70% are sites of past Antarctic activities and about 30% are memorials and monuments.

Listed HSMs shall not be damaged, removed or destroyed. HSMs may be designated as protected areas under Annex V of the Protocol.[6] Past activity remains that are not otherwise protected are subject to removal under requirements of Annex III of the Protocol on Waste Disposal and Waste Management. Unlike the natural environment, historic values[7] are not normally subject to the previsions of Annex I of the Protocol on Environmental Impact Assessment (EIA).[8]

The list of HSMs is reviewed and updated periodically, but it is neither comprehensive nor representative of different periods or themes of Antarctic history. There is a certain inequality in the sites designated (Cochran and Collinge 1994:15). For instance, the list includes Heroic Era huts and other remains, graves of different ages, and monuments of different kinds, some of which represent national or religious figures unconnected to the Antarctic. Since 1995 sites and monuments must meet certain criteria prior to designation,[9] but this requirement post-dates the designation of many HSMs and is not enforced strictly. Finally, there are still no

A diversity of historic sites and monuments in Antarctica. From left to right: Borchgrevink's huts at Cape Adare erected on February 1899, the first buildings on the Antarctic continent, with remnants of Scott's Northern Party hut in the foreground (HSM 22); cross at Observation Hill, Ross Island, erected in January 1913 in memory of Capt. R.F. Scott and his companions (HSM 20); and replica of a bust of Capt. L.A. Pardo, commander of the Chilean expedition that rescued the survivors of the British vessel *Endurance* in 1916, located at Chile's Frei Station on King George Island (HSM 53). The original HSM 53 is on Elephant Island (Photos: © R. Roura 1992, 2007, 2006.

uniform criteria or accepted standards as to how an HSM should be maintained after designation (see Morrison, this volume). This is of particular significance for the designation of scientific bases, which are likely to require costly and logistically complex maintenance.

2 Perspectives on Antarctic material culture

2.1 Scientific bases and the practice of inspection

The practice of inspection is established under Article VII of the Antarctic Treaty and Article 14 of the Protocol. The purpose of the inspections is to promote the objectives of, and ensure compliance with, the provisions of the Antarctic Treaty and its Protocol. Inspectors designated under Article VII (1) (formally called "observers") "shall have complete freedom of access", including the conducting of aerial observations, "at any time to any or all areas of Antarctica." During inspections, observers should be given access to all parts of stations, installations, equipment, ships and aircraft and all records that are maintained at those facilities in accordance with Protocol requirements.

As part of its antarctic activities GPI carried out unofficial inspections of over 160 sites or facilities from 1988 in the Antarctic Peninsula, Northern Victoria Land and the Ross Sea (ASOC and UNEP 2003). Inspection procedures consisted of an interview with local authorities followed by visual site examination and documentation, and an official tour on invitation. Environmental sampling was carried out in some instances, and on-site protests of different kinds were occasionally conducted, although this latter approach was only used for the worst examples of preventable environmental damage. Inspection reports were produced after each season and were made available to Antarctic Treaty Parties. Plainly these inspections had no formal status, but they provided information on the environmental performance of Antarctic scientific stations that was often unavailable at the time.[10]

ATCM Resolution 5 (1995) approved four official inspection checklists[11] that were produced as *aide memoires* for observers conducting an inspection. These checklists classify elements of the human built environment into four categories, which (probably unintentionally) constitute a useful classification of material culture in the antarctic landscape:

Permanent Antarctic stations and associated installations, including remote field camps (Checklist A);

- *Vessels within the Antarctic Treaty area* (Checklist B);
- *Abandoned Antarctic stations and associated installations* (Checklist C); and
- *Waste disposal sites* (Checklist D).

For the purposes of this paper there are therefore the categories permanent active stations and associated facilities, abandoned (or unused) stations, and waste disposal sites. Some of these may be, or may contain, designated HSMs or material remains of past activities that have heritage value and may one day be designated as HSMs. Any of these types of material culture can be examined from environmental or cultural heritage perspectives.

2.2 Environmental perspectives: NGO position on Antarctic scientific bases

NGOs demanded higher environmental standards in the operation of active stations, and the removal of unused stations and waste disposal sites. A statement that summarises the environmentalists' position on abandoned stations appears in the concluding remarks of the 1990-91 Expedition Report:

> "The abandoned bases littering the Peninsula need to be dealt with as a matter of urgency. They are not looked after, and are deteriorating from the weather, and some cases, from visitors. Most of them have hazardous material lying around. They also have a visual impact which should not be ignored. Anything of genuine historic merit at these bases should be restored, designated, and maintained properly. Everything else should be removed, although the process should be subject first to environmental impact assessments, as wildlife is recolonising many of the sites." (GPI 1991:23)

GPI visited few designated HSMs in its Antarctic expeditions, and in those visits it did not follow its usual inspection and reporting procedures. For instance, when GPI ships were in Ross Island – where the organisation ran a year-round station, World Park Base, between 1987 and 1992 – personnel from Scott Base were made

An abandoned antarctic scientific base: Cape Hallett Station in 1992. In the foreground some of the artificial penguin mounds built by the base's operators to encourage the re-colonisation of the site by penguins, which had been displaced to establish the base. Photo : © R. Roura.

available to open the historic huts in the area so that the environmental activists could visit them. However, GPI did not report on the visits to these or other historic sites. Overall GPI accepted as valid the designation of historic sites as HSMs, even though some of these sites had obvious environmental problems. Some of those same historic sites have since been recognized as contaminated and needing remediation, such as Scott's *Terra Nova* Hut at Cape Evans (e.g. Blanchette et al 2004). In contrast to historic *sites* the environmentalists did not openly criticize, but disapproved of, the proliferation of *monuments* in scientific bases that were designated as HSMs, on the suspicion that many such designations had a symbolic role that had little to do with science or even historic values.

Southern stores dump near Scott's Terra Nova Hut, Cape Evans, Ross Island, part of HSM 16 (left). The remains of a waste dump at Russia's Bellingshausen Station, King George Island, following a 2001 clean up (right). Photos: © R. Roura 2007, 2006.

A personal account of a former leader of GPI expeditions to the Antarctic region describes a 1993 encounter of environmentalists with the cruise ship *Kapitan Khlebnikov*. The account illustrates the tensions between environmental and cultural heritage perspectives with regard to the management of historic sites, and the different perspectives sometimes held by individuals with respect to GPI's official position. The encounter took place at Cape Evans, Ross Island, where a GPI team was monitoring environmental impacts at the former World Park Base site. From the site, which was 200 meters from the historic *Terra Nova* hut, the activists could see the landings:

> "After a brief pause, the *Khlebnikov* began disgorging inflatables to ferry passengers ashore…Many of them [the tourists] did seem to regard us with suspicion…One woman nearly wandered onto the site of World Park Base. Martin, one of our cooks, was there and asked if she could keep out because it was a scientific area. She responded that she was pleased the base had gone; it had been an eyesore next to such an historic monument. Martin pointed out that the historic monument was a wooden hut with trash all around it, and that the Antarctic surroundings were infinitely more historic and, indeed, monumental. She would have none of it. Yes, the hut might be surrounded by broken bottles, wood chips, wire, dead animals, food cans, and the kind of garbage that it is now illegal to even think of leaving on Antarctica, but it was historic garbage." (Mulvaney 2003:170).

To summarize, environmental NGOs demanded higher environmental standards of Antarctic scientific bases, and required the removal of abandoned facilities and waste materials that had no genuine historic value. However, they accepted as valid the designation of historic sites by the ATCM and did not scrutinize them despite the environmental risks some of them posed.

2.3 Cultural heritage perspectives: Historic site designation of Antarctic scientific bases

One of the characteristics of Antarctic science is (and has always been) its close involvement with politics, which results from the national scale support needed to conduct science in the antarctic region (Fogg 1992:2). Plainly, the reasons to operate an antarctic base are not only scientific but concern a range of other reasons, including attaining Consultative Party status,[12] influence in the ATS, and geopolitical presence. Science, however, has a priority role in the ATS and should always be present, even if other factors are also at play.

Science may be defined as "…our attempts to understand the natural world – not the mere accumulation of facts about it but its assimilation into abstract concepts from which predictions can be made." (Fogg 1992:4). It follows that a scientific base is one where (or from where) scientific activities are carried out. However, the role of science in many antarctic bases has never been and it still is not as high as it might be. An official inspection conducted in the Antarctic Peninsula in 2005 made comments that resonate with those made by environmentalists a decade earlier:[13]

> "Although some stations were undertaking world-class scientific research into a wide variety of disciplines… a larger number of stations appeared to have relatively modest, or even rudimentary, science facilities. This was particularly so when viewed against the substantial size of some stations' infrastructure." (Australia et al 2005:6).

This observation appears to be confirmed by comparing the output of research publications in peer-reviewed journals between 1980 and 2003 and the number of extant antarctic facilities in the early 2000s (Fig. 4). In that period, the most productive ATCPs ran three or four facilities, but so did other Parties that are comparatively (and in some instances considerably) less productive. The production of scientific papers by Parties with no antarctic facilities is not much inferior to that of Parties with five or more facilities.

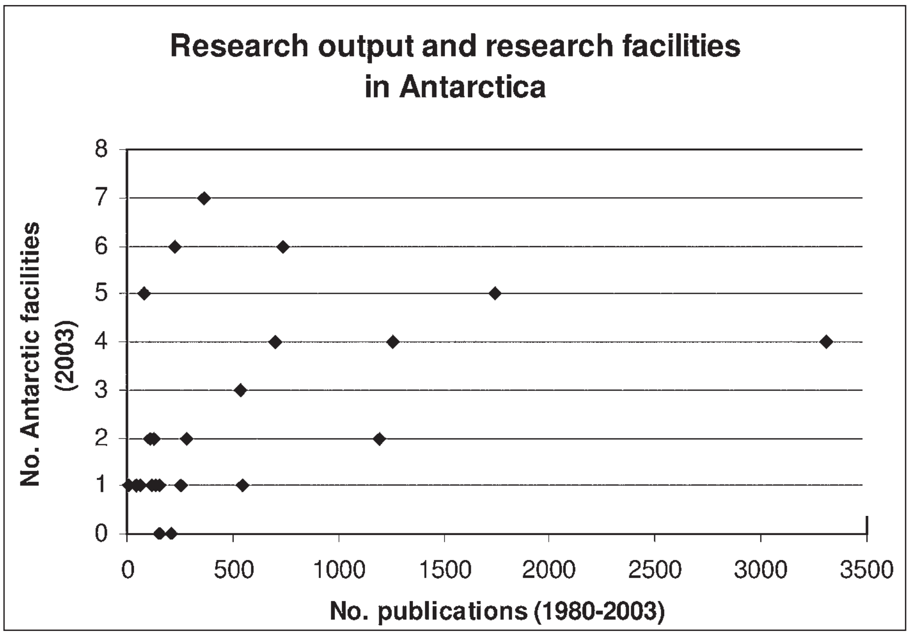

Fig. 4: Research outputs and research facilities of Antarctic Treaty Consultative Parties. Research output data between 1980 and 2003 from Dastidar and Persson (2005). Facility data from COMNAP (2003).

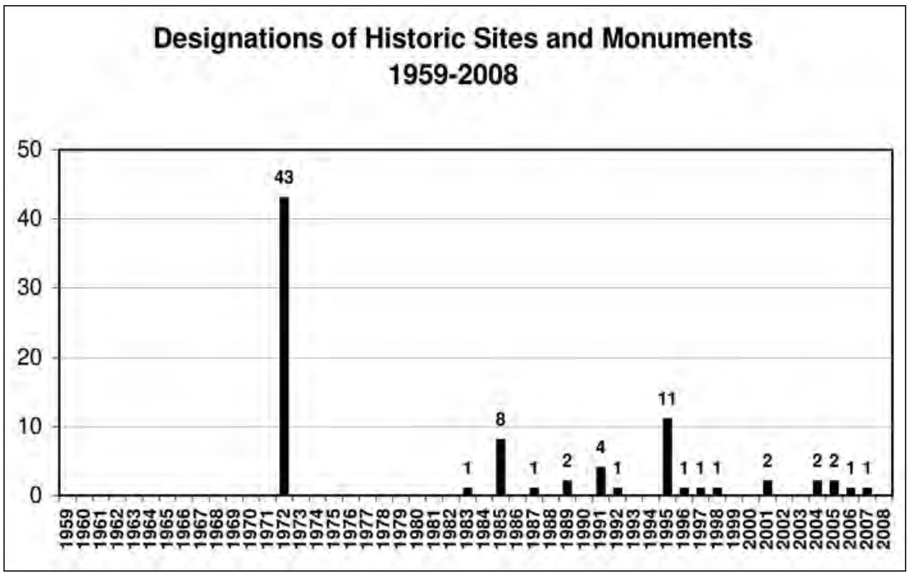

Fig. 5: Designation of Antarctic Historic Sites and Monuments since the signature of the 1959 Antarctic Treaty. Data from ATS (2008).

Forty-three HSMs were designated in 1972, many of which are linked to early antarctic exploration and/or science. Between 1983 (when a second wave of designations began) until May 2007, the ATCM approved 35 HSMs (Fig. 5). Of these, thirteen HSMs are the complete or partial remains of scientific bases or buildings, or structures used for scientific purposes; and seven are monuments located at or near to scientific bases. Among the HSMs designated since 1983, which include sites of historic significance such as the as yet unfound tent of Roald Amundsen near the South

Fig. 6: Monolith erected to commemorate the establishment of China's Great Wall Station in February 1985 (HSM 52). The initial construction of the station, carried out by a 600-strong construction crew, is alleged to have inflicted severe environmental impacts, and its subsequent operation was the subject of criticism by environmental groups (e.g. GPI 1990). A recent official inspection (USA 2006) commended aspects of the station's operations and also recommended some improvements. Photo: © R. Roura 2006.

Pole, there are some of the sites and facilities that were once regarded as problematic from an environmental perspective. Some of these are now protected and remembered for the historic values they supposedly embody – including the role they played in Antarctic science.[14] In addition, some bases have been "memorialised" – meaning that a monument to or at the base becomes in itself an HSM, somehow legitimising the presence of antarctic infrastructure (Fig. 6).

With the entry into force of the Protocol in January 1998, Antarctic Treaty Parties conducting inspections also required the removal of abandoned stations. A number of stations have indeed been fully or partly removed. In addition, a number of waste disposal sites have been fully or partly cleaned up since the entry into force of the Protocol – this being perhaps the requirement that Antarctic Treaty Parties complied with with more enthusiasm. However, a more recent official inspection made very similar recommendations to those made by environmental NGOs fifteen years earlier:

> "The Team observed a number of dilapidated huts and refuges…An effort should be made by those responsible … to either repair them fully for some reasonable use (such as support for science) or remove them. There is no basis for old structures without historic designation to be left in such places simply on the basis that they might at some point provide a bit of safety to someone; if that were an appropriate basis for building and retaining huts, they would dot the landscape in contravention of basic environmental principles, if not the Environmental Protocol itself." (USA 2006:11).

As a result of the rapid growth of Antarctic tourism since the 1990s, some stations have become (by chance or design) tourism attractions and regular destinations. Examples include Base A at Port Lockroy (HSM 61), and Chile's Gabriel González Videla, a station with two associated HSMs (30 and 56), which was refurbished to receive tourism visits (Chile 2007b). Indeed, the 2006 US Inspection report noted:

> "… in light of the central role of science in Antarctica, the Team found it curious that some stations (including ones not visited by the Team) seemed to be going out of their way to attract tourist vessels. While there is nothing wrong with focusing attention on the historic aspects of stations and their locales, and visits by tourists can increase general understanding of the role of stations in Antarctica, the Team felt that resources might be better focused on expanding science programs than attracting tourists" (USA 2006:11)[15]

Port Lockroy, Base A, Goudier Island, Antarctic Peninsula. Established 1944 for Operation Tabarin and abandoned between 1962 and 1994. Designated as Historic Site and Monument 61 in 1995. Since 1997 it operates as a summer-only station (primarily a "living museum") for tourist visits. Left photo – boatshed building prior to restoration; right photo – main base building, Bransfield House, after restoration. Photos: R. Roura 1993, L. Hacquebord 2005

Science has always played a role in Antarctic endeavours, and since the signature of the 1959 Antarctic Treaty it has become the primary activity in the region. However, not all antarctic bases have been primarily built or operated as scientific bases. In Antarctica, the placement of infrastructure on a certain place has long played a practical, ritual and symbolic role in safeguarding (or countering) territorial claims and of keeping a foothold in the region.[16] Infrastructure has also been used to enhance a Party's influence in the ATS that derives from an active Antarctic presence. In the same vein, the process of designating an HSM is part of a ritual, and the HSM itself remains as a lasting symbol of presence that continues well after the original activity has been terminated. Each HSM reflects the wish of one or more Parties to have an element of their own cultural heritage valued and protected. However, by designating Antarctic remains of past activities as an HSM an *international* status is given to elements that have primarily a *national* value. With regard to antarctic bases the risk is that an imaginary scientific past is created during the process of historic designation.

Overall, between 1983 and 2007 a number of antarctic bases that had been active only some decades earlier were designated as HSMs, while others were removed. Some bases were memorialised or turned into tourism support facilities. Early assessments that there were many redundant antarctic facilities, and many active facilities that conducted limited science, appear to be as valid in 2007 as a decade earlier.

