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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

# POLAR SETTLEMENTS – LOCATION, TECHNIQUES AND CONSERVATION

This publication is compiled and edited for
the International Polar Heritage Committee of ICOMOS by:

SUSAN BARR – President IPHC

and

PAUL CHAPLIN – Secretary General IPHC

ICOMOS

INTERNATIONAL POLAR HERITAGE COMMITTEE
COMITÉ INTERNATIONAL POUR LE PATRIMOINE HISTORIQUE POLAIRE
COMITĒ INTERNACIONAL DE PATRIMONIO CULTURAL POLAR

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:

The Norwegian Directorate for Cultural Heritage
P.O. Box 8196 Dep
N-0034 Oslo
Norway

The Directorate supports the IPHC Secretariat, which is based in Norway, and has financed this publication.

The early explorers searching these last frontiers of our planet knew less about where they were going than the first astronauts knew about the moon when making their landings. In the decades immediately after the first explorers those who ventured into the polar regions, albeit with commercial motives, did so without the benefit of modern communications and were no less isolated from outside help than the astronauts. In the Arctic at that time small communities had for thousands of years been eking out an existence from the polar wastes.

It is our duty to strive to preserve for future generations, the physical remains of these remarkable people.

Our conference in Chile in April 2010 and this resulting publication are part of our efforts to achieve this.

*Front cover:* British Base “Station E” (1946) on Stonington Island, Marguerite Bay. (Photo: Michael Morrison)
*Back cover:* Remains of Thule Eskimo dwelling in East Greenland. (Photo: Susan Barr)


This and our previous publications may be obtained through the IPHC website **www.polarheritage.com** or direct from **pchaplin@online.no** or **susan.barr@ra.no**
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# CONTENTS

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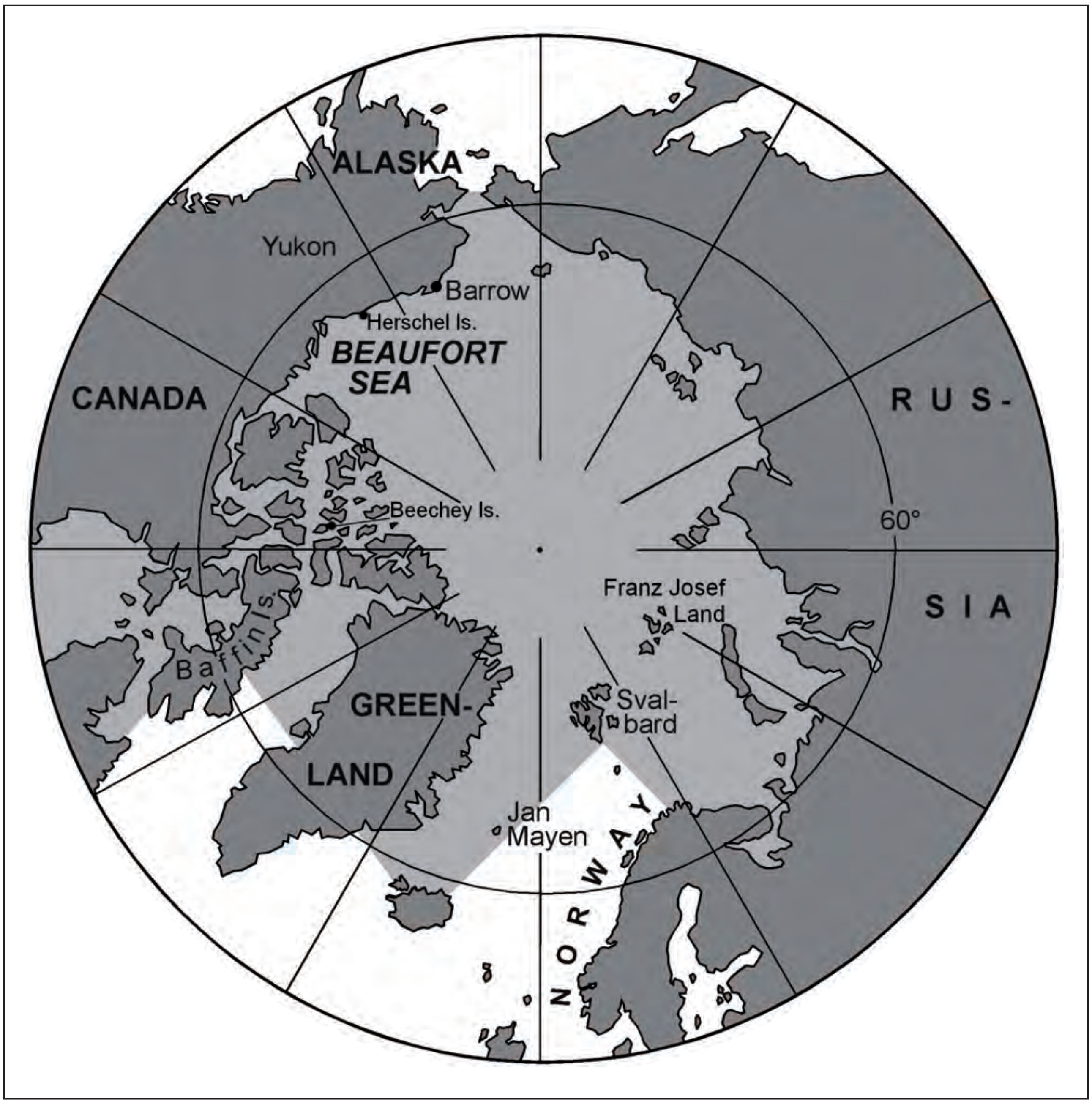
The Antarctic Region

land

ice

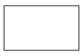
sea




The Arctic Region


land


ice


sea

# PREFACE

It was an unusual privilege for me to be invited to take part in the meeting of the ICOMOS International Committee on Polar Heritage, which was generously sponsored and hosted by the University of Magallanes in Punta Arenas, Chile. As my first meeting of the Committee, it was an opportunity for learning more about the richness of the cultural heritage of the Polar regions. However, what I found truly inspiring was experiencing how the extraordinary commitment and selfless hard work of the Committee members fulfilled the spirit of international cooperation that is at the very root of ICOMOS.

The formation of the Polar Heritage Committee under the able leadership of Susan Barr has opened the eyes of ICOMOS to important new areas of involvement and has helped in the worldwide dissemination of the plight of the cultural heritage in a region that had for too long been the restricted interest of a relatively small community of experts.

During the proceedings in Chile, much was accomplished in developing broad cooperative strategies to define, document and conserve these remote heritage treasures that exist in aggressive climates that are often devoid of imminent protective structures and a resident steward community. These difficult circumstances are precisely the reason why ICOMOS needs to maintain the conservation of our polar heritage under the highest priority.