3 Antarctic scientific bases and Rubbish Theory

Antarctic scientific bases and the process of designating HSMs can be examined from the perspective of Thompson's Rubbish Theory (Thompson 1979). Thompson identified three categories of objects: the «durable» – an object that increases in value over time and has theoretically an infinite life span; the «transient» – an object that decreases in value and has a finite lifespan; and «rubbish» – that which has «zero and unchanging value» and usually does not disappear but «continues to exist in a timeless and valueless limbo» (Thompson 1979:7-10). Rubbish, however, may at a later day be rediscovered and categorized as cultural heritage (Thompson 1979, Carman 2002; Howard 2003:47). The process is thus:

Transient ➠ Rubbish ➠ Durable

Cultural remains on the polar landscape may belong to any of these broad categories. A certain cultural heritage item may go through all these stages during its life cycle. However, the distinction between items in one category and the other may not be clear-cut. The remains of past activities may blend with items from the contemporary present that are still in use or that have only recently stopped being used. In between the past and the present there is a grey zone where the "artefact or rubbish" question has not yet been resolved or addressed. Looking at the "things" in the antarctic landscape (c.f. section 2.2) it is possible to broadly classify them thus, using Thompson's categories:

- Permanent stations can be regarded mostly as "transient";[17]
- Abandoned stations and waste dumps can be regarded mostly as "rubbish";
- Historic Sites and Monuments can be regarded as "durable".[18]

A scientific station may through its life cycle be in any or all three categories.

Through the 1990s and 2000s, factors such as the continued existence of the ATS and the end of the Cold War had made the presence of antarctic scientific bases no longer as necessary from a geopolitical perspective as they had been in the past. This resulted in a number of scientific stations being transferred from one Party to another, mothballed, removed, or abandoned (Fig. 8). This process was, in effect, a series of transfers from one of Thompson's categories to the next, with some bases remaining "transient" objects under a different operator, others becoming "rubbish" as abandoned stations, and yet others being designated as "durable" with an historic site designation. These decisions were made on the basis of national obligations (including obligations under international law) as well as national interests.

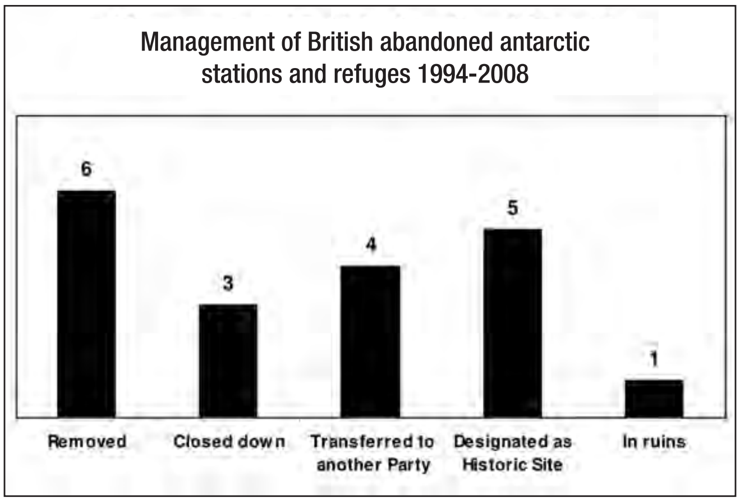

Fig. 8: An example of the fate of abandoned antarctic scientific bases. The United Kingdom which, as other claimant states, established numerous antarctic bases through the 1940s and 1950s, began to take action on its abandoned bases in the 1990s (Data from Cochrane and Collinge 1994, BAS 2008. Bases established outside the Antarctic Treaty Area were not included).

With the adoption of the Protocol environmental perspectives gained a dominant role in antarctic affairs. Deserted stations and field huts as well as waste dumps had to be removed in compliance with the Protocol. However, abandoned bases were generally regarded as a waste management issue rather than as a cultural heritage issue. The debate was primarily about the environmental, economic and technical merits of keeping or removing buildings and other wastes from Antarctica, rather than about the potential heritage value these might have held. For instance, in discussing policy changes with regard to waste management in the Antarctic, Walton notes – almost as a side comment – "Let us also not forget that one man's rubbish, when given the acceptable patina of age, is another man's historical artefact!" (1990:103).

The focus on environmental perspectives was partly related to the spirit of the times (the period coincident with the Protocol negotiations), and partly to the fact that some past activity sites were relatively recent. Up until the late 1980s about half of the HSMs dated from the heroic era of Antarctic exploration or earlier.[19] More recent sites were not usually listed as HSMs – and therefore likely to be categorised as "rubbish". Nevertheless, some Parties were already aware of the potential historic value of their own relatively recent

Artefact or rubbish? Fuel and whale-oil tanks at Hector whaling station in Whalers Bay, Deception Island, which are protected as part of a specially managed historic site (left). Fuel tanks at King George Island formerly used to supply the Soviet fishing fleet, the removal of which has long been requested by both NGOs and Antarctic Treaty Parties (right) Photos: © L. Hacquebord c. 2005, R. Roura 2006.

remains. A 1991 GPI field report about Australia's Wilkes Station refers to an archaeological assessment of the station that had been carried out the previous year, which had recommended that "…nothing be removed from Wilkes [Station] as all the buildings plus surrounding refuse including fuel drums, should be viewed as artefacts." (Cited in GPI 1991, Annex, pp.6-7).

However, GPI noted that given the Australian government's commitment to environmental protection it was unacceptable that Wilkes Station remained "in its appalling state" (Cited in GPI 1991, Annex, pp. 7). It urged for the station to be cleaned up, except buildings deemed of historic value, and even recommended taking a compactor to the site to facilitate the removal of drums and other wastes. Today this may seem barbaric from a cultural heritage perspective, particularly since Wilkes Station was one of the original stations used in the 1957-1958 International Geophysical Year (IGY). However, the calls for an environmental clean up should be placed in the context that Wilkes Station (consisting of the base itself and a number of waste disposal sites) had at the time been abandoned for more than 30 years after a relatively short period of activity (1957-1969), and it was just one of a number of abandoned stations in the Antarctic at the time.[20] Many fairly noteworthy scientific bases had not yet, or had only recently, been designated as HSMs. Examples include East Base in Stonington Island (designated in 1987), Base A at Port Lockroy in Goudier Island (designated in 1995) and Base B and the ruins of Base Aguirre Cerda, both in Deception Island (designated in 1995 and 2001, respectively). All of these had been once-abandoned scientific bases, and prior to designation as historic sites the environmental management of the sites had been a matter of concern for environmental groups.

Among the bases removed in compliance with environmental regulations there were some associated with the 1957-59 International Geophysical Year (IGY). A case in point is Cape Hallett Station, which was established during the summer of 1956/57 by New Zealand and the United States to provide weather data for American aircraft flying between New Zealand and Antarctica, as well as to undertake an IGY research programme. Cape Hallett Station was occupied year round between 1957 and 1964. After the IGY the station continued to undertake scientific research until a fire destroyed the station's main scientific laboratory in 1964. Subsequently the station was operated as a summer-only research station until it was abandoned in 1973. Clean-up operations started in 1984 and were completed in 2005 (New Zealand and USA 2006; USA 2008a:3). Environmentalists had long regarded Cape Hallett Station as problematic not only because it had been abandoned for many years, but also because it was established in the midst of a colony of Adélie penguins (*Pygoscelis adeliae*) with more than 60 000 pairs, several thousand of which were displaced to allow for the construction of the base. The base establishment and operation resulted in the decline of the penguin colony (USA 2008a:3).[21]

During the two decades it took to remove the station some of its components acquired "durable" status – many of the materials originating at Cape Hallett that were returned to New Zealand as refuse were collected by the Canterbury Museum in Christchurch. An exhibition was mounted on the basis that "the history of the station is both a human and an environmental account of an important era in Antarctic exploration and science" (New Zealand and USA 2006:8). Paradoxically, after the removal of the station attention was drawn to the enduring historic and heritage values of the base site related to its former use (USA 2008a:3). The revised management plan for Cape Hallett, which protects primarily the ecological and scientific values of the area, establishes that an appropriate authority should assess the historic value of any artifact that may appear at Cape Hallett as a result of e.g. erosion, before its removal and/or disposal. Management options are being

Cape Hallett Station exhibit at the Christchurch Museum, Christchurch, New Zealand. Photo: © R. Roura 2006.

discussed for the well-preserved remains of a husky that died in 1964, which was not removed during the clean up (USA 2008a:3). Visitors to the site should not disturb or remove any artifact from the former station and should notify the find to the expedition leader and relevant authorities (USA 2008b).

In the case of Cape Hallet Station environmental and cultural heritage perspectives reached a balance of sorts, although this took decades. The establishment and operation of Cape Hallett Station caused a significant impact on the local penguin population; and the base was then removed in compliance with environmental regulations requesting the clean up of former worksites, but at the expense of historic values. The cultural heritage of Cape Hallett Station was eventually recognised as “durable”, but only after the station had been categorised as “rubbish” and most material elements removed from the former station site.

GPI’s own World Park Base can be examined from the perspective of Thompson’s theory. Whilst not primarily a scientific base, some research was conducted there (Roura 2007). With the signature of the Protocol in October 1991 – one of the main objectives of GPI’s antarctic campaign – a decision was made to remove it in order to free resources that could be used elsewhere in the region (GPI 1992:4; Roura 2007). Conceptually all buildings, associated installations, and contents were transferred from the “transient” to the “rubbish” category.[22] World Park Base was entirely removed in 1992. A granite benchmark was placed at the site to aid environmental monitoring, but this too was eventually removed in 1996 (Roura 2004:55). There are now virtually no traces of past activity at the site (Hemmings AD, personal communication 2 February 2005, pers. obs. 27 December 2007).

Greenpeace departs Cape Evans after five years of continued operations, February 10, 1992. Scott’s Terra Nova hut is in the background. Photo: © R. Roura 1992.

4 Conclusions

In the context of negotiations leading up to the Protocol, environmental NGOs denounced what were perceived as poor environmental practices by Antarctic Treaty Parties. Whilst taking a hard line with regard to the need to clean up many sites and facilities, NGOs recommended that the historic merits of abandoned bases had to be assessed, and that they should either be protected as formally designated historic sites, and properly maintained, or otherwise removed. In this regard there was no conflict between environmental and cultural heritage perspectives with respect to protecting historic sites and the values they embody. After the entry into force of the Protocol, Antarctic Treaty Parties conducting official inspections adopted a fairly similar position to that of NGOs a decade earlier with regard to abandoned sites and facilities without historic designation. The fate during the past decades of abandoned scientific bases in Antarctica has been diverse, and can be analyzed from the perspective of Thompson’s 1979 Rubbish Theory.

However, environmental and cultural heritage perspectives are fundamentally different ways of regarding human presence in Antarctica. From an environmental perspective historic values are not generally considered part of the antarctic environment,[23] and the material remains of antarctic activities mark the boundary of civilization and the encroachment upon the last great wilderness – forming, in effect, an *Antarctic frontier*. Instead, from a cultural heritage perspective the same boundary forms a cultural landscape that is a material record of human achievements in the region, a source of information about the past, and a source of inspiration for future generations. There is a basic tension between these two perspectives. However, there are convergences too, which result from the growing pressures on the intrinsic values of Antarctica[24] and the legal requirement under the Protocol and its Annexes to protect them.

Science is the primary activity in the Antarctic under the 1959 Antarctic Treaty and related instruments, but not all Antarctic bases were primarily built or operated for scientific purposes. Safeguarding individual parties' territorial claims and influence in the Antarctic Treaty System were also factors.[25] Antarctic bases designated as historic sites should be remembered for the significance they may hold on scientific, historic, archaeological, or other grounds according to internationally accepted criteria, and not as symbols of an imaginary scientific past. The misuse of the historic designation process – assigning protected status to material remains that actually lack in significance – could result in an erosion of the wilderness, historic, and other values of Antarctica. Clarity of purpose in the designation of antarctic historic sites and monuments will enhance the significance of those that are left as a legacy for the future.

5 Acknowledgments

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Endnotes

1 ATCM Resolution 5, 2001.

2 Protocol's Annex III, Art. 1(5)

3 The author led or co-led numerous inspections as a Greenpeace representative between 1990 and 1997. He has no current involvement with the organization, and all the information used here is based on publicly available sources.

4 For a review of Historic Sites and Monuments in Antarctica see for instance Bizarri (2006) and Chile (2007a).

5 Protocol Annex V, Art. 8(2).

6 Annex V of the Protocol lists two categories of protected areas: Antarctic Specially Managed Areas (ASMAs) and Antarctic Specially Protected Areas (ASPAs). Both categories are subject to management plans approved by the ATCM. Entry to ASPAs requires a permit issued by competent authorities.

7 The Protocol is not internally consistent with regard to historic values. It sometimes refers to "historic values" and sometimes (in the context of areas) to "historic significance". Historic values are not listed in Art. 3 of the Protocol on Environmental Principles and are not usually regarded as part of the "Antarctic environment" in the meaning of domestic implementation (See Bastmeijer and Roura 2008:202, footnote 85).

8 "If the actual or potential presence of cultural heritage is not recognised during EIA, then that heritage is potentially at risk of being damaged or lost in activities subject to EIA, such as clean up operations. In these instances Antarctic EIA would be, in effect, "blind" to historic values." (Bastmeijer and Roura 2008:202).

9 ATCM Resolution 8 (1995).

10 After the entry into force of the Protocol in January 1998 official inspections started to scrutinise environmental aspects of Antarctic operations much more closely than hitherto.

11 A fifth checklist to assist in the inspection of Antarctic Specially Protected Areas and Antarctic Specially Managed Areas was approved by Resolution 4 (2008).

12 Operating a national scientific base is no longer regarded as an essential requirement to demonstrate active involvement in antarctic research. For instance, The Netherlands attained Consultative status in 1990 without operating a scientific base.

13 GPI base inspection reports, while focusing on environmental issues, sometimes commented on excessive military presence for logistic support; presence for apparent political (territorial) reasons; and limited scientific activity at some stations.

14 ATCM Resolution 8 (1995) contains seven guidelines that should be addressed when proposing new HSMs, of which three refer explicitly to the history of science or the development of knowledge of Antarctica.

15 See also Uruguay 2005, Chile 2007, and XXX ATCM Final Report, paragraphs 172-173, p 24.

16 For a discussion of ritual and symbols of colonizing powers (albeit not specifically in the Polar Regions) see Seed (1996).

17 Some antarctic stations have been active for decades and are likely to remain for the foreseeable future. However, the station buildings themselves may change over time. While the *location* of the station may be regarded as permanent, the *buildings* themselves can be considered transient using Thompson's categories. Some modern stations are being built with a projected lifetime and the ability to be dismantled with relative ease after their life cycle has been completed.

18 However, HSMs can be de-listed and there are a few instances in which this has happened.

19 The early period of Antarctic exploration known as the "Heroic Era" is usually taken to span the period between 1895 and 1917, ending with the departure from Ross Island of the *Aurora* relief expedition.

20 To date, Wilkes Station has not been proposed for designation as an HSM although it is protected by Australian legislation.

21 A part of Cape Hallet was designated as a protected area in 1966 on account of its "particularly rich and diverse vegetation that supports a variety of terrestrial fauna." This was expanded in 2002 to include the breeding area of a substantial colony of Adélie penguins (*Pygoscelis adeliae*). The area formerly occupied by the station has now been recolonised, although population numbers in 2006-07 were about a third of those in 1959 (USA 2008a).

22 In practice only a fraction of the base and its contents was dealt with as refuse – most materials removed from World Park Base, including buildings and other infrastructure, equipment, fuel, etc., were recycled or reused elsewhere.

23 See e.g. Bastmeijer and Roura 2008:2002.

24 As Lowenthal has noted, both the cultural and natural heritage are non-renewable and in limited supply; and both are endangered by the same forces (2005:85-86).

25 Pursuing national interests, however, is also part of Antarctic history and cultural heritage, if not as universally valuable as scientific research, the preservation of international peace, or environmental protection.

Observations on standards of management and maintenance

Michael Morrison

Introduction

The background to this presentation is a survey of the British huts on the Antarctic Peninsula in January 2007. This work was commissioned by a triple headed client: The British Antarctic Survey (BAS), The Foreign and Commonwealth Office (FCO) and the British Antarctic Heritage Trust (UKAHT) with a brief to formulate a strategic approach to management of the huts. The huts inspected were mainly British, erected in the 1940s and 50s, but we were also able to visit two huts associated with the Swedish Nordenskjöld expedition 1901-04: the timber hut at Snow Hill and the stone hut at Hope Bay. The visits were made possible as HMS *Endurance* was tasked with visiting all these sites as part of the 2007 programme of work. All in all the disused huts and associated structures at nine sites were inspected as well as looking at three operational bases.

I had previously carried out (in 2003) surveys of three of the historic sites on Ross Island and the site at Cape Adare. This was work for the New Zealand Antarctic Heritage Trust (NZAHT) and resulted in the Conservation Plans for the four sites (Hut Point, Cape Evans, Cape Royds and Cape Adare) prepared in conjunction with the New Zealand conservation architect Chris Cochran.

I was concerned that the approach to the hut sites looked after by the NZAHT was strikingly different from the management approach that was being adopted towards the huts on the Peninsula. The purpose of this article is to consider these differences – not particularly to say that one approach is right and another wrong, but to suggest that as they all have a common starting point as Listed as being of Historic Interest under the Antarctic Treaty, the differences should not be overlooked in future management considerations.

The Esse cooker and copper hot water tank in the kitchen on Horseshoe Island Hut.

Sledge meter wheels in the workshop in the Horseshoe Island Hut. Both photos: Michael Morrison

The main building at Port Lockroy on Goudier Island. Photo: Michael Morrison

The sites inspected

Of the eight "British" sites we inspected, five have already been declared historic sites:

- Port Lockroy, built in 1944 – Historic Site No. 61
- Wordie House, Argentine Islands, built in 1947 – Historic site No. 62
- Horseshoe Island built in 1955 – Historic Site No. 63
- Stonington built in 1960 – Historic site No. 64
- Deception Island – Specially Protected Area of Whalers Bay. The structures range from the pre-First World War Norwegian buildings to the 1960s portal framed and corrugated iron (British) aircraft hangar.

The British Base at Stonington Island. Photo: Michael Morrison

The American 'East Base' at Stonington. This was built by Admiral Byrd's 1939 Expedition and then reoccupied by Finn Ronne's Expedition in 1947. Photo: Michael Morrison

Of the remaining three sites visited two have been handed on to another country

- View Point has been handed over to Chile
- Hope Bay has been handed to Uruguay

Whilst the third, the hut on Detaille Island built in 1956, is difficult to get to and as a result no decision has been made about its future (yet!).

The background to present position was a Conservation Survey carried out for the British Antarctic Survey in 1994 by Chris Cochran working with Ian Collinge of BAS. This report was based on a similar series of relatively brief visits courtesy of HMS *Endurance*. Cochran and Collinge managed to visit nine sites, five of

The hut known as 'Wordie House' next to the old British Base 'Faraday' – now the Ukranian base Vernadsky. Photo: Michael Morrison which overlapped with my 2007 inspection. Their report recommended that four of the sites, Lockroy, Wordie House, Horseshoe and Stonington be put forward for Historic designation under the Antarctic Treaty. This recommendation was accepted and they were declared Historic sites on 19th May 1995.

The "Historic Site" designation

My interest focuses on three areas:-

- What constitutes a "historic site"
- What is an appropriate way of managing and maintaining a site that has been declared Historic
- What is the appropriate way to deal with any structure that is now redundant but is not an "historic site"

The Antarctic Treaty Resolution adopted at Seoul (Resolution 8 1995 – ATCM XXIX) sets out guidelines that anyone familiar with the preparation of conservation plans will recognise. To be of historic interest the site or monument should address one or more of:

1. A particular event of importance in the history of science or exploration
2. A particular individual who played an important role in the history of science or the exploration of Antarctica
3. 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 of knowledge in Antarctica
5. Particular technical or architectural value in its materials design or method of construction
6. The potential to reveal information through further study or the potential to educate people about significant human activities in Antarctica
7. Symbolic or commemorative value for people of many nations.

Whilst it will be obvious to all that Scott's, Shackleton's, Mawson's and Nordenskjöld's huts fit readily into most if not all of these criteria, the reasons why some of the other sites have been selected are much less obvious. Quite a good case can be made for the bases at Port Lockroy or Wordie House – but why the British base at

The hut on Detaille Island with the landing place and emergency stores hut in the foreground and a dog kennel top left. Photo: Michael Morrison

The Generator House at Detaille Island. Photo: Michael Morrison

Stonington? Chris Cochran recommended the Stonington base for historic designation following a very similar set of criteria to those adopted a year later at Seoul – but the events, the individual, the scientific research and the exploration that he uses to justify the historic designation are all in fact associated with the earlier hut on the site which was burnt down in 1975 and where only a few charred fragments remain. What remains to justify the designation is that this hut, built in four stages between 1960 and 1972, is representative of bases of that period and that it represents a departure from the timber framed huts of the 1950s in that it has a lightweight steel frame and plywood cladding panels.

This seems to be a modest claim for something as significant as an Historic Designation. On this sort of criteria it would be reasonable to argue that virtually every structure erected in the Antarctic has the potential to be designated – something that seems to be as undesirable as it would be absurd.

A further oddity of the Cochran and Collinge report is the suggestion that it is only necessary to keep one representative of each type of structure. This seems to be a response driven by financial concerns rather than any assessment of cultural significance. Cochran and Collinge visited the hut at Horseshoe Island and recommended it for designation. They failed to get to Detaille Island which has a hut of almost identical design – but knowing that the two were very similar they recommended that hut for clearance. This clean-up operation has been in prospect but has never taken place as weather conditions have not permitted access. We were able to visit this year and found that the hut at Detaille is arguably better preserved, has been much less disturbed by visitors and has contents that are at least as interesting, probably more interesting. BAS as the agency responsible for these sites are (not unreasonably) reluctant to take on a further historic site and will, in due course, clear it away – unless there is a change of policy. There seems to be little logic in one site being sufficiently historic and important to designate and the other (arguably more significant site) being removed.

The expense (or the potential expense) of maintaining an historic site, if this is to be taken seriously, is of course considerable. At present under the Antarctic Treaty there appear to be two acceptable classifications for a building – either it is an occupied scientific base or it is an historic monument. If it falls into neither of these categories (at least under current British thinking) it is a potential environmental hazard and should be completely cleared away. BAS, the agency responsible for these buildings and sites, it should be remembered is a scientific organisation funded by the National Environmental Research Council. They have become the custodians of these sites by default and are not funded to take responsibility for their long term maintenance and preservation, which is arguably a cultural and educational activity rather than a scientific one. It seems entirely appropriate that the responsibility of caring for one of the British sites, Port Lockroy, should have passed at least in the short term to The United Kingdom Antarctic Heritage Trust. But UKAHT is a charity supported by charitable donations and its long-term ability to manage this site, let alone to take on the responsibility for other sites, will be highly dependant on the goodwill of others – BAS and the Royal Navy, and to an increasing extent the tourist ships. The long-term funding of the upkeep of these sites is clearly a major problem.

Management responsibilities for Antarctic Historic Sites

The obligations towards historically-designated sites as stated in the Antarctic Treaty are specifically that: –

> *"Listed Historic Sites and Monuments shall not be damaged, removed or destroyed"*

Nothing in the Treaty puts any obligation on responsible countries to manage, maintain or repair these structures. It is rather as though they are a monument in the way that a standing stone or tumulus might be – i.e if you make sure that no one interferes with it then it will cheerfully look after itself. This is clearly a nonsensical position in the long term – but in the short term it has been possible to give something historic status and do very little about it. This is certainly the case with the American East Base at Stonington where nothing seems to have been done since the fifteen-day NSF "Clean Up" expedition which followed the 1991 National Parks Service survey expedition.

The short term costs of designating a site and then merely ensuring that it is not "damaged, removed or destroyed" contrasts strongly with the implications of a full environmental clean up of any site. The costs of a full clean up are, relatively speaking, enormous as contractors need to be used, ships chartered or re-tasked to allow the dismantling of structures and the removal of large amounts of waste. There are, however, some long term advantages for an organisation like BAS. They are an "environmental" organisation and it is simpler to get funding for an environmental clean up than it is for conservation work. Also once a site has been cleared it can have a line ruled under it in the accounts – there is none of the ongoing obligation that an historic site may imply.

So what is a reasonable way of discharging the obligations that an historic designation will incur? Cochran and Collinge's 1994 report was specific in recommending that, in addition to the immediate repairs, management plans needed to be drawn up for each site along with maintenance plans and proposals for the cataloguing and conservation of the numerous artefacts. Very little of this has happened. In the twelve years that have passed there have been some minimal first aid repairs at Horseshoe and Stonington – not enough to even keep the water out, and slightly more comprehensive repairs have been completed at Wordie House – though of a poor standard. At Deception Island there has been no work at all to the various buildings. There has also been a tendency to regard the main hut as the only element of the site with historic significance, missing the point that it is all the objects and structures on the site that create its historic and cultural significance. The only hut where there as been a sustained campaign has been at Port Lockroy. This has been brought back from complete dereliction to a standard where its future is secure, at least for the foreseeable future. There has also been a start on a catalogue of artefacts at Lockroy, but not at any of the other sites.

Recommendations

What should BAS be doing to look after these sites and indeed how should the other responsible countries be dealing with similar situations – for the problem does not occur just at the British sites? In my recommendations following this year's inspection I have suggested that the first priority must be to accept the need for active management and maintenance plans. What would an active management plan imply? Firstly that the responsible parties have decided what they want to achieve. Is the aim to preserve the buildings, their surrounding structures and contents for the next five years, for the next ten years, fifty years, in perpetuity? Is the aim to preserve the buildings and the contents and all the surrounding structures? Once the responsibility is accepted for the preservation and conservation of these buildings even at the most minimal level, then an active management plan is needed.

What, at its most basic, should a management plan cover? The following would seem to be the minimum:

- Deciding how the building should be used, if at all, and then monitoring this use.
- Putting the building shells into a good state of repair and keeping them that way.

- Considering all the secondary structures on the site (dog kennels, store sheds, radio masts, food dumps, fuel dumps etc) and assessing how much they are a significant part of the historic site.
- Using properly trained and skilled craftspeople and not supporting ad hoc repairs.
- Taking note of the health and safety issues of working at the site.
- Having the right material specified and used when any work is carried out.
- Managing the contents in a responsible way; this is likely to include the need for some sort of basic inventory and condition survey of the contents.
- Deciding on what is and what is not rubbish around the site and clearing away any that is dangerous, harmful to the environment or which is inappropriate.
- Having a routine maintenance strategy for the buildings, other structures and the contents to ensure that they survive for as long as is physically possible.
- Where a building is seriously damaged by weather or some similar event, making a conscious decision as to how to deal with it and not just leaving it in a state of collapse.
- Agreeing with any other interested party who is responsible for what.
- Having an appropriate budget allocated that makes the proper care of the sites possible.

What would be the minimum responsible way of looking after one of thee sites assuming it was in reasonable condition in the first place? I would suggest that this implies, as a minimum, an annual visit of inspection, routine maintenance and repair. This would deal annually with minor repairs and cleaning and would allow the condition of the structures and artefacts to be monitored. This would in turn encourage the planning and management of larger repair and conservation programmes.

Obviously this is only an outline framework that would need to be adjusted from site to site. At present the only site where this level of work is being carried out is Port Lockroy where it is being done by the UKAHT party who are operating the base as a "Living Museum". To achieve this sort of level of maintenance at the five sites which have an historic designation at present is going to demand a huge increase in the resources being allocated to these sites and it is difficult to see where this will come from.

Port Lockroy

It is somewhat ironic that the single site that is complying most closely with the concept of maintenance is the one that is most controversial in "Historic Building" management terms. In seeking for some common standards to be achieved by all the Parties to the Antarctic Treaty who deal with historic sites, one area that could most easily be agreed is that it is inappropriate to occupy a historic building other than in the most dire emergency. This has been turned on its head at Port Lockroy where the building is staffed over all the summer months by a team of three of four who greet the visitors and inform them about the history of the hut and the wider history of the British involvement in Antarctica as well as operating the very popular post office and the gift shop. These staff are providing a good standard of ongoing repair and maintenance work. They are in conservation terms breaking many of the normal rules – their presence is adding to the wear and tear on the interior of the building; the activities like cooking and heating produce widely varying environmental conditions; historic artefacts such as bunks, table and chairs are in every day use; modern bits of equipment are mixed in with historic artefacts in areas like the workshop. There is also the question of the standards of workmanship and that surfaces, rather than being conserved, are being renewed and repainted very much in the spirit of the original occupants. However, even though the occupation and the maintenance standards may be controversial, this hut is being well maintained where the others are not and the occupation and interpretation is probably doing more for the general tourists understanding of the history of scientific work and the exploration of the Peninsula than anything else.

Conclusion

Where is this all leading? I would suggest that there needs to be much more positive guidance in the Antarctic Treaty over the implications of any site being declared Historic. It does not seem sufficient that they shall not be *"damaged, removed or destroyed".* As a minimum the requirement should be to have an active management plan that declares the intentions for each site. A management plan could result in very different decisions for different sites. Perhaps at Deception Island the decision would be to do nothing to any of the buildings other than the minimum demanded by health and safety and environmental considerations – effectively accepting that all traces of the buildings and human occupation of the site will disappear over the next hundred years or so. At the other extreme the decision at Port Lockroy could be that the intention is to keep the buildings as close as possible to a functioning base with the implications that historic fittings and fixtures will be replaced with modern working replicas. The decisions made in the management plan then dictate the appropriate degree of maintenance work at each site. The argument will then be around the appropriateness of the management strategy and whether the maintenance work is meeting the needs of the particular strategy for any site.

At present, with the exception of Port Lockroy and Nordenskjöld's Hut, there does not seem to be an agreed management strategy for any of the sites. The repairs that have been done are minimal and certainly not sufficient to secure the long term future of the site or to meet even minimal obligations for maintenance. There has also been a tendency to focus on the principal building and to ignore the fact that all the other structures on the site make up the whole picture. Where work has been done it has been completed to inappropriate standards. By making the basic management policy decision for each site there would at least be a standard to be aimed at – be it slow disintegration, stabilization and conservation or occupation and interpretation.

It was proposed to the delegates at the IHPC meeting that the Antarctic Treaty should be amended to ensure that there is an obligation on any country proposing a site for listing as a Historic Site or Monument to prepare a management plan for that site. This obligation should also extend to those responsible for buildings, monuments and sites that have already been listed. The Management Plan should as a minimum requirement set out the following:

- The long term objectives for the management of the historic building, monument or site.
- Who is responsible for the management of the site and how this will be appropriately funded.
- The level of maintenance to be achieved and how this is to be delivered.
- The standards of workmanship and materials to be used.
- The proposals for the regular inspection and reporting on the condition of the building monument or site.
- The regulations for visitor management appropriate to the building, monument or site.
- The regulations, if appropriate, for the continued use of the building or site for scientific purposes or in an emergency.

It is further suggested that consideration be given to an additional category of building in Antarctica, something between the occupied base and the historic site. This would be in long winded terms "*The unused building of no specific historic interest but doing no harm to anyone"* category. At present there is apparently no alternative to a disused site being either historic or awaiting clearance. This might place pressure on the designation of sites as historic to avoid the massive clean up costs. If a lesser category existed there would be the possibility of carrying out minimal repairs to such buildings simply to keep them in reasonable order for a relatively short time frame at the end of which their condition and significance can be reassessed.

Scientific Evaluation of Deterioration of Historic Huts of Ross Island, Antarctic

Roberta L. Farrell, Shona Duncan, Robert A Blanchette, Benjamin W. Held, Joel Jurgens and Brett Arenz

Abstract

Early explorers of Antarctica's Heroic Era erected buildings and brought large quantities of supplies to survive during their exploration and scientific studies. For the past ten years, we have been studying the biological and non-biological causes of deterioration of the historic structures, considering applied goals to assist in conservation and preservation, and fundamental goals of studying isolated fungi and their biochemistry. Although Antarctica has one of the coldest and driest environments on earth, microbes colonized the wood and limited decay has occurred. The principle structural component of wood is cellulose, and some fungal isolates from the historic huts have been shown to produce the cellulolytic enzymes necessary for decay and at 4°C. Additional investigations are needed to provide a more complete understanding of the biology of these microbes but clearly their presence must be taken into account in future conservation efforts.

Introduction

The Antarctic Heroic Era was an exciting time of discovery and bravery – it was the furthest explorative reaching of man at the time, and can be likened today to venturing into space. The British National Antarctic Expedition (1901-04) led by Robert F. Scott built a wooden building at Hut Point on Ross Island, Antarctica, commonly referred to as *Discovery* Hut, to shelter and store supplies for 48 men for 3 years. The British Antarctic Expedition led by Ernest Shackleton followed in 1907 when a hut was built at Cape Royds to house a shore party of 15 men. Scott returned in 1910 on the ill-fated *Terra Nova* British Antarctic Expedition. This 25-person expedition erected a large prefabricated hut at Cape Evans to provide accommodation and also built a smaller structure that was framed in wood and lined with asbestos sheeting for taking magnetic observations.

The 'science lab' in *Terra Nova Hut*, January 2004. Photo: Roberta Farrell.

Discovery Hut was used extensively by the latter expeditions in the Heroic Era as a key stepping stone to the southern latitudes and a shelter for those who returned from the south. Although all three expeditions had primary goals to discover new land and be first at the South Pole, they also had important scientific objectives. Each of the expeditions had one or more biologist, geologist, meteorologist and physicist to carry out the scientific programs. When the expeditions ended and the relief ships arrived, a rapid exodus allowed only essential items to be returned to England. The huts and thousands of items were left behind, including food stores and fuel depots with unused containers of petroleum products, asbestos materials, and diverse chemicals.

For the past ten years, a joint scientific collaboration between The University of Waikato, New Zealand, and the University of Minnesota in the USA has evaluated the deterioration of the huts and artifacts of the Ross Island Historic Huts and their environs. The key to the collaboration has been to use state-of-the-art multi-disciplinary scientific methodology. Specifically, for the first time in the Antarctic, microbiology, wood chemistry, biochemistry, and molecular biology have been applied to the study of the deterioration while also working with Antarctic Heritage Trust and conservation architects who are developing conservation plans for the Ross Dependency Historic areas. The three major goals of the collaboration are as follows:

- Identify cause of non-biological & biological deterioration present in Historic Huts & artifacts.
- Characterize environmental pollutants in the historic areas left behind from the 'Heroic Era' of exploration.
- Investigate fungal biodiversity and ecosystem functioning in the Historic Hut areas and generally in Antarctica.

The Ross Island historic huts and surrounding areas attract tourists as well as scientists and visitors from nearby McMurdo and Scott Bases and are therefore the most affected by decades of human activities of any Antarctic historic areas.

Non-biological Deterioration

Non-biological degradation processes can severely affect the physical and chemical structure of wood.[1] Morphological examination of minute wood samples, including light microscopy, scanning electron microscopy, and transmission electron microscopy are used by the Universities of Minnesota and Waikato's collaboration to characterize decay patterns present.

Snow accumulation in the interior of *Discovery Hut*, August 2007. Photo: Roberta Farrell.