With the new emphasis of the ICOMOS Scientific Council for cross-disciplinary cooperation among all the International Scientific Committees, exciting new opportunities for Polar Heritage are coming to the forefront through joint efforts with other groups such as the Committees on Risk Preparedness and Wood Conservation. Other equally important horizons are also possible through the Cooperative Agreements that ICOMOS has with the International Committee on the Conservation of Industrial Heritage (TICCIH), and with the International Council of Museums for the integrated conservation of structures and the collections they house.

All of this, together with the existing cooperation with specialized government agencies in member countries of the Antarctic Treaty and with affinity organizations such as the Antarctic Heritage Trust makes us optimistic about saving for the future these places where past generations courageously overcame great adversity to explore new horizons and new possibilities.

Gustavo Araoz
President, ICOMOS


**ICOMOS President Gustavo Araoz and IPHC President Susan Barr in discussion during the conference.**

Fue para mi un enorme privilegio el haber sido invitado a tomar parte en la reunión del Comité Internacional del ICOMOS sobre Patrimonio Polar, generosamente auspiciada por la Universidad de Magallanes en Punta Arenas, Chile . Como mi primera reunión de este Comité, fue una oportunidad para aprender sobre la riqueza del patrimonio cultural en las regiones polares, pero sin embargo, lo que más me inspiro esta experiencia fue como el compromiso extraordinario y la labor desinteresada de los miembros del comité enarbolan el espirity de cooperación internacional que es la raíz del ICOMOS.

La formación del Comité sobre Patrimonio Polar bajo el capaz liderazgo de Susan Barr ha abierto para los ojos del ICOMOS una nueva e importante área de trabajo, pero quizás mas importante, ha ayudado a difundir mundialmente el peligro en que yace el patrimonio cultural de una region que por demasiado tiempo estuvo restringida a un grupo relativamente limitado de expertos.

Durante las sesiojes en Chile, mucho se logro en desarrollar amplias estrategia de cooperación para definir, documentar y conservar estos remotos tesoros del patrimonio que existen en climas agresivos, a menudo desprovistos de estructuras de protección y de comunidades residentes que tutelen por ellos. Estas difíciles circunstancias son precisamente la razón por la cual el ICOMOS tiene que mantener la conservación de nuestro patrimonio polar bajo nuestras mas altas.

Bajo el nuevo énfasis del Consejo Científico del ICOMOS en la cooperación inter-disciplinaria entre todos los Comités Científicos Internacionales, surge un agama de posibilidades para esfuerzos conjuntos con otros grupos tales como los comités de Preparación ante Riesgos y la Conservación de la Madera. Otros importantes horizontes son posibles a través de los Acuerdos de Cooperación entre el ICOMOS y el Comité Internacional para la Conservación del Patrimonio Industrial (TICCIH) y el Consejo Internacional de Muesos (ICOMOS) para la conservación conjunta de estructuras y las colecciones que en ellas se albergan.

Todo esto, conjugado con la cooperación ya en efecto con organismos gubernamentales especializados en los países miembros del Tratado de la Antártida y con organizaciones fines como el Antarctic Heritage Trust nos hace sentir optimistas en cuanto a salvaguardar par el futuro esto sitios donde generaciones pasadas se sobrepusieron a enormes adversidades para explorar nuevos horizontes y nuevas posibilidades para la humanidad.

Gustavo Araoz
President, ICOMOS

# INTRODUCTION

**IPHC Conference**
**Punta Arenas, Chile. $22^{nd}$ – $25^{th}$ April 2010**

After attending our very successful conference in Barrow, Alaska, in September 2007 our Chilean representative Rubén Stehberg became even more enthusiastic about the prospect of a conference in Chile, and with the support of Chilean ICOMOS President José de Nordenflycht, a general discussion that had already begun, rapidly became more focused.

It was extremely fortunate for us that José was able to engage the support of Universidad de Magallanes (The Universtity of Magallanes) in Punta Arenas, and the University's Antarctic Programme. The Instituto Antártico Chileno, The Antarctic Institute of Chile was also involved.

The conference foundations were laid, the dates confirmed and the theme: *"Polar human settlements: territory, technology and heritage»* decided. Everything was in place for the participants to arrive – or was it?

Complications began on February $27^{th}$ when a magnitude 8.8 earthquake struck Chile. This disaster, along with the subsequent tsunami, caused massive destruction and killed at least 500 people. While the direct effects of this in Punta Arenas were limited, the damage to Chilean infrastructure and the consequences for the people directly involved raised major doubts about the conference continuing. The resilience of the Chilean people prevailed however and our colleagues expressed a strong wish to maintain "business as usual" and quickly convinced us to go ahead with plans.

One week before the conference start date, on the $14^{th}$ April, the Icelandic volcano Eyjafjallajökull erupted. This was to create major disruption to air travel across western and northern Europe for over 2 weeks and suddenly the attendance of a large number of delegates was in serious doubt.

Unfortunately a few members were prevented from reaching Punta Arenas but most were able to organise last minute alternatives. One particularly eager and ingenious member, then in the UK, sent me an email on the $18^{th}$ April:

*Heathrow closed a few hours before my flight, so I'm off to France by train tomorrow in an attempt to reach Madrid overland to get a LAN Chile flight. I've packed light and have a bag of 'scroggin' [trail mix] so I'm ready to give it a go!'*

His journey involved six trains, six taxis, two shuttle trains, a five hundred metre sprint through Madrid Airport, and a detour through Peru. He finally arrived in Punta Arenas with time for three hours sleep before the conference opening. In spite of the many challenges, the majority of the other participants also managed to arrive.

We were particularly honoured that ICOMOS President Gustavo Araoz accepted the invitation to attend. The conference was also well attended by a good many visitors and students from the University. Proceedings were conducted in English, but in order to reflect our Spanish-language context and the multilingual nature of ICOMOS, our Argentinean representative Javier García Cano was conscripted at short notice to provide Spanish summaries for the presentations. We are very grateful for his efforts and commitment.

We are pleased that we have been able to follow this up by including Spanish summaries for the articles published here. A few contributors have produced their own summaries and we are very grateful to Rubén Stehberg for his valuable assistance with the remainder.

Paul Chaplin
Secretary General, IPHC

**Conferencia IPHC**
**Punta Arenas, Chile. 22nd – 25th Abril 2010**

Luego de participar en la exitosa conferencia de Barrow, Alaska, en Septiembre 2007, nuestro representante chileno Rubén Stehberg se entusiasmó con la posibilidad de organizar una conferencia en Chile. Una vez conseguido el apoyo de José de Nordenflycht, Presidente de ICOMOS Chile, la idea se fue materializando rápidamente.