Ultraviolet (UV) light, iron corrosion products, salts and other caustic compounds cause a deterioration that progresses from wood surfaces to inner regions of the wood. UV light may cause a selective attack of lignin and hemicellulose resulting in a defibration of the wood. Over time a gradual loss of the outer wood cells takes place and the surface gradually erodes away. Salt accumulations in wood cause chemical erosion of the lignified middle lamella and alterations to cellulose within the secondary walls. This chemical attack has only recently been described and the conditions for its occurrence elucidated.[2] Damage may occur quickly where large concentrations of salt are in contact with moist wood or very slowly as low concentrations of salt accumulate in wood after evaporation. The diffuse nature of the damage throughout the wood, lack of fungal mycelia and selective attack on the lignified middle lamellae suggest deterioration of the surface layers of the wood are affected by this attack. Although the exact process of salt deterioration in wood is not fully understood, it is apparent that the high salt concentrations cause a chemical reaction to take place in which the hemicellulose and lignin in the middle lamella is degraded.[2] This is exhibited in affected woods by a defibration of surface fibers, giving the wood surface a fuzzy appearance. There are many locations at all three huts that are affected by salt deterioration. All of these locations involve moisture absorption from melt water in pools on the ground, or by the melting of snow from the roof dripping directly on to the hut walls or artifacts[2], or from melting snow, which enters the huts during the winter.


Evidence of affected wood at Terra Nova hut at Cape Evans: on the right it shows at the base of the exterior walls with the furrowed appearance of the wood surface due to salt erosion and on the left the evidence of selective removal of thin-walled earlywood cells. Photos: Roberta Farrell.

Wind erosion can be identified in many locations of the huts and associated artifacts.[3] High velocity winds originating from the South Pole carry airborne particles that cause a sand blasting effect on the exposed wood. Therefore most of the significantly eroded areas are those that face south. By using digital videography over the past six years the collaboration has documented that the exterior wood is not eroded uniformly by wind. Windborne particles erode the highly lignified, thick-walled latewood cells at a slower rate than the thin-walled earlywood cells, leaving affected wood with an uneven, furrowed appearance, as shown in Figure 3.

Biological Deterioration and Biodiversity in the Historic Huts

Biological degradation of wood and other organic matter is common in the huts. Actively growing fungi have been observed and isolated from walls, floors, ceilings and beams, clothing, leather, wood, foodstuffs and other artifacts within the huts, and from air sampling. The Universities of Waikato and Minnesota's joint collaboration has isolated and identified wood decaying microorganisms present in the Historic Huts and environs, and addressed the general biodiversity of microorganisms present.[4, 5, 6, 7] The samples have been brought out of Antarctica to the University laboratories where these samples are cultured for isolation of fungi and/or bacteria, on a wide variety of growth media, at various temperatures, typically in the range of 0 to 25 ºC, or studied by molecular techniques. Pure cultures of fungi have been obtained and identified using various taxonomic keys from the mycological literature and/or molecular DNA probes, just as is done in forensic analysis.

The temperature with the huts ranged from 2.5 ºC to -39 ºC over the period January 1999 to December 2002[11]. Conditions were favourable for fungal growth for a minimum period of 0 hours to a maximum of 569 hours during 2000 to 2002[11]. Organisms that can grow at these cold temperatures are defined as psychrophiles or psychrotrophs depending on the range of temperatures they can grow at. Selections of fungi isolated from the huts were tested over a range of temperatures ranging from 4 ºC to 25 ºC. All the fungi tested could grow at 4 ºC and all could grow at 25 ºC with the optima growth temperature being 15 ºC, classifying these fungi as psychrotrophs[8].

Research into cold adaptation mechanisms in cold inhabiting organisms has showed that there are a wide variety of possible methods to ensure survival in unfavorable conditions and that most organisms use a variety of strategies. One possible method is cold avoidance, surviving the winter in a more cold resistant form such as spores. Using air sampling, quantitative numbers of fungal spores were determined during the summer period (January) and after winter (August). It was found that the number of spores present after the winter was not significantly different than during summer, which is the period of most rapid growth.

Fig. 4: Testing for aerial spores using a Merck MAS-100 Eco® in *Terra Nova* Hut, August 2007. Photo: Phillipa Barn.

Cellulases, enzymes that catalyse the degradation of cellulose in fibers, such as wood and/or cotton textiles, have been isolated from several of these organisms and have been characterized as to their role in the decay of wood at temperatures experienced within the huts[8]. A plate screening technique was used to screen a selection of the fungi isolated from Antarctica for cellulase activity. 26% of the fungal isolates were deemed to be cellulase positive. When cellulase activity was compared at cold and temperate temperatures, most of the fungi were able to produce the enzymes at both temperatures with a few producing more at the cold temperature.

An unusual wood destroying fungus is causing decay in the historic woods that are in contact with the ground.[7] Micromorphological examinations indicate just one type of decay, a soft-rot, is present in all of the deteriorated woods. Pure cultures obtained from the historic woods were identified by morphological characteristics and phylogenetic analysis. The fungus grows into the wood cells, forming elongated cavities within the secondary wall layers. New knowledge of these polar fungi is needed if we are going to find effective controls that can be used to preserve the huts long into the future. Successful conservation of the huts requires an understanding of these mechanisms, and of the biology and ecology of these decay organisms so degradation processes can be controlled.

General Environment of the Historic Huts and Environs

The environment of the Historic Huts is also being scientifically studied. There are many chemicals in various unlabelled bottles, containers and in glass tubes or other scientific apparatus left within the huts that should be evaluated to ascertain their identity. Chemical spills may also still occur by freeze-thawing of liquids and subsequent glass breakage or by inadvertent accidents from curious tourists that visit the hut or even conservation and research activities within the hut. An historic chemical spill within the Cape Evans hut, apparently from caustic substances from one of the scientific experiments, has caused an unusual deterioration and defibration on affected woods.

Decaying stores around the hut are degrading the environment, as shown in Figure 4, and under current environmental protocols for Antarctica intervention to prevent further pollution is imperative. Fuel depots with unused containers of petroleum products, asbestos materials, and diverse chemicals were also left at the huts [9, 10].

Decaying food stores exterior to *Nimrod* Hut at Cape Royds prior to conservation efforts. Photo: Roberta Farrell.

The joint collaboration found high concentrations of polyaromatic hydrocarbons in soils under and around the historic fuel depots. Asbestos materials within the huts have been identified and extensive amounts of fragmented asbestos were found littering the ground around the Cape Evans hut. These materials are continually abraded and fragmented as tourists walk over them and the coarse scoria breaks and grinds down the materials. Although these areas are important historic sites protected by international treaties, the hazardous waste materials left by the early explorers should be removed and remedial action has been proposed to restore the site to as pristine a condition as possible.

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Challenges of Conservation in the Antarctic

John Greenwood and Megan Absolon

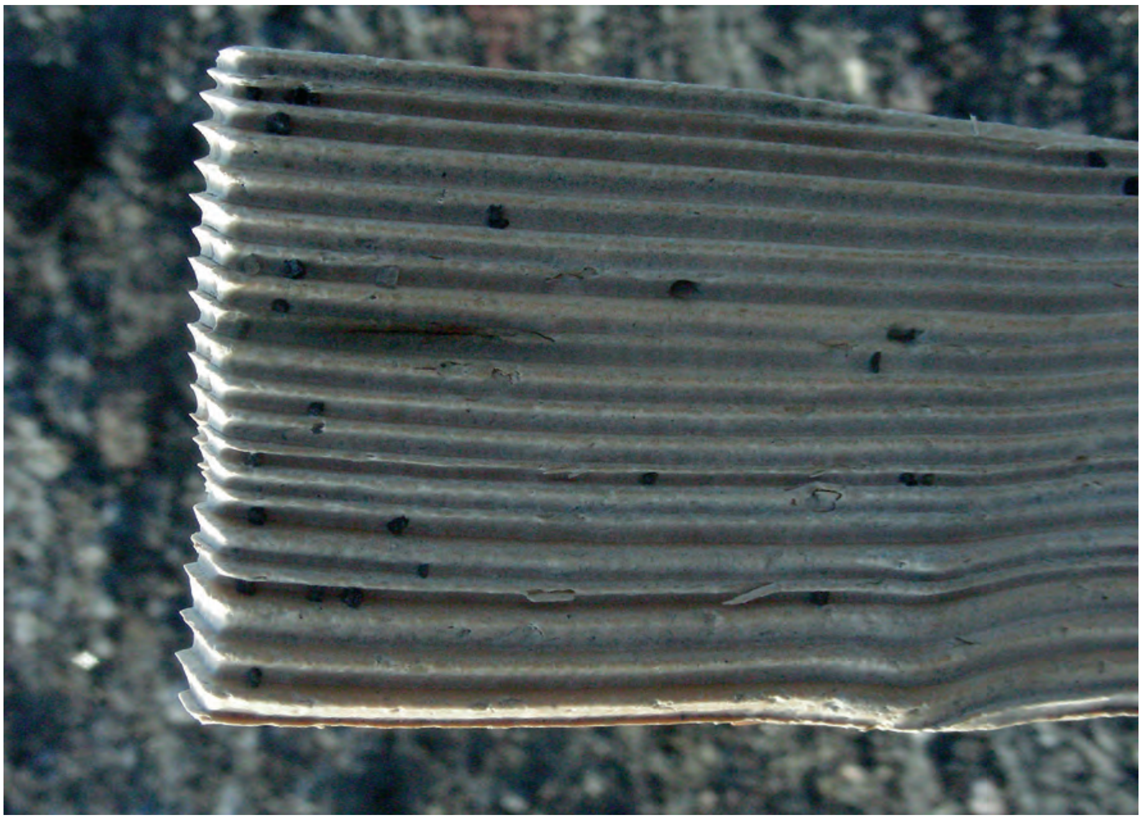
The lure of Antarctica

Most people will never visit Antarctica, but long to experience its unique character, its extremes and its distant glamour (Dodds, Klaus J. 2002) To even consider visiting is a challenge of stamina, perseverance and finance. The sheer difficulty of seeing the place and its isolation does not diminish its power to seize people's imagination. Many, if not most, people have an image of the continent and in general their view is formed, at least in part, by the exploits of the Heroic Era explorers (Wheeler, B. & Young L. 1998). Even if they are not able to visit, they can thus see the place as a 'Surrogate Adventure' (Makay R. 2007).

As a continent, Antarctica has an unusual and short historic past. It is the only continent that has the first habitations still extant; these buildings still contain and are surrounded by a large number of the artefacts left from each expedition (AHT 2004). This material legacy is supported by a full and well-documented collection of reports, diaries and accounts detailing the everyday minutiae of the lives of the occupants. The archive of documents and material evidence is highlighted by popular culture, documentaries, stories and films, some more entertaining than accurate.

The Antarctic Heritage Trust was formed with the vision to "Conserve in perpetuity the human heritage in the Ross Sea Region; Inspiring the future by conserving the legacy of discovery, adventure and endurance" (AHT 2003). It has worked steadily towards this vision and in so doing has set a series of challenges for the conservators it has employed.

To set out to conserve what is in essence the majority of the most significant buildings and artefacts that cover the entire human habitation of a continent is a daunting challenge. To conserve huts, which were built of wood, canvas and other environmentally vulnerable materials in one of the most inhospitable and harsh conditions in the world, challenges the skill and professionalism of those lucky enough to work on them. Not



Wood damaged by wind and scoria erosion Cape Evans. Photo: AHT 2007 only to preserve the structures, but also to carry out full conservation treatments on thousands of objects covering a range of material including metal, paper, wood, textile and food remains. To conserve them in a full and complete manner and then replace these artefacts back into the extreme conditions is not an undertaking to be taken lightly.

The hut projects include Cape Adare from the first British Antarctic Expedition 1898, Discovery Hut from Scott's expedition of 1902, Cape Royds from Shackleton's expedition 1908 and what to some is the most iconic, the hut at Cape Evans where Robert Scott set off for his race to the Pole. These huts represent what is now referred to as the Heroic Era of polar exploration. They are more than huts, and represent an era of endeavour, a world view that encompasses the British Empire, a period when countries struggled for world domination and a past world of adventure and heroism. There is so much more to conserve than simply the material remains; there is the complex and sensitive immaterial and even spiritual aspects relating to discovery, adventure and endurance to consider as well.

The huts and their associated artefacts have been recognised as some of the world's most important and endangered buildings (World Heritage Fund 2007). This is of portentous significance in itself. However, unlike the majority of buildings in this category, the huts have not been around for thousands or even hundreds of years and they are not visited by large numbers of tourists. Very few people will see them and their significant history only spans a few years. For most people they exist only in photographs, stories and their imagination. They are a heritage anomaly.

Conserving Antarctic heritage

As a conservation project the huts and artefacts present huge challenges. The AHT has invited conservators throughout the world to come and work on the project. It is one of the few truly international conservation projects. Small teams of conservators, specialists within their respected fields, are recruited for what is in reality a very short six months, and they work closely and co-operatively as a team. The conservators have to undergo probably the most rigorous and intrusive medical check-up of their lives, make great financial and personal sacrifices and when they arrive undertake a period of field training involving extreme cold weather survival and sleeping in ice caves. They have to have the physical and mental stamina to live and work in a small, enclosed community and form close bonds with colleagues from a variety of different backgrounds. All this must be

Removing build-up of snow and ice at Scott's hut, Cape Evans at the start of the summer field season. Photo: AHT 2007

Interior of Scott's hut Cape Evans before the removal of artefacts for conservation. Photo: AHT 2007

undertaken with harmony and patience as there is no escape, especially when the base is isolated for the period of the dark antarctic winter – a double challenge for the conservation work. The summer team has to carry out complex and technically challenging conservation techniques in the field at temperatures below freezing and camp out for extended periods with a few companions and a lot of penguins for company.

The fact that Antarctica is cold, windy and inhospitable is self evident. There are extremes of temperature and wind that make working in the field very difficult and necessitate the use of very different techniques and the adaptation of materials and equipment. Data gathering and environmental monitoring by the Universities of Waikato and Minnesota show that the temperatures in the summer can rise to $+5^{0}$C with average relative humidity within the huts being 72-82% and extremes reaching above 90% (Blanchette, R.A., Farrell R.L., et al 2002). 'Normal' conservation techniques as taught to students involve water-based materials, polymers and plastics and adhesives that are heat sensitive. These techniques and materials are ingrained into the work of the conservator and it needs careful planning and forethought to foresee the problems. Water freezes almost instantly, adhesives will not set and polymers crumble and disintegrate. Simply carrying out everyday conservation becomes a challenge. Work in the relative comfort of the lab may appear on the surface to be the same, however the long-term effects on the historic material will be radically different and the effects on the environment have to be considered.

Materials and treatments

There has been some testing of materials (Viduka et al) carried out to ascertain what is the most suitable for the conditions. Under the terms of the Antarctic Special Area Permit and the terms set out by the AHT, all materials (with very few exceptions) will be treated and stored and returned to their original setting. This is contrary to the accepted ideas of conservation where items are removed from poor conditions, treated and replaced in controlled, suitable conditions. Extreme cold, high winds, high humidity inside the huts and low humidity outside are far from ideal conditions.

When choosing materials and treatments, the environment presents other challenges. All material must be transported down either by plane or ship. This necessitates long-term planning. Materials must be stored and significant quantities stockpiled. Space is at a premium at an Antarctic base and very expensive to maintain. Only materials that are undamaged by extreme cold can be stored outside. There are legal constrains specific to the region. Under the terms of the Antarctic Treaty all materials must be considered for their environmental impact (Antarctica Environmental Protection Act 1994). Disposal of materials and chemical waste is complex and expensive as all but the grey water from washing must be shipped back to New Zealand. All materials must be recycled and even natural materials such as wood are subject to strict import restrictions.

Other logistic challenges include the necessity to transport material to the historic huts either over the ice by Hagglund vehicles or out to the more restricted site at Cape Royds and Cape Adare by helicopter. The latter is expensive and with complex weight restrictions.

There are thousands of objects associated with the huts and the time scales involved to complete the project are limited. Conservators must work to tight targets and deadlines. There are objects identified as priority, but on the whole the vast number of artefacts need to be conserved as they are unpacked. The objects also present their own hazards. Some of the materials used within the huts, such as asbestos, have associated and deadly effects. There are bottles of chemicals, some unidentified and some poisonous, from the laboratories and darkrooms that were in the huts. These have to be handled in an environment where the wearing of protection can in itself be a challenge as the conservator is also wearing bulky extreme cold weather clothing. The high relative humidity produced by the enclosed spaces within the hut and the lack of ventilation have encouraged mould and fungal growth, releasing spores which may cause breathing difficulties (Blanchett R.A. 2004). There have also been potential biohazards associated with the corroding food cans and from fodder in the stables.

The structural stability of the huts is of paramount importance and there is an on-going process of structural conservation. Sourcing the materials presents challenges. The wood for the original huts, Scots pine, spruce and fir came from the United Kingdom (AHT 2003). To replace with acceptable similar timbers requires sourcing wood with near-matching visual properties, obtaining permits to bring it into New Zealand, then shipping it undamaged on to Ross Island. The wood for the timbers needs to be worked in situ. Workshops with power, shelter, heating and storage need to be established. Moving heavy equipment across the ice involves specialist field support. Fuel for power and heating must be transported and stored and the environmental impact of spillage use and storage is strictly controlled (Antarctic Environmental Protection Treaty 1994). The choice of fastenings and fittings and setting up field workshops is just the start of the problem. Producing the aesthetic balance between the structural stability and historic accuracy is a complex and difficult task as the original wood is heavily weathered, with fibre damage and salt impregnation. (Blanchette, R.A. et al 2002)

The myths

There is a body of opinion that the artefacts left by the Heroic Age explorers are in good condition. The myth that artefacts are in a near perfect state (Trevellyn M.1996) is well explored by Hughes (Hughes 2000), but is perpetuated in the media and the story persists (Dominion Post 2005). The idea of *frozen in time* and *freeze*

Transporting conserved artefacts over the sea ice to Cape Royds in a Hagglund. Photo: AHT 2007

Author separating venesta boxes from Bowers annex, Cape Evans, for removal and conservation. The boxes are frozen together which necessitates the use of wedges, metal plates and club hammers. Photo: AHT 2007

drying preserves everything is too ingrained to be easily disproved by scientific facts. These ideas in turn produce a false notion of what the visitors and tourists expect.