Tuvimos la suerte de que José consiguiera el patrocinio de la Universidad de Magallanes en Punta Arenas y de su programa antártico. Asimismo, el Instituto Antártico Chile otorgó su apoyo. De esta manera, quedaban decididos las bases de la conferencia, sus fechas y, el tema "Asentamientos humanos polares: territorio, tecnología y patrimonio". Todo estaba preparado para recibir a los participantes.

Las complicaciones comenzaron el 27 de Febrero 2010, cuando un terremoto magnitud 8.8 asoló Chile. Esto, más el tsunami que lo siguió, causaron una destrucción masiva en el centro sur del país y causaron la muerte, al menos de 500 personas. Aunque los efectos directos en Punta Arenas fueron limitados, el daño a la infraestructura chilena y sus consecuencias para la gente directamente involucrada nos llevaron a considerar la inconveniencia de continuar con la organización del evento en ese país. Sin embargo, la capacidad de recuperación del pueblo chileno y el fuerte deseo de los colegas chilenos de continuar la organización del evento según lo programado, prontamente nos convencieron de proseguir con el programa.

Imprevistamente, el 14 de Abril, una semana antes del comienzo de la conferencia, el volcán Eyjafjallajökull de Islandia, entró en erupción. Ello creó una gigantesca congestión del tráfico aéreo en el norte y oeste europeo, por más de dos semanas y, consecuentemente, quedó en suspenso la asistencia al evento de varios delegados. Un miembro particularmente ingenioso y ansioso, Bryan Lintott, en aquel momento en Inglaterra, desarrolló el siguiente viaje. Luego de tomar seis trenes, seis taxis, dos conexiones en tren, correr 500 m a través del aeropuerto de Madrid y tomar un desvío a Perú, logró llegar a Punta Arenas y descansar tres horas, antes del inicio de la conferencia.

Fuimos particularmente honrados con la aceptación para asistir al evento por parte de Gustavo Araoz, presidente de ICOMOS. Su presencia constituyó para nosotros un motivo de orgullo y alegría. A la conferencia concurrieron numerosos delegados extranjeros, muchas visitas chilenas y estudiantes de la universidad. La conferencia se desarrolló en idioma inglés, pero a fin de reflejar el contexto idiomático español y la naturaleza multi-idiomática de ICOMOS, se solicitó al representante argentino, Javier García Cano, que efectuara un resumen en castellano de cada presentación. Estamos muy agradecidos de su trabajo.

Hemos continuado con esta línea bilingüe al incluir resúmenes en español en cada uno de los artículos que se publican en este libro. Algunos autores proporcionaron su propio resumen, mientras que el resto fue traducido por Stehberg.

*Paul Chaplin, IPHC*

**Delegates at Fuerto Bulnes (Bulnes Fortress)** (Left to right) Julian Bickersteth, Jorge Berguño, Paul Chaplin, José de Nordenflycht, Claudia Ojeda, Adam Wild, Cornelia Lüdecke, Javier García Cano, Rubén Stehberg, Johan Mattsson, Sherrie-lee Evans, Michael Pearson, Russel Gibb, Andrés Zarankin, Benjamin Held, Susan Barr, Ximena Senatore (with baby, Tircio), Brian Lintott. Kneeling in front – Gustavo Araoz, Mónica Valentini.

# INTRODUCTION TO THE CONFERENCE

**Antarctica: the last heritage frontier**

José de Nordenflycht
ICOMOS Chile President

As we planned this scientific meeting – more than a year ago – the famous sentence attributed to Shackleton came to my mind immediately. The sentence, that the apocryphal tradition tells us that Shackleton published in the press, is:

«*Men wanted for hazardous journey. Small wages. Bitter cold. Long months of complete darkness. Constant danger. Safe return doubtful. Honour and recognition in case of success*.»

One year later, with a recent earthquake in Chile and a volcano eruption on the European horizon, we can say that the people of the IPHC have the same type of challenges as Shackleton expressed, and this is not only a metaphor.

We first heard about the International Polar Heritage Committee in 2002, when architect Javier García Cano introduced me to Susan Barr and Paul Chaplin in the context of the ICOMOS General Assembly held in Madrid that year. Our Argentinean colleague obviously thought that some Chilean people should participate in this International Scientific Committee that had been formed two years earlier in 2000.

Ten years later ICOMOS Chile is now an active member in this International Scientific Committee and, in 2007, organized a first regional meeting – that we called hemispherical because it was attended by colleagues from Argentina, Australia and Chile. Happily these are all here today with us at the beginning of this new meeting.

In this challenge for us to be organisers of the first official meeting of the International Polar Heritage Committee in the southern hemisphere and in a Latin-American country, we are very happy with the consequences of that first small encounter in Madrid.

To this we can add the fact that in this scientific meeting we have the support of the ICOMOS President, architect Gustavo Araoz, who with his presence here reinforces the interest of all the ICOMOS members to work within an institution that has a commitment to an inclusive and democratic participation that calls for a regional representation in projects under the common doctrine of heritage conservation.

All of these facts show the commitment of Chile and its scientific institutions, represented by the Universidad de Magallanes and the Instituto Antártico Chileno, and the context in which ICOMOS Chile wants to be at all times a means for international scientific dialogue in our country to support the decisions and actions in the many fields of our heritage.

As we know, perhaps, Antarctica is the last frontier of human world solidarity, which inspires one of the most successful geopolitical treaties in recent history. That spirit is deeply consistent with the values that inspire the conservation of heritage from the past fifty years. We must remember what is written in the Charter of Venice, in compliance with which we must make our best efforts to show solidarity with future generations.

In this way the polar heritage is not only – as one might say – the last geographical frontier, it is indeed the vanguard of heritage, and we work hard to prove this.

We want to thank the IPHC for putting its trust in the Chilean Committee of ICOMOS, and also to thank for their support and enthusiasm the Instituto Antártico Chileno, represented in the person of Ambassador Jorge Berguño.

Finally we want to give many thanks and recognition to all the people in the team at the Universidad de Magallanes, represented in the person of the Chancellor Dr. Víctor Fajardo, who have worked very hard to make the meeting a success, which we are sure it will be.

Punta Arenas, 21 April 2010.

**Antártica: la última frontera patrimonial**

José de Nordenflycht
Presidente ICOMOS Chile

Desde que planificamos esta reunión científica –hace más de un año – la famosa frase atribuida a Schakleton, vino a mi mente inmediatamente.

La frase, que la tradición apócrifa nos cuenta que Schakleton publicó en la prensa, es:

*Se buscan hombres para peligroso viaje. Salario reducido. Fr o penetrante. Largos meses de completa oscuridad. Constante peligro. Dudoso regreso sano y salvo. En caso de  xito, honor y reconocimiento*."