The Heroic Age of the explorers has left us with a legacy of myth. Using the name *heroic* and words such as *endeavour* deliberately guides us towards a view of the explorers as Edwardian heroes. Heroic people have heroic myths and this provides the conservator with what is perhaps the most complex challenge regarding conservation in polar regions. How do you conserve the spirit of the place? There are intangible elements associated with historic sites that are complex and personal. These elements are built up of stories, reports, ideas, and are interwoven with the artefacts, physical remains and the environment. Without this element any visit would be sterile and empty. It is what creates the magic. The relationship between the myth of the iconic Heroic Era is reflected in the fragile and ethereal nature of the huts and their survival against the elements, and produces a complex picture of the heritage that is being conserved (Mackay R. 2005).

The interpretation of a site and the factors involved, the choice of which artefacts to display, how the place is set out and even the lighting contribute towards the creation of an environment where the visitor can learn, enjoy and make the most of their link with the past. To conserve the spirit of the place, the place needs to strike a resonance with the visitor. The conservation of the intangible aspects is much more challenging than working with the tangible.

As with all heritage conservation a decision must be made as to how and to what level an assemblage of artefacts is conserved. The historic huts in the care of the AHT have been very carefully documented and the philosophies for the conservation clearly stated. The challenge is to create the balance between reflecting the huts' occupancies and producing a feeling of reality linking time and place; a link with the heroic explorers.

The sites have been changed throughout their brief existence, having been used by a number of expeditions and as shelters for some of the explorers whilst travelling between sites. They have been altered and the contents moved around during various periods within the last 50 years. There has been conservation and restoration carried out at various times, objects removed and remedial and emergency repairs carried out. As with all such sites, the reproduction of the original is impossible and there can only be a reinterpretation based on evidence and research.

The conservators need to work closely with the curators and collection managers. It is the role of these heritage professionals to correctly judge the historic and political interpretation of the huts. It is the role of the conservators to correctly judge the level of conservation intervention. This conservation intervention in the huts is in many ways similar to the conservation of sacred places around the world and calls for similar judgement and knowledge. The conservators have to face the challenge of working to preserve the intangible ideas represented by discovery, adventure and endurance.

Polar conservation

The potential for the development of conservation techniques and further research is vast. The field of polar conservation is largely unexplored and the knowledge gained so far is a gateway to the future. It would be a mistake to think that conservation within the Antarctic is unique. The Arctic presents the same environmental conditions with the same challenges. Unlike the southern polar region, the Arctic has a long history and pre-history, it has a large number of indigenous groups and their heritage, archaeological record and environment are well studied. There needs to be close co-operation between groups working to conserve the material remains from both polar regions and coordinated research and study undertaken. The opportunities that are offered through the International Polar Year are an excellent starting point for this co-operation and hopefully will be the starting point for the development of the field of polar conservation.

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MINUS SIX DEGREES OF SEPARATION

Adam Wild

There is a dynamic nature to the architectural process of considering a problem and the variety of responses and solutions to it. This is an action of potential infiniteness. The process is not necessarily a straight line from A to B. Each extension affords a wider scope from which to consider appropriate and ethically derived decisions. The journey, direct or otherwise, should engage multidisciplinary science. This is as pertinent in building conservation as it is in new architectural design.

The Antarctic Heritage Trust's Ross Sea Heritage Restoration Project is charged with the care of the heritage of the Heroic Era located in the Ross Sea region of Antarctica. The expansion of the project's designed resolution has embraced a broader, and for it richer, view and response to the task at hand. For me the journey in this case has resulted in a collaborative phenomenon; something introduced to me as "the Antarctic way". A process where everyone was interested in what everyone else was doing; where help could be offered, and was, freely. It is a place where any door can be opened.

The expansion of the project's "discipline" seems at times serendipitous. In this paper I call it: *minus six degrees of separation*.

minus one degree: in the beginning

In 2001 I was visited by a project manager whose brief it was to find an appropriately qualified conservation architect to join the Antarctic Heritage Trust's Heroic Era Huts' project team and, in response to his own sense of practicality, find someone "fit enough" to pull him out of a hole in the ice and "young enough" to see the job through. The opportunity of being a member of an international team responsible for the conservation of the huts associated with the Heroic Era of antarctic exploration, their context and for the conservation of the *spirit* of what these places have come to mean, was clearly going to be something pretty special. That all this was to happen in that most enigmatic of continents, the Antarctic, seemed all too much the stuff of dreams.

minus two degrees: north

Any project can have an air of the unconventional and unexpected. Having been engaged in the Heroic Era Huts' conservation project I found that my first steps towards the Antarctic were northerly in direction and serendipitous in consequence.

In December 2001 I found myself at the top of New Zealand House in London, at the international launch of the project. Being in London also gave me an opportunity to meet with the project's international peer reviewer, Michael Morrison. This gave Michael and I an opportunity to break the convention of author and reviewer and instead we were able to discuss in person the objectives and processes ahead. Something struck me about the value of meeting and working with Michael before getting underway and establishing a relationship that has facilitated and encouraged dialogue and collaborative thinking. Collaboration across disciplines has become a consequence of the *spirit* of this project.

London was followed by an invitation to Cambridge and the Scott Polar Research Institute (SPRI). There I was met by its archivist and curator (now retired) Bob Headland, who I was to meet again on Ross Island a few years later. Again, convention seemed to dissolve as Bob's welcome came with a glass of wine and a piece of Christmas cake! Through Bob, I was also introduced to a number of "Antarcticans", including Alan Carroll, ex Base Leader at the British Antarctic Survey's base at Port Lockroy from 1955 to 1958. Through correspondence with Alan two fascinating opportunities for extending our understanding of the Ross Island Heroic Era Huts have been revealed.

The first was an introduction to a descendant of Harry Dunlop, Shackleton's *Nimrod* carpenter. Dunlop's personal diary and photos recording the construction of the hut at Cape Royds had never been released by the family before this time and it was as a consequence of our correspondence with Alan that this information was able to be reviewed. Alan's second "lead" in the quest to better understand Shackleton's Cape Royds hut came from the chance discovery of an extant example of a prefabricated hut equivalent to that used by Shackleton and manufactured by the same Humphreys Limited, Knightsbridge. These huts were, after all, catalogue buildings.

minus three degrees: south

The stories of Scott and Shackleton are well known. So too are some of the continent's essential statistics: the coldest, driest and windiest continent; containing 80% of the earth's fresh water.

It is this paradox which has been credited with slowing the decay of the timber huts and associated materials left behind by the early explorers. However, this extreme and remote environment presents its own technical and logistical challenges including: high relative humidity; temperature change; chemical degradation; high ultra violet light levels; wood destroying soft rot fungi, existing historic environmental pollutants and, strong Katabatic winds composed of a thick layer of «heavy» cold air that slides down the polar icecap towards the coast under the influence of gravity. These winds vary depending on location, but are generally worse in coastal regions. Wind speeds of up to 150 km/hr with gusts up to 200 km/hr are not uncommon.

Despite the ravages from the environment and the "desolation" of the past 100 years as Scott had anticipated, these places have somehow survived against expectation. In combination these factors present some unique challenges to the conservation of the huts, their environmental context, and to the working team. The particular and often severe effects of the Antarctic environment can be exacerbated by the unique topographical contexts of each of the huts and their construction systems. In addition to these physical factors the huts, their fabric, and their artefact collections are read together in that physical context as the historic cultural heritage markers and unique values. Each of the huts has particular and distinctive contexts which inform our understanding of their significance and this understanding leads directly to appropriate processes towards their conservation.

Discovery Hut (1901-1903) is a square-plan prefabricated wooden building constructed by James Moore of Sydney at a cost of £360.14.5d. Originally designed by Professor Gregory before his resignation from the expedition as head of the scientific staff, its Australian origins were apparent through the open veranda on three of its four sides. The timber roof, panelled walls and floor enclosed an air space for insulation, but the hut was famously cold and during the Discovery expedition was never permanently occupied as sleeping accommodation. When complete the hut may well have been painted; remnants of a terracotta paint can still be seen. Skylights to the verandas appear to have included an early form of wired glass featuring a one inch hexagonal wire mesh.

Discovery Hut stands on the path of every journey from the Ross Island Heroic Era huts to and from the Trans-Antarctic Mountains, the glaciers that lead to the polar plateau and the Pole. It is beginning and end to each 'push' South and, 'home' for each returning party. It tells a haunting story of desperate survival and stands as testament to the Heroic Era expeditions and their spirit of Antarctic exploration and science. Today it shares a strangely incongruous modern context with the neighbouring McMurdo base.

Discovery hut sharply contrasts with McMurdo Base behind it. Photo: Adam Wild 2001

Cape Royds

After the experience of the Australian outback hut at Hut Point, various attempts to insulate the later huts were made. The specification prepared by Humphreys Limited for Shackleton lists the "*whole of the space between outer and inner lining to be packed with slag wool*", but what we have found at Cape Royds is that Shackleton has used granulated cork within the interstices of the wall. Over the years, the effect of the wind on the wooden hut has meant that the cork has been shaken out like grains of salt from a salt shaker. Alan Carrol wrote to me regarding the Humphreys-built "Shackleton" hut he had found in the UK and its insulation:

> *"Insulation? – we British folk didn't hold with such sissy stuff back then. Even the prefabricated 1943 'Spitzbergen' hut sent to Lockroy only had sheets of foil-backed Sisalkraft paper tacked on the studding. We were men, back then, I tell you (or is it that which made me what I am today. There's a thought.)"*

On the roof, in the darkroom, the cold porch and to the inner and outer faces of Mawson's lab a layer of 'Stoniflex' felt was specified and applied. Our search for the manufacturer of 'Stoniflex' has identified an Irish company, but no more. Analysis of samples taken from site have identified that the material is a jute-based felt, but this analysis has not identified any other additives.

The relative dryness of the environment at Cape Royds has meant that over time the vertical tongue and grooved cladding has shrunk and the joints between each board have opened. The nature of the dry snow (as fine as cornflour or talcum powder) means that it can penetrate any cavity, thaw and refreeze forcing open the joint further. The work at Cape Royds has been blessed with the engagement of an especially skilled carpentry team.

To address this essential issue of the external cladding and its weather-tightness the conservation carpentry team led by Gordon McDonald and Charlie Brentnall devised a special routing blade which could be worked up the inside face of the grooved joint without (it was hoped) having to remove the board from the wall. The concept then was to slide a flashing up the joint and effectively seal the interstices of the wall from further snow ingress. This was discussed by the team and prototypes of the tooling trialled and mock-ups tested. The malleability of the proposed flashing led to considering thin strips of copper. We had seen however that previous use of copper and copper alloys on the hut were inclined to patina and as a consequence stain the historic fabric. An alternative flashing in a clear, ultra violet resistant product called 'strata glass' commonly used as canopy "glazing" in the boat building industry was proposed. The product can be pre-cut by computer to the specified widths and as single lengths (without joints) rolled ready for insertion in the newly cut joint. It is scratch resistant, clear, stainless, and reversible. Implementation of this on site has proved successful and that success has direct potential for applications at the other huts.

Gordon Macdonald and Charlie Brentnall at Cape Royds. Photo: Gordon Macdonald 2006.

Cape Evans

Scott's attempts at insulating the Cape Evans hut were equally inventive. The timber frame was lined with six layers of material. On the inside face of the framing there are two layers of vertical tongue-and-groove boarding with insulation between, while on the outside face there is one layer of tongue-and-groove boarding, then insulation, then finally weatherboards (figure 3). The insulation consists of layers of shredded seaweed sandwiched between linings of Hessian, known as Gibson Quilting.

In a more temperate climate, the strengths and the weaknesses of the Cape Evans hut site would be more apparent. Sited on the foreshore it commands views to sea, punctuated by the terminal "tongue" of the Barne Glacier. However, the hut straddles the contours of a natural watercourse which, even in the Antarctic

Details of insulation, Cape Evans hut. Photo: Adam Wild 2001

environment, channels snow, ice and melt water beneath the hut in a natural path to the sea.

Proximity to the sea, even in the frozen Antarctic, has an effect on the fabric of the huts. This appears, in combination with abrasion from wind-driven ice and scoria and the effects of ultra-violet light, as a chemical degradation of the fibres of the timbers by way of saturation of the timber with salts. Without the cleaning effects of rainfall or washing, the timbers become saturated with salts which affect the cellular structure of the wood resulting in the defibration of the timber.

The effects of freeze/thaw cycles and the chemical degradation on the fabric of the hut and its contents are real and ever present. It seems too easy to accept the generalised clichés of the Antarctic environment (cold, dry, windy) and not to examine the specific and particular nature of the local environment of each hut.

There is a distinction between the sustainable patina of building fabric over time and the consequences of environmental effects that otherwise threaten the historic place. At Cape Evans there is a subtle example of this in the patina on the glass panes in the windows of the science lab area. These have been exposed to the prevailing southeast winds for nearly 100 years. The consequent opacity of the glass allows the transmittance of a soft light into the space enhancing the qualities of the space and testifying to the patina that speaks of Ruskin's "voicefulness" of age and presents a vision of truth and myth. Truth has past, present and future readings.

Wind scoop Cape Evans hut. Photo: Adam Wild 2001

minus four degrees: science

I first met Roberta Farrell and Bob Blanchette at Scott Base over a conversation concerning our respective and separate projects. While we were all associated with work on or around the Heroic Era huts we were not collaborating in the consequence of our work or the research behind it. I recall the epiphany of understanding at just what a resource was sitting across the table and how directly their science could add to our understanding of the huts, their fabric, their environment, the factors that are affecting them, and our conservation response.

The biological decay of the timber has been slow, but the huts are not free from this form of deterioration. The key factors that influence the rate of biological decay are temperature and relative humidity (see Farrell et al, this volume).

The Cape Evans hut presents its long southeastern face to the prevailing wind, and over time this has presented a barrier to the wind-driven snow, which has built up against this wall. The consequence of this build up of snow is still to be fully understood. On one hand the super-cooling effects of snow banked up permanently against the southern wall are of clear concern for both the interior building fabric and artefact collection; while at the same time it represents a kind of natural aerofoil, dissipating the effects of the prevailing wind over, rather than against, this long exposed elevation. When rediscovered in 1947, it was noted that the hut appeared somewhat disorderly after the buffeting of 35 winters. Scattered about the cabin were cartons of provisions, still good to eat. The extent and survival of artefacts adds to the evocative richness of the Cape Evans hut. From the stove and the iconic mess deck table to the most fragile of the scientific equipment, there is the sense of the immediacy and liveliness of this history.

I'd like to conclude this fourth negative degree of separation with a brief description of what might come next in our process of conservation and collaboration, by way of technology and our ability to embrace it.

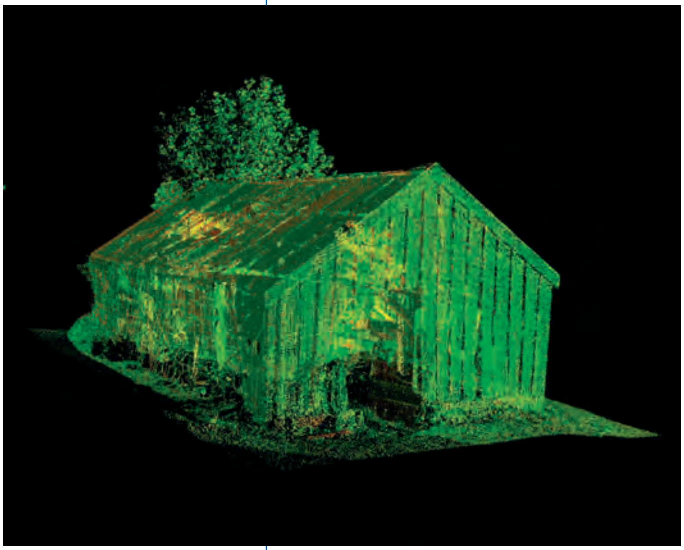
In New Zealand my colleagues and I have embraced laser scanning technology and are making much of its application in building conservation. We use high definition surveying (HDS) using a Cyrax three-dimensional laser scanner recording 600 points of high-resolution three-dimensional data per second. This allows the quick capture of spatial data from complex objects. HDS offers a number of applications in heritage recording, conservation, modelling, damage modelling and archaeology.

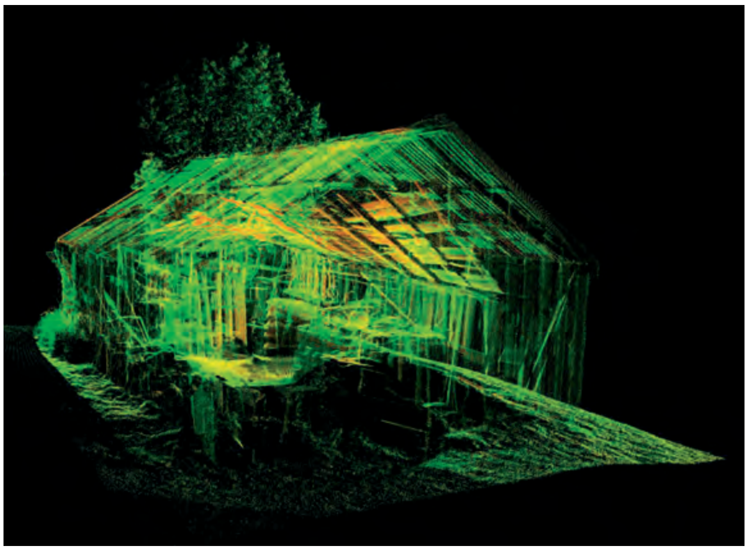
This is a subject that is gaining increasing coverage internationally and deserves its own paper. Rather than begin that paper here I'd like to describe its applications on a current project and wonder how, with this technology, we might better survey, understand and conserve the very imperfections that give places of particular value their distinctiveness and consider its application in polar regions.

Smithy. Wagener Subritzky Homestead (1862). Photo: Archifact ltd 2004

The Wagener-Subritzky homestead in New Zealand includes a pioneering family's smithy dating from 1860-62. The original and surviving timber structure is cobbled from a variety of at-hand materials (much like the stables at Cape Evans) and has been left intact. In 1969 the family, having retired the homestead to the role of a museum, erected an ingenious outer shell to protect the original structure until they could find a way (and a means) of repairing the original building. The issue ahead of us is two-fold: how to survey this complex structure and, based on that survey, how to describe how to conserve them accurately. The scanned model (below) describes the complexities of both the original and the later structures.

Our model clearly shows the two structures, provides detail of the fittings and surviving equipment in situ and gives important record to the imperfections, the *spirit*, of this place. We can now make informed and appropriate responses to its conservation. The furnace and its bellows are still in place (see centre of figure 7) as are many of the tools used and products resulting from the work of the smithy. This technology scientifically records form and fabric contributing to the richness and interpretation of the place. The model also gives opportunity for the virtual visitor as this is a place whose fragility means that public access is impossible.





Laser scan of the exterior of the Smithy, Wagener Subritzky Homestead.

Laser scan of the Smithy showing interior detail. Wagener Subritzky Homestead. Both images courtesy of Geometria Limited 2007

minus five degrees: interpretation

The interpretation and the sense behind the reading of a place of cultural heritage significance can, like truth, become a casualty of the nature of that perception and interpretation.

The interpretation of the Heroic Era huts has given rise to debate over the layers of occupation associated with each of the huts and the value (or otherwise) in replicating lost elements. Truth and interpretation can be conditional on the breadth of perspective of readings and the understanding of histories observed, investigated and revealed. The visitor is of concern in the interpretation of these projects. Visitors may be a physical presence or a virtual phenomenon. There remains an ethical question linked to interpretation and context and that is to what extent does our conservation determine interpretation and can we avoid interpretation even if we want to? The evolution of international conservation Charters and their expanding analysis and reference to contexts and disciplines within which a place or object should be read, enable the appropriate conservation of the cultural significance represented by that place or object. William Lethaby (1857-1931) wrote of putting on the complete 'garment' of a place so as to properly 'see' it. This seems to me to embrace the multiplicity of stories that stem from the many hands of its creation and from those who had contributed to it in use or knowledge. Lethaby recognised a connection of object to land and to people, forming a sense of place 'profound and mysteriously human'.

The Heroic Era huts are necessarily physically remote; this is part of their spirit. The deterioration of some of their historic context, such as the stored materials around the hut, the fabric of the huts themselves, and the deterioration of the environmental context is part of the truth of the sites and is not separable. Place, and its authenticity and significance, is irrevocably linked to this context. The interest in the everyday world of a place and a time is not a fixed one; our sense of value can shift. Context is recognised as vital to a place. Time and its effects "connects forgotten and following ages with each other, and half constitutes the identity", or so Ruskin believed. Conservation in this context is about a sense of space, a sense of material, the 'spirit' of the place. We can, we have done, and we must continue to use disciplines outside our own to better understand these essences. Context has a context; that's the political bit. Ultimately it is the acceptance of the broadest contexts that help challenge predetermination.

minus six degrees:

These degrees of separation are about time and place and people and science and technology coming together. Being at the IPHC Barrow conference represented for me a further expansion of the project and the science of my discipline. In sharing our experiences we engage greater understanding and strength through partnership. Being together over those days was an important and all too rare opportunity to share and collaborate from Pole to Pole.

Conference delegates also contributed to an educational outreach programme with talks to schools in the region. The author with one school group.

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I would like to acknowledge the support of Archifact Limited for its commitment to the conservation of cultural heritage and its support of my time in presenting this paper to the IPHC conference.

I would like to thank Brian Lintott, Chairman of ICOMOS New Zealand, David Reynolds of the Northern Regional Office of the New Zealand Historic Places Trust, and George Farrant, Heritage Manager, Auckland City Council for their support.

I would like to acknowledge the anniversary of the International Geophysical Year, the establishment of Scott Base and the commitment of Antarctica New Zealand to 50 years of science in Antarctica.

I have also been asked to record that in presenting this paper I am neither representing nor presenting on behalf of Antarctic Heritage Trust New Zealand. I would however like to acknowledge the team and work associated with the New Zealand Antarctic Heritage Trust in conserving the heritage associated with the Antarctic's Heroic Era.

East Base, SOS: Assessment of deterioration and recommendations for conserving this important Antarctic historic site

Brett E. Arenz and Robert A. Blanchette

East Base is located on Stonington Island just west of the Antarctic Peninsula (68°11'S, 67°00'W). It was built in 1940 and is the oldest standing United States base in Antarctica. Over the past decades, the wooden structures at the site have experienced serious deterioration. An assessment of the current condition of the historic structures was carried out in January 2007 as part of a cooperative expedition by the National Science Foundation and the British Antarctic Survey. Many forms of abiotic deterioration and biotic degradation are affecting the wooden buildings and artifacts. Wind is eroding the exterior wood surfaces and salt accumulations in wood cause corrosion and defibration. Wood and other organic materials in contact with the ground and where moisture accumulates are also being attacked by wood destroying fungi. Previous conservation work completed in 1992 at the site has helped to partially protect the buildings but deterioration since that time has increased. These historic structures urgently require conservation work to insure their preservation. Attention is desperately needed as soon as possible or the structures and artifacts at this important historic monument will be lost.

History of Site

East Base was constructed in 1940 by the US Antarctic Service expedition led by Admiral Richard Byrd. Stonington Island was chosen because of its unique southerly location along the Antarctic Peninsula and a glacial ramp connected the island to the Peninsula, providing easy access for dog-sledding teams to reach the mainland throughout the year. The base was occupied until March 1941, and later used by the British in 1946 as a temporary shelter while they were constructing their own base on the Island, designated as Base E. East Base was again occupied by the American Ronne Antarctic Research Expedition (RARE) in 1947 led by Finn

Fig. 1. East Base on Stonington Island, Antarctica showing the Ronne hut (left), Main Building (center) and Science Building with Met Tower (right) as they appeared during the assessment in January 2007. Photo: Brett Arenz

Fig. 2. The Main Building showing collapsing floor built by British Antarctic personnel from Base E. This floor was built 4 feet above the original floor and covers historic artifacts, debris and ice. Photo: Brett Arenz

Ronne. This expedition remained at the site until 1948. During this time great advances were made in mapping the previously unexplored area of the peninsula south of Stonington. This expedition marked the first overwintering by a woman in Antarctica. After 1948, it was never again utilized by an American team but was used by the British at Base E until they abandoned Stonington Island in 1975 because the glacial ramp had deteriorated and access to the mainland was eliminated. An account of the history at East Base and condition of the buildings at the time was made by Lipps (1976).

Past conservation

East Base is the oldest existing United States Antarctic base and was designated Historic Monument #55 by the Antarctic Treaty nations in 1989. It was visited by personnel from the National Park service in 1991, and an East Base Management Plan was developed (Spude and Spude, 1993). This plan outlined several actions needing immediate attention and listed many long term recommendations. In 1992, some of the recommended repairs were made and the condition of the historic site further documented (Parfit, 1993). A more detailed account was also published on the project in 2002 (Broadbent and Rose, 2002). Since 1992, no other work has been done at the site and this paper provides an in-depth account of the deterioration taking place and documents the current condition of East Base.

2007 Assessment and Current Condition of East Base

There are 3 buildings currently standing at East Base: the Main Building (former bunkhouse), Science Building and Ronne Hut (Fig. 1). In addition, the floor timbers of two other buildings, the Machine Shop and a storage shed, are present. The original construction of the buildings was with 8 by 4 foot prefabricated panels with a plywood interior and a drop siding exterior. The 3 ? inch gap between the interior and exterior walls was filled with rock wool insulation. After construction, the buildings were covered with a layer of canvas to prevent wind and snow from entering the structures through cracks and crevices. Little of this canvas layer remains except at some sections on the main building that are leeward from the prevailing winds and partially covered by a large snow bank. Portions of each of the buildings were later covered with black “Ruberoid” felting material by British personnel at Base E. Some of this material still remains but most has been stripped away by the strong winds that occur at the site.

The British made substantial modifications to all three buildings and their original uses would not be readily apparent to a visitor without interpretive materials. The Science Building was used as a sledge workshop and for tent storage. The Ronne Hut was used as an emergency generator site and a concrete slab has

Fig. 3. Exterior north wall of the Main Building showing the loss of many wall boards. Photo: Brett Arenz

been placed in a hole cut into the floor. The Main Building received the greatest modification of all three buildings as the original floor was apparently covered with a thick layer of ice when the British returned to Stonington in 1957 so they built another floor four feet above the original. A partitioning wall was constructed on the eastern side of the building which houses a room with the original floor. A large portion of the main building was used for storage and for seal processing as seal meat was used to feed the dogs on the sledging teams. Consequently the interior of the main building is filled with seal carcasses in addition to ice and other debris. The British-constructed floor is also collapsing in many areas making the interior of this building hazardous to enter (Fig. 2). There is a broken door on the north side of the building, and an entrance in the roof on the south side which provides entry via a ramp to the collapsing floor. The door on the eastern side of the building leading to the room with the original floor has broken off in the last 15 years, apparently due to corroded hinges. There is also a large number of missing roof timbers and wall slats on the building with many more timbers missing on the main building than the two other buildings (Fig. 3).

The Science Building and Ronne Hut are in relatively good condition compared to the Main Building. Because they were comparably weather tight, the conservators in 1992 chose the Science Building to set up a museum type display of artifacts that had been found outside (Fig. 4). These artifacts were from both the 1941 USAS and 1947 RARE Expeditions. Additionally, there are some materials, such as sledging flags and dog harnesses, from the time after 1948 when the British occupied the structures. A cache was also made in the Ronne Hut for additional artifacts that the 1992 conservation crew thought deserved additional protection.

In addition to the wooden structures, there are numerous dump sites and caches located around the buildings. These sites were mapped extensively and reported in the East Base Management Plan (Spude and Spude, 1993). Most of these materials were covered by a light layer of gravel by the 1992 team and they remain buried. No excavations were done and an assessment of their condition was not made. One dump site contains a World War I era light tank and an artillery tractor (Fig. 5). These vehicles were brought to the island by the USAS team in 1940 but proved to be of little use because of inadequate traction in the deep snow. Another object of historic interest is an aircraft engine still in its packing crate near the science building.

The cold temperatures of the polar environment have provided some protection from microbial decay, as compared to what may occur in temperate or tropical areas, and the isolated location of Stonington Island has saved artifacts from pilfering. However, significant and serious deterioration to the historic buildings and ar-

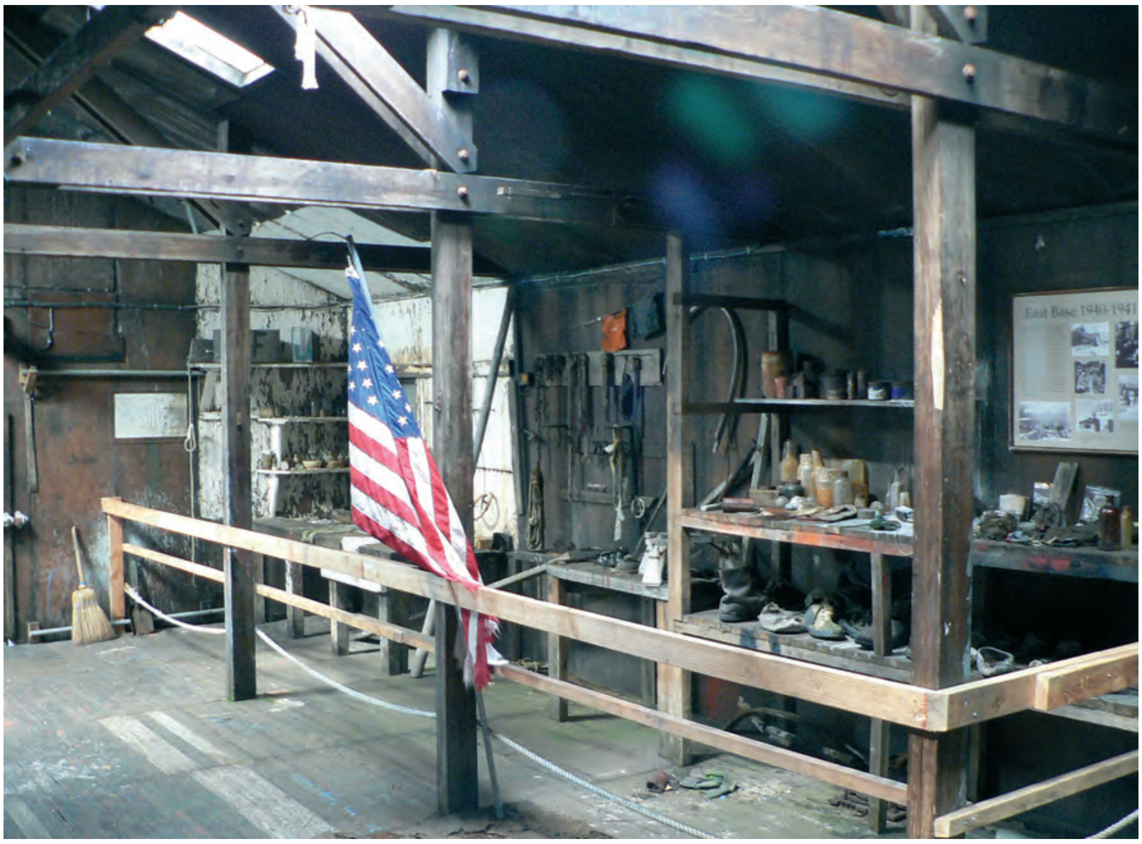

Fig. 4. Inside the Science Building showing the artifact display set up by the 1992 conservation team. Photo: Brett Arenz

tifacts is being experienced. Losses are occurring from environmental (wind) damage, salt defibration and biodegradation of wood due to fungal decay.

Exceedingly strong winds at the site can be very damaging. This was experienced during the site visit when winds of approximately 80 knots from the North East occurred for most of the day. Although this made outside assessment work virtually impossible, it did allow for valuable observations to be made on the effect of wind on the structures. With the eastern door having previously collapsed on the main building, wind was funneled into the room and pushed upward on the roof. On the southeast corner of the building, the roof was observed to rise up from the wall repeatedly throughout the day by about 15 cm. During this time, one roof board was observed to fly off the science building roof. This demonstrates the seriousness of the current situation and potential for the roof and walls of the building to be completely destroyed if conservation efforts are not initiated soon.

There is also evidence of surface erosion of wood boards due to the wind, but it appears to be limited because of the lack of small soil particles on Stonington Island. The heavy erosion of wood at the historic huts built by Scott and Shackleton on Ross Island seems to be exacerbated by the loose volcanic scoria on the ground that causes a sand-blasting effect when winds are strong. This small loose volcanic soil is not present at Stonington Island and the wood erosion observed here is probably primarily due to ice crystals blasting the wood during storms.

Salt corrosion of wood and surface defibration was also apparent on some areas of the wooden structures. This was most obvious on the interior walls of the meteorological tower attached to the science building. The process of salt corrosion of wood in polar environments has been previously described by Blanchette et al. (2002). Absorption of sea spray on wood and evaporation results in high concentrations of salts on wood surfaces. The high salt concentrations cause a chemical attack and a breakdown of the middle lamella that attach wood cells to one another. This leads to a defibrated "fuzzy" appearance on wood surfaces and detached wood cells that can easily become removed by the wind. Periodic rainfall occurring on Stonington Island can leach the salts from the wood and may be limiting the accumulation on exterior surfaces. In areas protected from rainfall, such as the windward-facing walls inside the science building where salt spray gets blown into the building, there is significant defibration. The collapsed door on the northern side of the met. tower is also an entrance facilitating entry of salt spray into the building interior, and the salt defibration is most notable at this location.

Another serious concern is degradation by wood-destroying fungi. Although wood decay may be considered unusual and unexpected in Antarctica, it occurs frequently on wood that has been introduced to the continent. Decay of historic woods in Antarctica was reported by Blanchette et al. (2004) occurring at the Ross Island historic expedition huts. Although the polar environment is exceedingly cold and dry, environmental monitoring within the Ross Island huts revealed that there were appreciable amounts of time in the Austral summer when temperatures are above 0 ºC and relative humidity above 80% (Held et al., 2004) providing time periods that are conducive for fungal growth. In addition to concerns about the soft rot type decay that occurs in the wood other fungi, such as surface molds, cause dark discoloration on wood and other organic based artifacts. Evidence of the diversity and distribution of these species indicates that most of the species responsible for degradation are indigenous to Antarctica and therefore well adapted to the rigors and extremes of the Antarctic environment.