Un año después, con un reciente terremoto en Chile y una erupción volcánica en el horizonte europeo, podemos decir que los miembros del Comité Científico Internacional de Patrimonio Polar están en la misma sintonía que Schakleton, y esto no es sólo una metáfora.

Conocimos sobre el trabajo del Comité Científico Internacional de Patrimonio Polar en el año 2002, cuando el arquitecto Javier García Cano me presentó a Susan Barr y Paul Chaplin en el contexto de la Asamblea General de ICOMOS realizada en Madrid ese año.

Nuestro colega argentino obviamente pensó que los chilenos deberíamos participar de este Comité Científico, formado recientemente en el año 2000, solo dos años antes de ese encuentro.

Diez años después de ello el Comité Chileno de ICOMOS tiene un miembro activo en éste Comité Científico, ha organizado una primera reunión regional el año 2007, la que denominamos hemisférica porque participaron colegas de Argentina, Australia y Chile, todos quienes afortunadamente están hoy con nosotros al comienzo de esta nueva reunión.

En este desafío que significa ser organizadores de la primera reunión oficial del Comité Científico Internacional de Patrimonio Polar en el hemisferio sur y en un país latinoamericano, podemos estar muy felices de las consecuencias de todos esos pequeños encuentros anteriores.

Si sumamos a ello el hecho de que en esta reunión científica contamos con el apoyo del Presidente de ICOMOS, arquitecto Gustavo Araoz, quien con su presencia aquí nos refuerza el interés de todos los miembros de ICOMOS por trabajar en una institución que debe mantener su compromiso por una participación inclusiva y democrática que apele a su representatividad regional en proyectos que nos convocan a todos, bajo una doctrina común de salvaguarda del patrimonio.

Todos estos hechos demuestran el compromiso de Chile y sus instituciones científicas, representadas por la Universidad de Magallanes y el Instituto Antártico Chileno. Contexto en el cual ICOMOS Chile quiere ser en todo momento un medio para el diálogo científico en nuestro país, que debería apoyar las decisiones y acciones en todos los campos del desarrollo de nuestro patrimonio.

Como sabemos, tal vez, la Antártica es la última frontera para la solidaridad humana, la misma que inspira uno de los más exitosos tratados geopolíticos de la historia reciente. Ese espíritu tiene una profunda coherencia con los valores que inspiran la conservación patrimonial desde los últimos cincuenta años, donde debemos recordar lo que se ha escrito en la Carta de Venecia, en relación a que debemos hacer los mejores esfuerzos para ser solidarios con las generaciones futuras.

Por eso que el Patrimonio Polar no es solamente –como se podría decir- la última frontera geográfica, ya que de hecho es la vanguardia del patrimonio, y nosotros tenemos un arduo trabajo para probarlo.

Queremos agradecer al Comité Científico Internacional de Patrimonio Polar por confiar en nuestro Comité Nacional y también agradecer el apoyo y entusiasmo del Instituto Antártico Chileno representado en la figura del Embajador Jorge Berguño.

Finalmente queremos dejar expresado nuestro agradecimiento y reconocimiento a todo el quipo de la Universidad de Magallanes, representado en la figura de su Rector Dr. Víctor Fajardo, quienes han trabajado rigurosamente para que esta reunión sea todo lo exitosa que ya podemos auspiciar.

Punta Arenas, 21 de abril de 2010.

# ARCTIC AND ANTARCTIC – DIFFERENT, BUT SIMILAR: CHALLENGES OF HERITAGE CONSERVATION IN THE HIGH ARCTIC

Susan Barr

**Summary**

Although grouped together as "the Polar Regions", the Arctic and Antarctic admittedly have similarities, but are in many ways quite different. Geography, climate, politics, flora and fauna clearly distinguish the one from the other as does, not least, the indigenous history of the Arctic. The relative accessibility of the Arctic compared to the Antarctic has led to a far more differentiated and much longer history of human impact in the northern region, and from this also a larger and more differentiated cultural heritage. This paper gives an overview of some of the challenges of heritage conservation in the Arctic – which are mostly aggravated as a result of climate change – and shows how cooperation between heritage professionals in both polar regions is both fruitful and necessary.

**Resumen**

Aunque suelen agruparse como "las Regiones Polares", ya que el Ártico y la Antártica tienen grandes similitudes, presentan sin embargo, grandes diferencias. La geografía, el clima, la flora y fauna, las políticas gubernamentales y las relaciones internacionales, claramente distinguen una de la otra y, más aún, el Ártico tiene su propia historia indígena. La relativa accesibilidad del Ártico comparada con la Antártica le agrega, a la primera, una diferenciación en términos de una mayor historia del impacto humano y un patrimonio cultural más prolongado y más diferenciado. Este artículo proporciona una aproximación a los desafíos que enfrenta la conservación del patrimonio en el Ártico –el cual se ve agravado por el cambio climático- y muestra como la cooperación entre los profesionales del patrimonio en las regiones polares es altamente fructífero y necesario.

**Introduction**

The Ends of the Earth – Poles Apart. Often regarded as two variations on the same theme, the two polar regions share many characteristics and yet are fundamentally different in several ways. [Refer to maps at front of publication]

*The Antarctic* is popularly described as being on average the coldest, driest and windiest continent and with the highest average elevation[1]. It is 1.4 times larger than USA and is surrounded by three large oceans – the Atlantic, the Pacific and the Indian Oceans – with a distance of 1000 km from South America and 4000 km from South Africa. About 98% of the land is covered by ice with an average thickness of 1.6 km and this comprises about 70% of the world's store of freshwater. In winter the sea ice more than doubles the extent of the continent.

Politically Antarctica is an international area defined as all land and sea south of 60°S. National claims to territory are not relinquished, but are laid aside for the time being and the Antarctic Treaty System regulates international relations within the region and dedicates the continent to science and other peaceful purposes. There has never been an indigenous population on the continent and scientific bases are the only more or less permanent settlements, housing about 4000 scientists and support staff during the summer and 1000 during the long winter. More than 40,000 tourists visit Antarctica in the summer, mostly keeping to a limited number of sites and areas.

*The Arctic*, on the other hand, is an ocean surrounded by land – the national territories of USA (Alaska), Canada, Denmark/Greenland, Norway (Svalbard) and Russia. The centre of the Arctic Ocean is

[1] See for example Wikipedia

permanently covered by ice, which at its maximum extent during winter stretches to the land borders. Climate change is currently affecting the Arctic more noticeably than in most other regions and the diminishing state of the Arctic sea ice is being closely monitored.