Our preliminary investigations at East Base indicate that soft rot fungi are present and are causing significant wood decay. Dark staining surface molds that disfigure wood are also present and causing problems. Taxonomic studies reveal that some of the same wood-destroying fungi responsible for the soft rot in the Ross Island huts, specifically fungi in the genus *Cadophora*, are also present on wood at East Base. The actual amount of wood decay in the various buildings and wooden artifacts at East Base was not able to be determined during this preliminary assessment. The amount of decay present in woods that are in contact with the ground needs further investigation to determine the extent of colonization and loss of structural integrity that has occurred.

The fungi most abundant as surface molds found inside the structures at East Base, specifically *Cladosporium* and *Geomyces,* also have been found at the Ross Island huts (Arenz et al., 2006). Interestingly, East Base is located nearly 10 degrees latitude further north than the Cape Evans hut on Ross Island and has a generally warmer and more humid environment, but our studies show fewer active molds inside the buildings at East Base. Environmental monitors were left at East Base in January 2007 and will be used to review precise environmental conditions at the site. Possibly, greater air circulation and drier conditions occur in these generally open buildings at East Base and this discourages mold growth.

Most of the windows and skylights in the building, having been broken or missing, were reinforced with Plexiglas by the 1992 conservation team. This seems to have been an effective repair as in only one skylight was an interior Plexiglas pane found to have subsequently fallen out, and no examples of broken panes were found. However, an attempt to protect the 1941 visitor welcoming message, left by then base commander Richard Black in the science building, seems to have had the opposite effect as it is now completely illegible. A Plexiglas pane was placed directly against the wall to cover the paper and this apparently trapped moisture behind it resulting in extensive fungal growth. A similar effect was found on two pages from Jennie Darlington's book "My Antarctic Honeymoon" (Darlington and McIlvaine, 1956) fixed to the wall in the partitioned smaller room in the main building. The pages were covered with mold and are becoming illegible due to the dark fungal discoloration caused by the Plexiglas trapping moisture which encourages their growth. Other interpretive panels placed in the science building that were completely enclosed from all sides are in good condition by comparison.

Recommendations

The deterioration occurring at East Base is significant and repairs, conservation and additional investigations are needed as soon as possible. All open or missing doors and windows in the three buildings should be repaired or replaced to preserve the remaining integrity of the structures. In the Main Building, all three entrances need to be closed to the outside environment; the broken door on the north side of the building, the open ramp entrance on the roof and the door on the eastern side. As a temporary repair, the eastern side door from the inside of the building was nailed shut during our visit but a more permanent repair is needed. If regular access for visitors to this room is desired, a door with non-corrodible hinges should be used. The Ronne Hut door is still in place but open and only a snow drift presently inside the room prevents the door from being completely opened. If this is to be a secure site for artifacts, the door must be secured. Repairing these openings will help protect the structures from the very high winds which occur here as well as helping to prevent some of the snow drifting inside, which when it melts will provide sufficient moisture needed for fungal growth to occur.

Fig. 5. Stonington Island has many large artifacts remaining from the 1941 expedition including a World War I era tank with tractor (in background). Photo: Brett Arenz

Significant work will need to be done on the roofs of all three structures to make them relatively weather tight. One particular weak spot is the roof on the south-east corner of the main building which moves up and down during windy days and may completely detach soon. Hopefully, repairs to the door made in January 2007 will help prevent wind from pushing the roof up from underneath and will at least allow it to rmain attached. However, the roof must be reattached to the wall and reinforced for longer term structural stability.

The original conservation objectives for the buildings and artifacts outlined in the 1993 Conservation Plan written by the National Park Service (Spude and Spude, 1993) are for long term preservation efforts, and many aspects such as the biotic and abiotic degradation taking place are not addressed. If these historic buildings and artifacts are to be saved, an interdisciplinary team, such as that organized by the Antarctic Heritage Trust for preservation of the Ross Sea huts, should be established. Some immediate recommendations, however, can be made. Moisture must be excluded from the interior hut environment as this is supporting fungal growth and serious deterioration of the wood and artifacts. In addition to repairing the doors, work needs to be done to the roofs of all three buildings to make them reasonably water tight. If current environmental trends in the area continue, leading to warmer and wetter conditions, this will become even more essential. If left undone the existing decay fungi will progressively cause more damage and losses.

Although Stonington Island is relatively remote, it does receive visits by cruise ships, and over 600 signatures were counted in the guestbook that had been left by the conservators in 1992. Given current trends of increasing Antarctic tourism, this very significant historic site will undoubtedly have even more visitors in the future. Considering that parts of the huts could represent safety issues, particularly the false floor in the main building, work is needed urgently to deal with these concerns.

The presence of the United Kingdom's Base E just a few hundred meters away from the U. S. East Base and the historic use of Base E by the British after 1941 strongly suggest that any conservation efforts should be coordinated with the British Antarctic Survey. Both bases need conservation for successful preservation in the future. The success attained at East Base in exploring the geography of the Antarctic Peninsula would not have been possible without collaboration between the US and the UK, and the history of both sets of buildings is tied to each other. Collaborative efforts for conservation of both Bases are strongly encouraged to insure these important historic Antarctic sites are protected for future generations.

The site represents a remarkable period of history when the last of the empty spaces on the Antarctic map were being filled in, and rightly deserves its designation as an historic monument. The conservation work done at this site in 1991 and 1992 was commendable, especially considering the short amount of time the team stayed at the site. However, the buildings at East Base are now at a critical stage. They are currently standing, but if current deterioration is allowed to continue their decline will not be a gradual one. The high winds in this area expose even small structural weaknesses to potential losses of building parts. The detachment of roof or wall boards will undoubtedly lead to rapid destruction and collapse of the entire structure. Michael Morrison, an architect from the United Kingdom who was a part of the BAS heritage survey team remarked that "I do think that a joint agreement over the management and future of the site is urgently needed between the United Kingdom and the United States. I feel that unless something is done urgently the situation will change from being a problem into being a disaster!".

Conservation work and continued investigations on the agents causing deterioration must be completed at this site soon or the opportunity for such work will be gone and this incredible monument to Antarctic exploration will be lost.

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Protection and preservation of the oldest sites of the Antarctic: the case of Fildes Peninsula and Byers Peninsula in the South Shetland Islands

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Introduction

The first and most intensive human occupation of the Antarctic happened between 1820 and 1824. More than 100 ships and thousands of sealers explored and camped on the beaches and ice-free areas of the South Shetland Islands, where the seals congregated during the summer. This scale of intensive occupation never occurred again in the history of the region, except perhaps for the recent development of scientific bases. The biggest concentrations of early historic sites have been discovered on the Fildes Peninsula on King George Island and on the Byers Peninsula, on Livingston Island. Almost all of these sites result from the activities of the sealers who operated during the early 1820s, with a few dating to a short re-occupation around the 1870s (Pearson & Stehberg, 2006).

The work done for the international project of archaeological research in Antarctica by Chileans, Argentineans and an Australian has provided an alternative approach to understanding the mechanisms whereby this continent was incorporated into the scope of the capitalist system at the beginning of the 19^{th} century. At that time thousands of men were sent to this inhospitable land at the end of the world to work in the worst conditions for several months at a time.

It is interesting that the histories of these persons were neglected because the focus of Antarctic History has been the named heroes who have "discovered" these new territories. Our work has tried to change this situation by trying to contribute to building a history of the people-with-no-history (Wolf 1982) in Antarctica. At the same time, we approach the history of Antarctica from a particular perspective which allows us to link a large-scale process such as the expansion of capitalism to a local context such as the everyday life of the protagonists of the first pages of the history of Antarctica (Senatore y Zarankín, 1999; Zarankín y Senatore, 1999 a, 1999b y 2005).

Concerning the archaeological sites found, we would like to establish a differentiation between those of Fildes and Byers. The Fildes historic sites consist of a group of six small encampments distributed along different beaches of the western coast of the peninsula. The Byers historic sites comprise 26 stone-built refuges, dispersed along all the peninsula's beaches. Most of the sites are affected in varying degrees by natural or human-caused deterioration and need to be protected and preserved. While these sites are not scientific bases, they were the logistic bases for the economical exploitation of seals, and represent the earliest human activity in Antarctica. As such, their archaeological deposits are likely to provide important baseline information about environmental conditions in the early 19^{th} century, and these sites certainly provide unique evidence about human activities in, and responses to, Antarctica nearly 100 years before serious scientific research began during the 'Heroic' era in the early 20^{th} century. This research potential, being explored by our field research program, is enhanced by the survival of a small number of original journals from the sealing era.

A group of regional IPHC representatives from Australia, Argentina and Chile, with the cooperation of the Chilean Antarctic Institute[1] and two Argentinean Antarctic archaeologists and a Chilean lawyer, are working together on a plan of protection and preservation of the sites[2]. Because of the proximity of the Fildes sites to the Chilean, Russian, Chinese and Uruguay scientific bases, the first step of the plan consisted of the presentation to the Antarctic Environmental Committee of a proposal to create an ASPA (Antarctic Specially Protected Area), to control the activities of scientific and other visitors to the area and, in the near future, we will work with Antarctic Treaty parties to prepare a management plan for the sites[3].

For the Byers cultural resources, we sent a list of the 26 sites, with a map and some information on each one, to the Antarctic Environmental Committee so that the information could be sent to the British Administrator of the area in order that the existing ASPA can be updated to include specific and effective protection and preservation of the historic sites in their Management Plan.

This paper gives specific information about the sites we consider need to be protected, the principal factors of deterioration that affects the stone-built refuges, and discusses the principal issues we will need to address in a management plan for the cultural resources.

The sealers sites

Most of these sealers sites founded in the South Shetland Islands are shelters located within 250 m of the seashore. They were built in natural shelters such as a cave or open air rock formations, using these as walls and piling up local stones to close them up. Morphological patterns show square, rectangular, semicircular or irregular spaces with varied opening entrances. Some also have smaller structures standing against or very near them. Inside and outside the structures, whale vertebrae, ribs and jaw fragments were found which may have been used as elements to outfit the shelters or external areas. We consider that roofing possibilities may have limited the size of these structures. The limited size of the structures suggests that they were either used as shelters by small groups of workers or that they were used for tasks that did not require the presence of many workers inside them at a time.

We will provide a brief description of each selected site and a short discussion about the actual state of preservation and the principal agent of deterioration we observed in the last January 2007 field season. The description of the two areas is provided below.

a) Fildes Peninsula stone-build refuges

The follow figures gives basic information about each historic site (Stehberg y Gatica, 2001; Stehberg, 2002; Stehberg 2002, 2003):

Geographical location and cultural description of the Fildes Peninsula historic sites.

Name	UTM Coordinates	Geographical Location	Cultural Description	Conservation State
Beach 7a	3.107.620 N 398.650 E	Located near the Russian Refuge, this semi-circular dry-stone structure is isolated in the central part of a sandy beach.	The collapsed walls of the structure stand approximately 700 mm high, and within it is a whale vertebra, fragments of glass and metal, and pieces of wood; the glass dating from the 19th century.	The site is exposed to wind, snow loads and the activity of seals and scientists, there being a Russian refuge hut nearby. Site partially excavated in 2001.
Klotz valley (Beach 9) North Cove	3.107.150 N 399.080 E	A natural rock shelter and a stone structure are located adjacent to a low cliff face at the narrow northern end of the beach, close to the sea.	The rock shelter when excavated contained some cultural material (ceramics, glass and wood) in the surface levels of the outward sloping ground. The cultural remains were consistent with occupation in the 19th century.	The rectangular stone structure was partially excavated, and a timber plank with an iron spike was located on the floor beneath fallen rubble.
Fontoura (Beach 12)	3.104.750 N 397.300 E	Against the side of a rock outcrop	The site consists of a stone wall enclosing a rectangular area about 7 m long and 2.4 m wide. Another possible site, approximately 3 x 2 m in extent, is located in the extreme south of the bay, against a rock stack on the shore, with a few fragments of material from the 19th century.	The interior is filled with sand. Was partially excavated in 2001.

Name	UTM Coordinates	Geographical Location	Cultural Description	Conservation State
Cuatro Pircas	3.105.750 N 397.150 E	The stone structures are situated on a broad beach (known as Rambo Beach after a Brazilian 20th century refuge, the remains of which survive), between the steep hills and the sea which is about 80 m distant	Four structures are located in close proximity at this site on Adelia Cove. One structure is rectangular without a doorway, and is thought to have served as a store into which seal skins were piled. The other rectangular or semi-circular structures are open on one side, and are interpreted as being habitation or kitchen structures. Partial excavations uncovered metal containers, glass and ceramics, wood, nails, leather from shoes, textiles, and seal skin. The cultural material dates the site to the 19th century.	The site is exposed to wind, snow loads and the activity of seals and human visitors.
Tómbolo 1	3.100.600 N 395.140 E	Located at the eastern end of the tombolo	Two circular stone fireplaces. These are the bases for try-pots used to boil down elephant seal oil. The seals would have been killed along the adjacent beaches in the 19th century. Near this site is another fireplace that may have been a small domestic fireplace servicing the sealers.	The site is exposed to wind, snow loads and the activity of seals
Tómbolo 2	3.100.630 N 394.890 E	Located against the base of the steep hill slope at the western end of the tombolo.	A large square stone-walled structure. A central entry point survives, and within and surrounding the site is an extensive scatter of glass bottle fragments, ceramics, iron from barrels, whale bones and shoe leather. The site is interpreted as a 19th century sealers' occupation place.	The site is exposed to rock falls from the hill, wind, snow loads and the activity of seals.

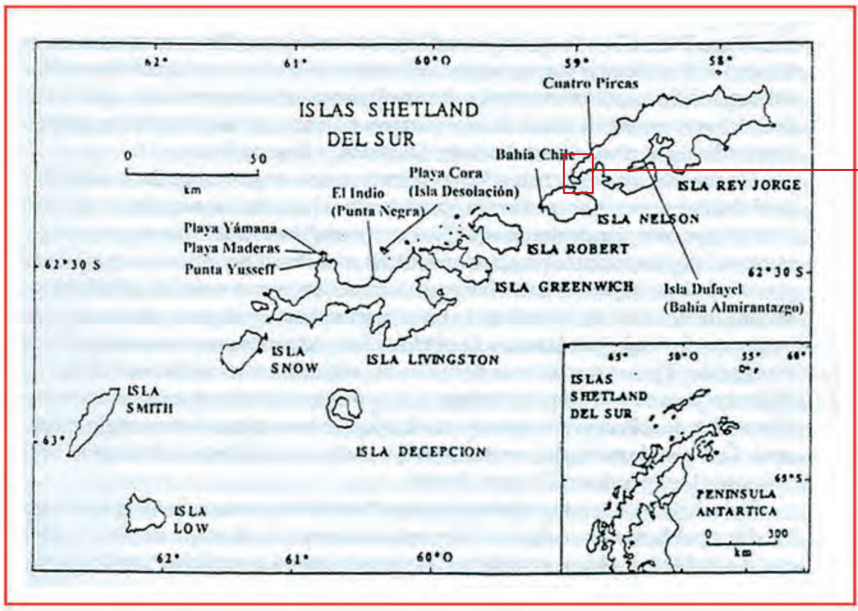
Also, there are two historic sites in the area, not belonging to the sealers. It is postulated that the sites are the remains of mid-20th century camps. Their basic description is:

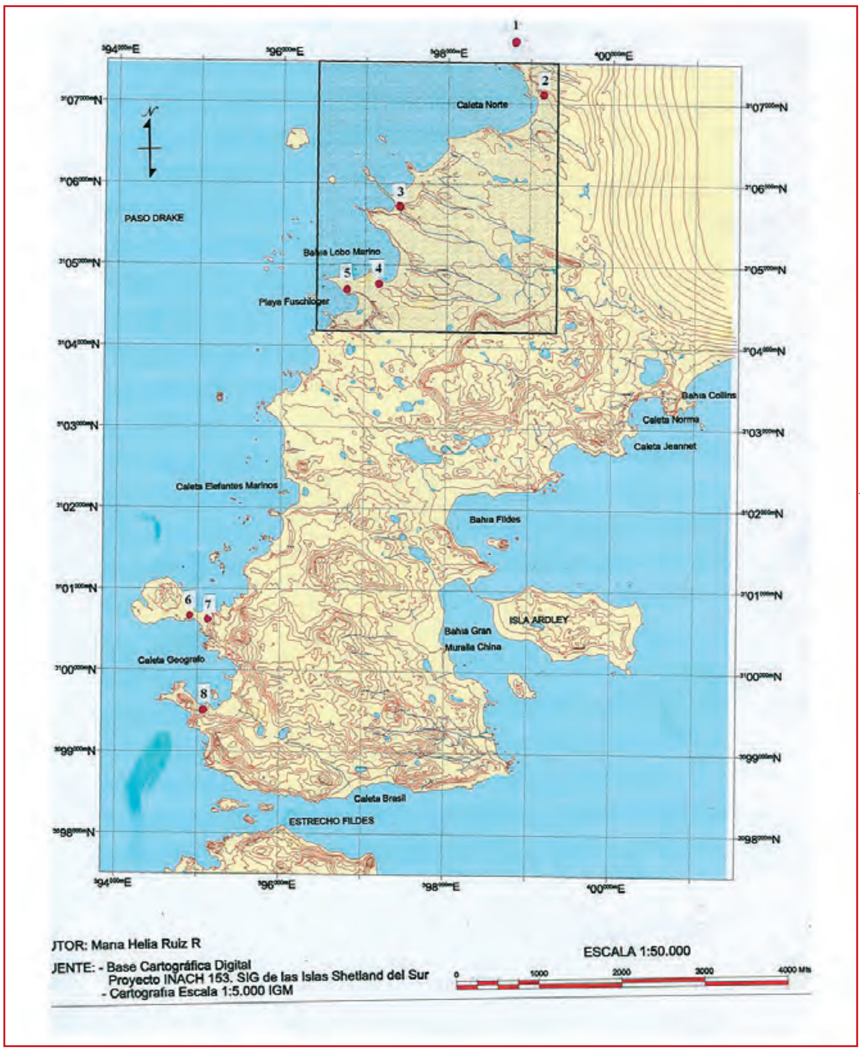
Name	UTM Coordinates	Geographical Location	Cultural Description	Conservation State
Flat Top Head, Geografo Cove	3.099.550 N 395.290 E	Adjacent to a large rocky outcrop behind the beach.	There are many timber planks on the surface, which may have been occupied.	The site is exposed to wind, snow loads and the activity of seals.
Fuschloger Beach	3.104.650 N 396.785 E	At the northern end of Fuschloger Beach among the rocks between the cliff face and the shore.	Timber planks of a possible refuge or cache of material. A wooden cross on the surface may indicate a burial site. The site remains suggest a mid-20th century date.	The site is exposed to wind, snow loads and the activity of seals

These remains need to be protected, so the management plan has to consider them.