The extent of the Arctic is less easy to define than the extent of the Antarctic. Various definitions take into account average summer temperatures, extent of permafrost, vegetation zones and other parameters, which gives a myriad of wavy lines running through the land areas at various distances from the Ocean and the North Pole. The High Arctic is the name usually given to the most northerly area where the climate is harshest and conditions for all forms of life (humans, flora and fauna) most extreme. All the national land areas except the Svalbard archipelago have indigenous populations and also huge areas of wilderness with little or no evidence of previous settlement or exploitation.

**ICOMOS IPHC joining the Poles**

The International Council on Monuments and Sites (ICOMOS) approved the formation in 2000 of an International Scientific Committee for the polar areas: the International Polar Heritage Committee (IPHC – www.polarheritage.com). This was based on the recognition that, although the Arctic and Antarctic are a world apart, the diversity of the cultural heritage in both regions, together with the challenges and solutions of preservation, are very similar. It seemed therefore both logical and productive to bring together scientists, conservators and managers who were working with the heritage in at least one of the regions so that their problems, results, solutions and ideas could be shared for mutual benefit. In order to keep the scientific field as homogeneous as possible the first objective of the IPHC was defined as: "Promoting international cooperation in the protection and conservation of *non-indigenous* heritage in the Arctic and Antarctic". At the same time it was recognised in the second objective – "To consult and cooperate with Arctic indigenous peoples regarding heritage of cross-cultural significance" – that Arctic cultural heritage to a large degree is of indigenous origin and would not be ignored by the Committee. Indeed for several members of the IPHC working in the Arctic, there was no way that the indigenous aspect could or would be overlooked.

**Cultural heritage as a common factor**

The non-indigenous use of both polar regions has mostly focussed on exploitation of natural resources, either through hunting/trapping or through mining. Science and exploration are additional contributors to the monuments and sites left today. Sites from the earliest use of Antarctica resemble Arctic indigenous sites in that they are very modest in size and material use and can be difficult for non-professionals to comprehend. Driftwood, whalebones, rocks and whole or part use of natural sheltering formations are described from early 19th century use by sealers in the South Shetlands[2] and can easily be compared with High Arctic sites where a few large stones or rocks in an unnatural position can be an indication of an earlier dwelling, a grave or a marker of some sort. Casual dating of such sites can be a problem, and the question of whether one is dealing with a relic of human activity from 10 years or 100 years back can need professional analysis.

**Remains of Thule Eskimo dwelling in East Greenland. Photo: Susan Barr**

[2] See Stehberg, Rubén 2004: *Archaeologists document historical heritage in the South Shetland Islands*. In: Polar Monuments and Sites: Cultural heritage work in the Arctic and Antarctic Regions. IPHC, Norway and Stehberg, R., Pearson, M., Zarankín, A., Senatore, X. and Gatica, C. 2008: *Protection and preservation of the oldest sites of the Antarctic: the case of Fildes Peninsula and Byers Peninsula in the South Shetland Islands*. In: Historical Polar Bases – Preservation and Management. IPHC, Norway. (Also see M Pearson/R Stehberg in this publication).

Ernest Shackleton's 1908 hut at Cape Royds, Antarctica. Photo: Ed Anderson

One of the most-prominent symbols of Antarctic cultural heritage is the historic huts from the Heroic Era at the beginning of the 20th century: Carsten Borchgrevink's from his 1898-1900 expedition (the first scientific expedition to winter on the continent and the first buildings erected there), Otto Nordenskjöld's from 1901-04, two from Robert F. Scott's expeditions 1901-04 and 1910-13, one from Ernest Shackleton's 1907-09 and Douglas Mawson's from 1911-14.

There are many huts in the Arctic. In the Svalbard archipelago alone there are some hundreds in various conditions from the well preserved to ruins. Arctic huts stem from hunters and trappers, from early prospecting and mining attempts, from scientific and exploring expeditions and from official missions of one kind or other. Styles, materials and not least the challenges of preserving the huts are so similar between the Arctic and the Antarctic that it would be irresponsible not to pool the professional resources that work to protect the huts in the one or the other region.

As man expanded into these "white areas on the map", exploitation of natural resources was either the driving force for the expansion or a result of the discoveries made by explorers and scientists who had their own reasons for travelling into the unknown. It was natural to follow the marine resources – walrus,

A traditional, protected trapper cabin in Svalbard with radio antenne reflecting temporary use as a scientist's base. Photo: Susan Barr

Whales were processed at Whalers Bay, Deception Island from 1906-31 and the industrial remains are a striking monument to this activity. Photo: Susan Barr

seals, whales – into the ice, first into the Arctic and then into the Antarctic where sealing became an established activity in the South Shetland Islands by the early 19th century[3]. Arctic whaling expanded into the Antarctic at the beginning of the 20th century, where the remains of industrial whaling stations on Deception Island in the South Shetland Islands and the sub-Antarctic South Georgia stations, particularly Grytviken, are large tourist attractions.

Whaling remains in the High Arctic date from the beginning of the 17th century, with Svalbard and Jan Mayen containing a number of important sites from early Dutch and English whaling. Industrial remains which are more comparable with Whalers Bay (Deception Island) and the South Georgia stations are, however, related to the early mining activities of the same period, i.e. the first part of the 20th century. Such heritage sites are found in many areas of the Arctic as gold, coal, iron ore, zinc, asbestos and other minerals were perceived to be the gift that the untamed Arctic could give to civilisation. Many of the seemingly promising finds proved to be a disappointment and the prospecting and mining camps were just deserted as the miners laid

[3] Senatore and Zarankin, Stehberg this volume

Historic coal mine 2B in Longyearbyen, Svalbard presents a huge challenge to conservators and the heritage management. Photo: Susan Barr down their tools and climbed onto the ships taking them back home to their various countries. Buildings, railway tracks, machines and tools were left to rot and rust very slowly in the cold and dry polar climate, leaving ample material for later industrial archaeologists and historians to study and for tourists to wonder or shudder at.

Tourism is now the most-rapidly expanding polar industry. Cruise ships have carried passengers to High Arctic Svalbard since the end of the 19th century. Cruise tourism to the Antarctic began almost 100 years later – in the 1960s. For almost all cruises to the polar regions, cultural heritage sites stand high on the list of the attractions that tempt customers to these areas.

**Arctic monuments and sites – similar, but different**

The description above shows how similar the monuments and sites of both polar regions are. At the same time there are obvious differences between the areas. The Arctic has monuments and sites dating back to the earliest-known indigenous inhabitants. In north Greenland Palaeo-Eskimo living sites from 4500 years ago have been studied, and at Barrow, Alaska Inupiat remains from 500-900 AD are currently being rescued from sea erosion.