Map showing the geographical location of the Fildes historic sites:

1) Beach 7 (Russian refuge)
2) Klotz valley
3) Cuatro Pircas
4) Fontoura
5) Fuschloge
6) Tombolo 1
7) Tombolo 2
8) Geographer Beach.





b) Byers Peninsula stone-built refuges

The following figure gives basic information about each historic sealing site (Zarankin & Senatore 1999a, 1999b, 2005; Senatore & Zarankín 1999).

Name	Coordinates	Geographical Location	Cultural Description	Conservation State
Lima Lima Cave	62º36´ 927´´S 61º02´ 218´W	At the bottom of a small rocky hill by the sea.	The cave is 3,5m high, 22 m deep and 6 m wide. In the back of the cave there are two walls forming an entrance to an enclosed area of 4.2 x 2.1m. This site was excavated in 1995-6.	While the stone walls are well preserved to date, between 1995 and 2007 a gradual collapse of the cave walls and ceiling has occurred.
Lair Point 1	20 E 0600825 3055748	Built against a rock stack.	Structure consisting of one stone hut and one annex.	This structure is badly preserved due to the action of fauna, water and wind erosion. No changes have been observed since 1995.
Robbery Beach 1	62º37´317´´S 61º01´943´W		Structure facing the beach consisting of two stone walls enclosing an area between two rock stacks. There are 2 whale vertebra in the interior	No changes have been observed since 1995.
Cutler 1	20 E 0600940 3 054986		The structure consists of a hut site with three stone walls against a rock stack. There is high density of artefacts on the surface (fragments of metal, glass, stoneware, among others). This site is thought to be have been excavated by British naturalists in the 1950s.	The stone walls are well preserved despite high impact of the local fauna on the site. No changes have been observed since 1995.
Cutler 2		Stone structure against a rock stack	Structure consisting of three stone walls.	This site was identified in 1995 but not found in 2007. This might have been due to the effect of erosion and rock falls from the stack.
Negro Hill	20 E 0602276 3050490	Stone structure against a rock stack	The site consists of four stone-walled structures of different dimensions against a single rock stack. This site was excavated in 1999. It had been occupied at two different times during the 19th century.	Two huts are relatively well preserved, while the remaining two are affected by the action of elephant seals and fur seals.
South beach 1	20 E 0603682 3050538		The site consists of a stone wall closing a natural area formed by a rock outcrop, and an annex. This site was excavated between 1995 and 1997. The main hut was the living area of 19th century sealers, where many artefacts were found. A hearth was found in the annex related to the processing of elephant seal oil.	The site is well preserved but the expansion of a nearby lagoon is a concern as it has already covered part of the annex and it is extending to the main hut.
Stackpole 1	20 E 0604866 3050058		The structure consists of a low line of stones. The purpose of this structure is unclear due to its poor preservation.	It has limited visibility since the structure does not rise above the ground.
Stackpole 2	20 E 0604865 3050057		The shape of this structure suggests that it could be a grave. It consists of an association of stones and whale bones.	Since 1995 some changes have been observed due to the action of people: two whale vertebrae have been moved and appear as if they have been used as seats.
X1 Point	62º40´277´´S 60º55´748´W	Against a rock stack close to the sea and a lagoon	The structure consists of three stone walls. High impact of different agents has affected the preservation of the site.	The whale bone used as roofing support seen in 1995 inside the hut is now almost buried 7m away.
X2 Point	20 E 0606309 3049435	Against a big sea stack	Stone-walled hut site contains a whale jaw bone suggesting a roof support.	The site is poorly preserved due to the action of elephant seals. One of the stone walls is partially collapsed, the other one is 1.5 m tall and is well preserved.

Name	Coordinates	Geographical Location	Cultural Description	Conservation State
X3 Point	62º40´272´´S 60º55´417´´W	Against a rock stack	Stone-walled hut. Several artefacts including a paddle are now visible on the surface site	The preservation of this structure is compromised due to the action of elephant seals eroding the surface and stratigraphy of this site. Some changes have been observed since 1995.
Vietor 1	20 E 0597543 3049198	Against a rock stack	The structure consists of three walls against a rock stack enclosing an area of 2.10 x 1.80m. It contains several whale vertebra “seats” and a whale rib used for roofing.	From 1995 to 2007 some changes have been observed. Five circular holes were found on the rock face immediately behind the hut, indicating the extraction of geological samples (probably geomagnetism). The rear wall of the hut appears to have been pulled down to form a level surface for the geological drilling.
Vietor 2	20 E 0597458 3049192	Among rock stacks	The site consists of a large stone structure of 5.40 x 2.40m with an annex of 2.10 x 1.5m.	From 1995 to 2007 some changes have been observed: Some whale vertebrae placed inside the inner area of the hut have been moved.
Vietor 3	20 E 0597255 3049215	Against a rock stack	This structure consists of a 2.5 m long double line of stones. A whale skull bone is placed at the end and continuing one of the line of stones.	It has limited visibility since the structure does not rise above the ground.
Sealer´s Hill 1	20 E 0596613 3049305		Structure consisting of a stone-walled hut and an annex against a rock stack.	The preservation of this structure is compromised due to the action of elephant seals, which often occupy the main hut, thus eroding the surface and stratigraphy of this site. From 1995 to 2007 some changes have been observed: a whale vertebra is now visible on the surface, and the entrance walls of the main hut have collapsed.
Sealer´s Hill 2	20 E 0596616 3049306		A structure made up of a series of curved walls of stone forming a roughly circular space	No changes have been observed from 1995.
Sealer´s Hill 3	20E 0597120 3049437	Against a low rock outcrop	Structure consisting of a stone-walled hut and an annex containing a whale jaw bone	No apparent changes since 1995 have been observed, except the displacement of three whale vertebra from the main hut that have been found at 10m and 20m from the site.
Sealer´s Hill 4	20 E 0597056 3049491	Cave at the bottom of a cliff	Structure consisting of two stone-walled enclosures. There are whale vertebrae near the site.	No changes have been observed since 1995.
Sealer Cave	20 E 0596636 3049304		Smith and Simpson reported in the 1950s a stone wall across the rear of the cave, with timbers and seal bones on the floor	None of these elements or the structure can now be found inside the cave.
Long Rocks	20 E 0595137 3049366		An area of 1.20 x 3m in. There is a high density of artefacts (leather shoes, fragments of wood, glass).	An area of 1.20 x 3m in. There is a high density of artefacts (leather shoes, fragments of wood, glass).
Devil Point 1	20 E 0593295 3049637	Between two rock stacks	Stone wall hut contains whale jaw bone suggesting roof support. Fragments of stoneware, glass and metal artefacts are spread inside and around the site.	Stone wall hut contains whale jaw bone suggesting roof support. Fragments of stoneware, glass and metal artefacts are spread inside and around the site.

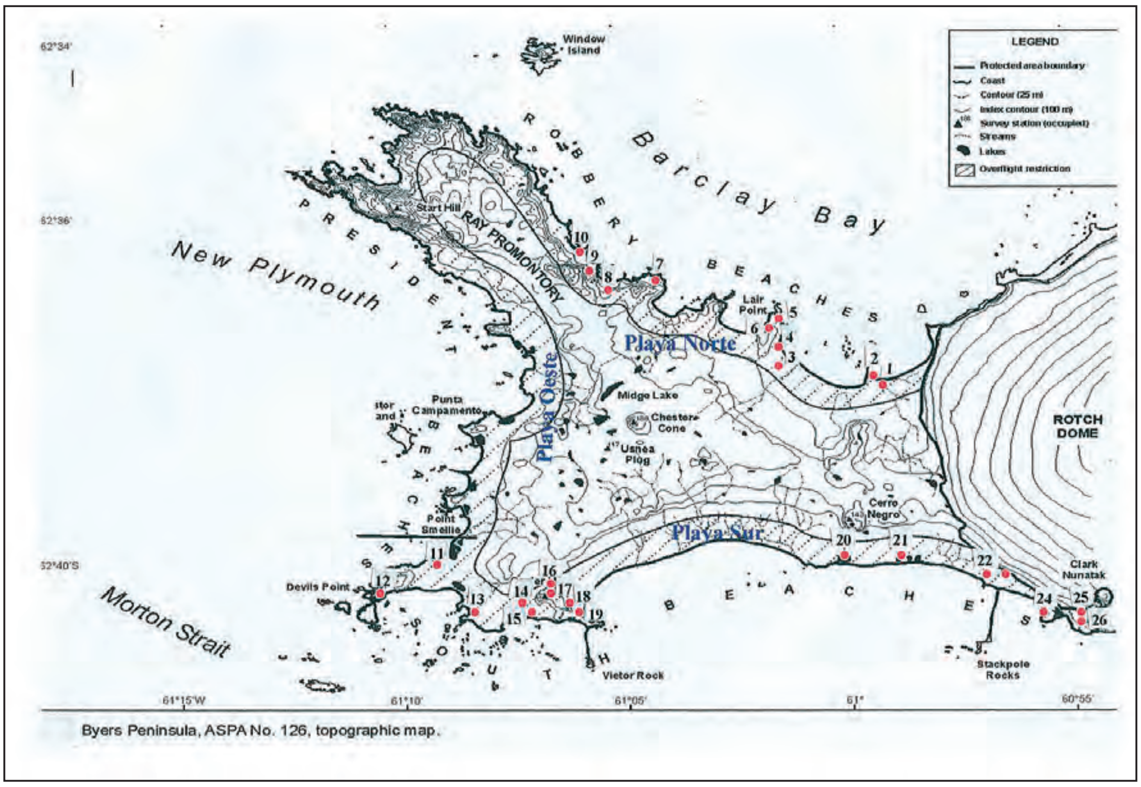
Name	Coordinates	Geographical Location	Cultural Description	Conservation State
Devil Point 2	20 E 0594310 3050542	The site is located at the edge of a penguin rookery on the slope of a hill.	Reported in the 1950s as the base of a wooden hut on a sealer's cargo sledge. In 2007 only the remains of a sledge were located and excavated, with no other evidence of occupation.	Melt water crosses over the site causing erosion.
Varadero Point	20E 0598495 3056580	Against a rock stack.	The structure consists of three stone walls enclosing an area of 2.40 x 2.10m. The hut contains 4 whale ribs suggesting roof supports. The annex contains 1 whale rib.	The stone walls have collapsed.
Penca 1	20 E 0598494 3056583	It is placed 15m from an elephant seal colony.	The structure consists of a 4-walled stone structure containing three whale vertebra seats.	The stone walls are completely collapsed due to the elephant seal action.
Penca 2	20 E 0597306 3056773	Small rock shelter formed between two large sloping rocks.	The presence of stones in the entrance suggests that a stone wall might have existed.	
	20 E 0597241 3057218	Placed on a small peninsula far from a rock stack.	Isolated hut. Straight stone walls enclose a roughly square space. It contains whale vertebra "seats".	This site is poorly preserved.

Other sites, not belonging to sealers:

Name	Coordinates	Geographical Location	Cultural Description	Conservation State
Lair Point 2	20 E 0600892 3055251	On the sandy beach surface, 300 m from the sea.	This site consists of the material remains of a British expedition of geologists and naturalists during the 1950s. Wooden skis were found.	Almost completely destroyed by wind, snow and the activity of seals.

Map showing the geographical location of the Byers historic sites:

1) Cutler 1
2) Cutler 2
3) Robbery Beach
4) Lair Point 2
5) Lair Point 1
6) Lima Lima 1 and 2, cave
7) Varadero Point
8) Pencas 1
9) Pencas 2
10) Pencas 3
11) Devil Point 2
12) Devil Point 1
13) Large rocks
14) Sealer Hill 2
15) Sealer Hill 1
16) Sealer Hill 4
17) Sealer Hill 3
18) Vietor 2 and Vietor 3
19) Vietor 1
20) Black Hill 1
21) South Beach 1
22) Stackpole 2
23) Stackpole 1
24) Point X 2
25) Point X 3
26) Point X 1



Some 19th century sites of Byers Peninsula.

Cutler 1

Point X2

Devil Point 2

Lair Point 1

Planning the protection and preservation of the sites

This topic was discussed in the First Regional Meeting of ICOMOS IPHC representatives of the Southern Hemisphere: Argentina, Australia and Chile at Viña del Mar, Chile February 07-08, 2007. After a discussion, the committee decided to do the following activities. First, to prepare a list of the Fildes historic sites (Working Document Nº 1) and the Byers historic sites (Working Document Nº 2), containing the basic information about the cultural resources that need to be protected. The Working Document Nº 2 also has a brief recommendation of the basic preservation actions we consider need to be adopted.

Second, to contact the Chilean Antarctic Institute in order to ask if Chile is interested in presenting the issue to the next Antarctic Environmental Committee meeting (April, 2007). The Working Documents Nº 1 and Nº 2 were given to Ambassador Jorge Berguño, Head of the Chilean Coordination office of the Chilean Antarctic Institute, at Santiago. Mr Berguño agreed with our suggestions to consider Fildes and Byers as different cases. Byers Peninsula is an Antarctic Special Protected Area (ASPA), managed by the British, so Working Document Nº 2 was sent to them, to include the list of the sites in their Management Plan. The case of Fildes is different because it has no any special protection. The idea was to suggest the western coastal area as an ASPA, including all the historic sites. Because the area is cut by the Chilean airport, the area needs to be divided into two different groups. A map showing this was annexed to the Working Document Nº 1.

The Chilean Delegation to the Antarctic Treaty presented the two issues at the April 2007 meeting of the Antarctic Environment Committee, which will study our proposal.

Our next activities will be to collaborate with the Chilean Delegation and the Antarctic Environment Committee in the development of a management plan for the Fildes Peninsula sites, and to provide to the British administration of Byers more detailed information if they need it.

Publications

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ZARANKÍN, A. Y XIMENA SENATORE. 2005. Archaeology in Antarctica: Nineteenth-Century capitalism expansion strategies. International Journal of Historical Archaeology, 9(1):43-54.

Endnotes

1 Ambassador Jorge Berguño, Head of the Chilean Coordination office of the Chilean Antarctic Institute, at Santiago.

2 07-08.02.07 First regional meeting of ICOMOS IPHC representatives of the Southern Hemisphere: Argentina, Australia and Chile. History Institute PUCV, Viña del Mar. Chile.

3 Ambassador Jorge Berguño, Head of the Antarctic Coordination Office in Santiago, helped us to prepare the Working Documents and presented it into the Antarctic Environmental Committee.

Pole to Pole

Paul Chaplin

A video-conference discussion between Scott Base, Antarctica and the IPHC conference in Barrow, Alaska

Point Barrow, at 71º20'N, is the northernmost point on the USA mainland. It is the home of the Barrow Arctic Science Consortium (http://www.arcticscience.org/), who hosted the IPHC / IPY conference in September 2007.

During planning for the event I was communicating with Roberta Farrell, one of the delegates, who was at that time working at New Zealand's Scott Base in Antarctica, at 77º51'S. Video conferences from Scott Base had been done before, but there had never been a link to a point as far north as Barrow. So Roberta suggested that a video conference between the two locations would be a great way to allow two additional people to participate. John Greenwood and Megan Absolon had been engaged by Antarctic Heritage Trust (AHT) as conservators for the 2007 Antarctic summer work programme, and would have an interesting contribution to make to the conference in Barrow (also see their article in this publication).

While the two locations lie slightly north and south of their respective poles, there is certainly little by way of civilization or conventional communications separating them from 90º north and south. The concept therefore would not only justify the title of the connection, but also the claim that if it was not the longest range terrestrial video conference ever held it was certainly one of them.

The idea was immediately embraced by telecommunications and data experts at Scott Base and Barrow who agreed that it was feasible, and the technical arrangements were quickly confirmed. Other support staff at both Barrow and Scott Base as well as Antarctic Heritage Trust (http://www.heritage-antarctica.org/AHT/) were also very entusiastic, so the scene was set for a new milestone in telecommunication and international polar heritage cooperation. Total numbers involved in the conference itself may not have been great,

John Greenwood describes the challenges of conservation of artefacts in a polar environment. Photo: Paul Chaplin

John and Megan explain the work they are undertaking in the conservation laboratory at Scott Base. Photo: Paul Chaplin

but the link attracted considerable interest amongst the local residents and media in Barrow and provided a welcome diversion for Scott Base staff.

The half-hour link gave John and Megan the chance to describe the conservation work they were conducting in the AHT conservation laboratory at Scott Base and they also participated in a discussion on the issues and ethics involved with the treatment of artefacts from the heroic era huts of Scott, Shackleton and Borchgrevink in the Ross Sea region of Antarctica.

Delegates to the IPHC International Polar Year conference (Barrow, Alaska, September 2007) assembled with video link participants in Scott Base, Antarctica.