In many areas there is a richness of cultural remains from several different historical periods. Herschel Island off the north Canadian coast is one example, where 1000 year old Thule remains rub shoulders with sites from early 20th century American whaling activities. Svalbard is characterised by single sites containing remains from several or all of the historical periods from the beginning of the 17th century to the present day, since the few coastal sites that were suitable for activities such as hunting, trapping, mining and scientific bases were used again and again.

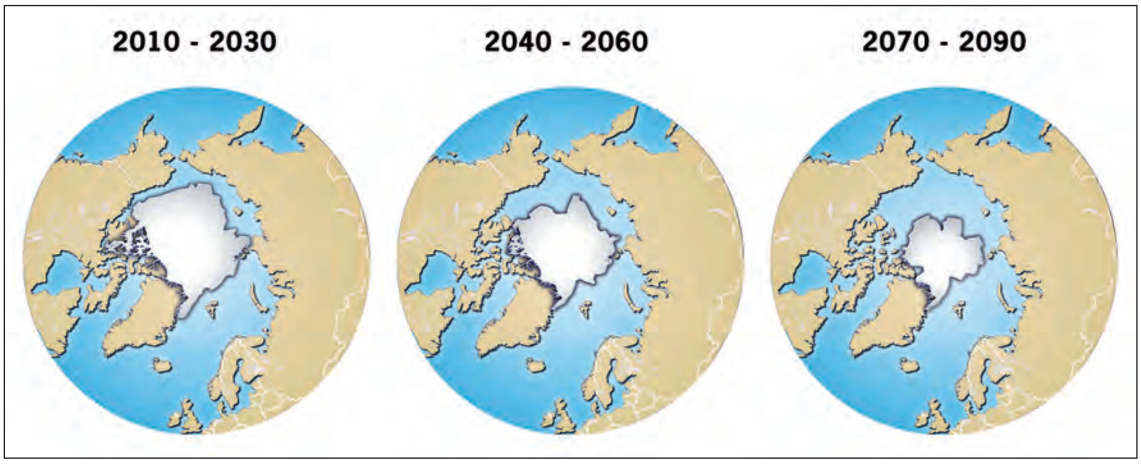
A Norwegian trapper cabin from the early 20th century built on top of the remains of an earlier Pomor Russian cabin, Svalbard. Photo: Susan Barr

Relative accessibility together with the fact that the Arctic climate, although severe enough in winter, is still more lenient than that of the Antarctic, are keys to the differences between the overall Arctic and Antarctic cultural heritage. Despite this, all the main challenges to the protection and preservation of Arctic sites as described below, will be recognised as relevant in the Antarctic situation as well.

**Climate change – The polar challenge**

It is well documented[4] that the Arctic atmosphere is warming faster than the average global increase. Both the extent and thickness of the sea ice covering the Arctic Ocean is decreasing, leading to difficulties for both Arctic communities and Arctic fauna which depend on stable ice conditions for winter travel and food gathering. Structures such as roads, bridges and buildings also suffer from melting permafrost which destabilises

[4] See for example ACIA (Arctic Climate Impact Assessment) at http://www.amap.no/acia/ and CICERO (Centre for International Climate and Environmental Research – Oslo) webnews 15.11.2009: "Arctic is warming faster than thought" http://www.cicero.uio.no/webnews/index_e.aspx?id=11235




Projected changes in Arctic pack ice (sea ice minimum extent). Projections are based on models of the IPCC Third Assessment Report (IPCC TAR). http://maps.grida.no/go/graphic/projected-changes-in-arctic-pack-ice-sea-ice-minimum-extent . Hugo Ahlenius, UNEP/GRID-Arendal

foundations, and glacial melt water takes new and more violent courses. Effects on heritage conservation include:

**Coastal erosion:** A majority of High Arctic monuments and sites are situated along the coast, where access is easiest and where marine and land fauna have their natural habitats. Diminishing sea ice has as a consequence that the protection from wave erosion by an ice belt along the coast is no longer there and this factor, coupled with destabilisation of permafrost, leads to rapidly increasing erosion and the disappearance of monuments and sites into the sea. A similar effect can be seen along river courses, where increased glacial melt water adds to the problem.

In some appropriate cases a smaller monument such as a hut, may be saved from the erosion edge by being physically moved back from the edge. This has been done with a building from the American whaling period on Herschel Island in Canada[5]. Two small hunter's cabins in Svalbard have also been moved in this way, while structures such as York Factory in Canada (see below) are far too large to be moved to safer ground. Other measures such as barriers of rocks, concrete or sandbags may be used to delay or stop the erosion, as with the sandbagging along the shoreline at Barrow, Alaska, but such barriers cannot be engineered at the most remote sites and they also present an unsightly intrusion into the landscape.

[5] See Olynyk, Doug 2004: Canada's Yukon Territory – Heritage at the Edge. In: Cultural Heritage in the Arctic and Antarctic Regions. IPHC publication, Norway pp.53-56.
See for example "Alaska permafrost thawing, Siberia frozen peatbogs melting" at
http://www.thewe.cc/weplanet/news/arctic/permafrost_melting.htm
"York Factory – National Historic Site of Canada – Management Plan" at http://www.pc.gc.ca/lhn-nhs/mb/yorkfactory/plan.aspx

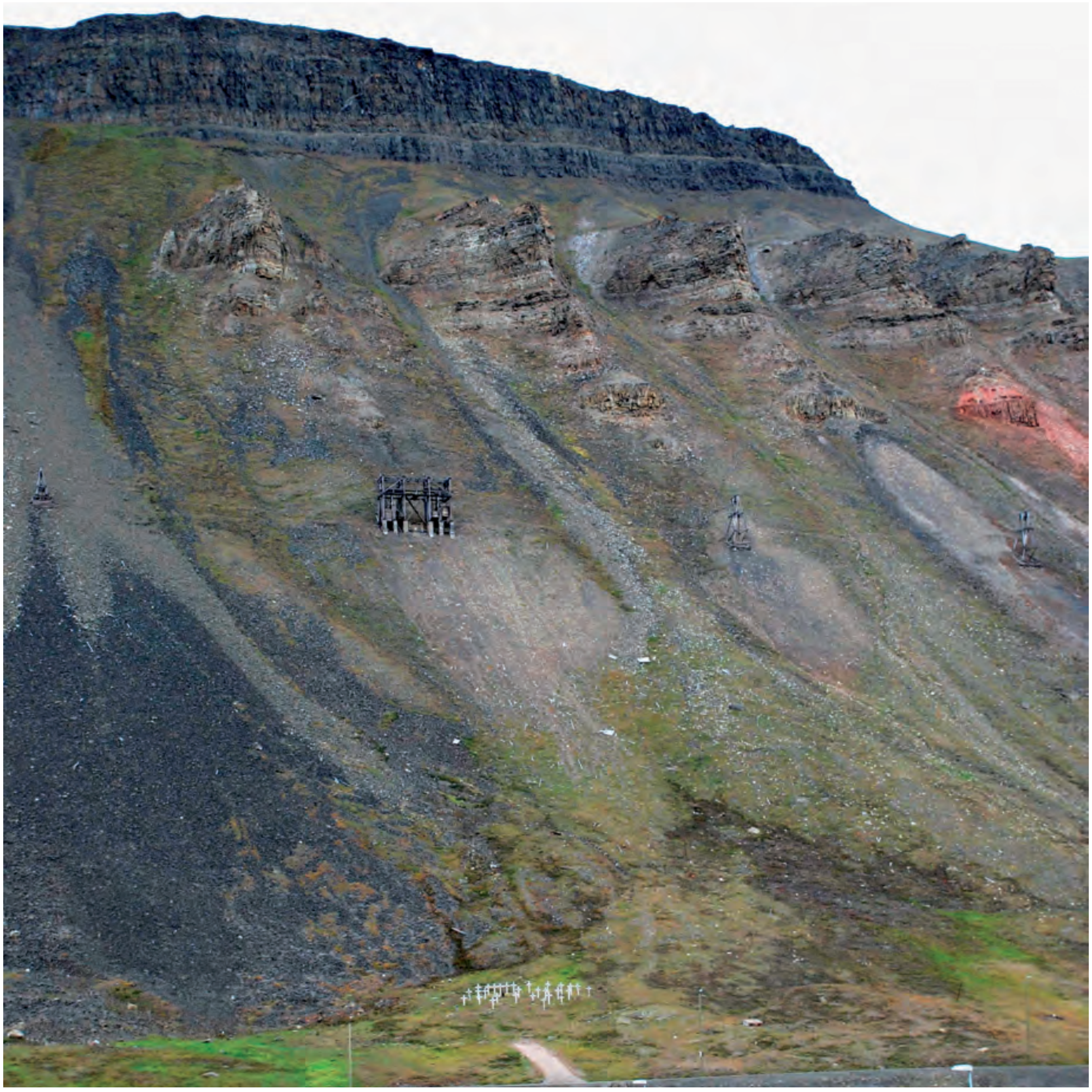
Sandbagging of the coast at Barrow, Alaska to try to prevent wave erosion of the low-lying coastline. Photo: Susan Barr

**Melting permafrost:** The thawing of permafrost owing to higher average temperatures[6] not only leads to the release of methane into the atmosphere, but also has as a consequence that buildings and structures which have foundations in or on the permafrost become destabilised with cracks and foundation collapse as a result. In places where ice lenses (areas of ice under the ground surface) melt, large cracks and holes can appear in the ground or large pieces of the ground can fall away at a time. In 2008 a four-metre wide belt of coastline in Svalbard suddenly collapsed without warning as a result of such thawing.

The Canadian National Historic Site of York Factory on Hudson Bay has gradually been loosing area to erosion for decades. The problem is now increasing and solutions are not easy to find. A quote from the Management Plan describes the situation:

> ***York Factory Under Threat***
> *York Factory is in trouble. As people who have lived and worked there know, erosion along the north bank of the Hayes River has been happening for a long time. York Factories I and II were lost to riverbank erosion, probably as long ago as 1900. It is estimated that much of the archaeological remains of York Factory III, the cemetery and the Depot, will be lost within 100 to 150 years at the current rate of bank loss. The rate of erosion has been about three metres/five years as averaged over a one hundred year period. However, in any given year or location along the bank, erosion can be minimal to extreme, with large slump blocks being common.*
>
> *Permafrost decay and poor drainage also threaten York Factory s historical remains. York*

[6] See for example "Alaska permafrost thawing, Siberia frozen peatbogs melting" at http://www.thewe.cc/weplanet/news/arctic/permafrost_melting.htm



The adjusting station and three pylons for the historic aerial transport system for coal can be seen in the middle of the hillside above Longyearbyen, Svalbard. Photo: Susan Barr

*Factory is near the southern edge of permafrost in Canada. The site faces permafrost degradation from combined effects of climate warming, increased water drainage and the softening and sloughing of soils, which will also contribute to riverbank loss.*[7]

A further example of cultural heritage loss from permafrost melt – in this case also combined with increased precipitation as another result of climate change – is the destabilisation of hillsides around the settlement of Longyearbyen in Svalbard, where the pylons for the historic aerial transport system for coal from the mines to the shipping area are in grave danger of tipping over or sliding down the slopes. In this case too it is difficult to see what solutions could be implemented to stabilise and save the pylons from their apparent fate.

**Increasing rot, mould and fungal growth:** The High Arctic was traditionally thought to be free from rot, mould and fungal growth owing to the cold and dry climate. In fact 17th century graves uncovered in Svalbard in the 1980s contained skeletons with some hair and skin still intact on the skulls and with woollen clothing almost in original state[8]. In warm and moist micro-climatic environments, however, mould and rot have flourished even in the High Arctic. Such micro-climates are for example in sheltered and sunny spots on the wooden walls of huts, particularly where the wooden boards meet soil, turf or other materials which protect from the drying effect of the wind, or inside buildings where the 24-hour summer sun shines through a glass window and meets humidity from melting ice and snow that has drifted into the building.

The changing climate is bringing relatively milder and wetter conditions to the Arctic and thereby improving the conditions for and accelerating the occurrences of rot, mould and fungal growth[9]. This is a

Mould and fungal growth inside a building at 80°N in Svalbard. Photo: Susan Barr

The base of a building in Svalbard had rotted from contact with soil. It has been raised up from the ground prior to substitution of rotten wood with new materials. Photo: Susan Barr

[7] "York Factory – National Historic Site of Canada – Management Plan" at http://www.pc.gc.ca/lhn-nhs/mb/yorkfactory/plan.aspx

[8] Hacquebord, Louwrens 1984: Smeerenburg: het verblijf van Nederlandse walvisvaarders op de westkust van Spitsbergen in de 17de eeuw. Disertatie. Amsterdam/Groningen.

[9] See Farrell, Roberta, Blanchette, Robert et al 2004: Scientific evaluation of deterioration in historic huts of Ross Island, Antarctica. In: Polar Monuments and Sites: Cultural heritage work in the Arctic and Antarctic Regions. IPHC, Norway and Mattsson, Johan and Flyen, Anne-Cathrine 2008: Bio-deterioration in buildings in Svalbard. In: Historical Polar Bases – Preservation and Management. IPHC, Norway. And articles in this volume.

Tourists around an important, but fragile historic site in Franz Josef Land. Photo: P.J. Capelotti

huge challenge for the conservation of, for example, the various historic huts in the Arctic where the question of authenticity of materials vies with the more drastic method of exchanging larger parts of the structure. If all the standing planks a simple hut is built of have rotted away at the base where they have been in contact with the damp soil, should all the planks be replaced or just the lower parts of each one? If the former method is chosen, what do we have left of an original construction?

**Increasing tourism:** As the barrier of ice around the Arctic recedes it opens up areas to traffic such as cruise ships and other vessels that previously had been wary of moving into ice-filled waters. Coupled with the fact that modern tourists seek new experiences in all corners of the globe, and soon perhaps even beyond the globe, Arctic monuments and sites have been rapidly opened up to a traffic that in the worst case can seriously damage or even destroy the very values that tourists come to experience.

There are several ways of tackling this challenge of satisfying the legitimate wish of the interested public to see the unique Arctic monuments and sites, at the same time as these sites need protection from the wear and tear that many visitors can cause. The best solution for all parts is if information and cooperation between the managers/conservators and the tourist agencies and guides can secure non-invasive and non-impacting visitation to sites. Visitors may be advised to move along certain routes, to avoid certain areas of the sites, or even to keep a designated distance from the sites that enables viewing without actual contact. Signs or barriers do not fit well with the open and more or less untouched wilderness, and this method of information and control should be used sparingly. In other cases it may be deemed necessary to close certain sites to the public. In Svalbard regulations were passed effective from 1st January 2010 closing or regulating access to nine particularly significant sites in order to keep them as well preserved as possible from human impact. This restriction was mostly accepted without too many objections by the cruise companies since it was recognised that there are many other sites in Svalbard that are still open for tourism. Restriction of visitation to important heritage sites is also a globally-used practice, with the Lascaux caves in France containing unique Palaeolithic paintings being a well-known example.

High Arctic vegetation is fragile and at the climatic limits of possible growth. Too many footsteps can easily wear away what little there is. The result is a network of distracting paths to and around sites on the tourist list. In addition sites can loose protecting vegetation, opening archaeological remains to increased natural degradation or erosion.

Degradation of heritage sites from visitors who wilfully damage or remove material is a problem that

Northumberland House, Beechey Island, Canada - famed from the Franklin search expeditions and with historic remains strewn around that can easily be trodden to bits by careless visitors. Photo: Susan Barr

calls for extra information and monitoring, the latter in fact being easier to control when visitors are in the organised groups that cruise tourism consists of. Even in such controlled groups unintentional damage can be caused by visitors – and even guides – treading on the loose and scattered remains that often surround heritage sites[10].

**Professional cooperation**

Since the IPHC was formed in 2000, two conferences have been held in addition to other smaller meetings and numerous email exchanges. This is the third publication and is the result of the latest conference which was held in Punta Arenas, Chile in April 2010. At the conference in Barrow, Alaska in September 2007[11] the participants were linked during one session by video-telephone to conservators working at New Zealand's Scott Base, Antarctica on artefacts from Scott's and Shackleton's huts on Ross Island. Participants were able to see examples of the artefacts and to discuss conservation challenges which are common to those working in both polar regions.

The conclusion was obvious: that such professional dialogue and cooperation as exampled by this exchange will benefit the management and conservation of the fragile heritage of the polar regions.

[10] See Roura, this volume.

[11] Barr, S. and Chaplin, P. 2007: Historical Polar Bases – Preservation and Management. IPHC, Norway.

# POLAR HERITAGE CONSERVATION AND ARCHAEOLOGY

Michael Pearson

## INTRODUCTION

Historic sites in Antarctica contain archaeological material that can be of major historical and research significance. Polar heritage sites can be defined by, or have their significance enhanced by, archaeological remains, and archaeology has long been a tool used in the conservation of such sites.

Archaeology includes both the study of above-ground physical evidence of the past and its excavation from below the ground. The archaeological remains may contain information about the history, construction, habitation and decay of the site itself, as well as clues about the more prosaic and mundane aspects of survival in polar environments—those things that do not make it into the official lists and records of the expeditions (Pearson 2004). The archaeological resource also has the potential to address much broader questions about human history and behaviour.

While above ground archaeological recording and research may have little impact on a heritage site, archaeological excavation destroys, to some degree, the site it studies. Once excavated, nobody can ever again fully recover and study all the evidence the site once contained. All that is left is a hole in the ice, or in the ground (hopefully backfilled) and a collection of artefacts, samples and observations housed somewhere else. While every archaeologist believes that his or her work recovers evidence that provides important information about the past, the level of recording, documentation, analysis and publication of polar archaeological work varies dramatically. The reality is that some archaeology results in little of value to either conservation or academic research.

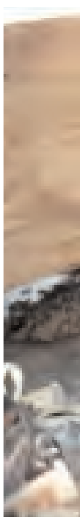
**Resumen**

*Los sitios hist ricos de la Ant rtica contienen materiales arqueol gicos que pueden tener gran importancia para la investigaci n y para la historia. Los sitios de patrimonio polar pueden definirse por — o elevar su significado por- sus restos arqueol gicos y la arqueolog a ha sido, por mucho tiempo, una herramienta utilizada para la conservaci n de dichos sitios.*

*La arqueolog a incluye tanto el estudio de la evidencia f sica superficial del pasado, as como la excavaci n del sub-suelo. Los vestigios arqueol gicos pueden ofrecer informaci n sobre la historia, la construcci n, la habitaci n y el ocaso del sitio mismo, as como las claves sobre aspectos m s cotidianos como la supervivencia en ambientes polares — aquellas cosas que no aparecen en los registros y listas oficiales de las expediciones (Pearson 2004). El recurso arqueol gico tambi n tiene el potencial de ampliar las preguntas que usualmente se hacen sobre la conducta y la historia humana.*

*Mientras que la investigaci n y el registro arqueol gico superficial tienen escaso impacto sobre el patrimonio del sitio, las excavaciones arqueol gicas destruyen, en alguna medida, el sitio y su registro. Una vez excavado, nadie podr recuperar completamente el sitio ni estudiar la evidencia con que cont anteriormente a la intervenci n. Todo lo que queda es un agujero en el hielo o en el terreno, adem s de la colecci n de artefactos, muestras y observaciones almacenadas en alguna otra parte.*

*Mientras cada arque logo piensa que su trabajo sirve para recuperar evidencia capaz de proveer informaci n muy importante sobre el pasado, el nivel de registro, de documentaci n, de an lisis y de publicaci n del trabajo arqueol gico polar, puede llegar a variar dram ticamente. La realidad es que cierta arqueolog a proporciona resultados de poco valor tanto para la investigaci n cient fica como para la conservaci n. Este art culo proporciona una revisi n de algunos trabajos arqueol gicos realizados en el pasado en la Ant rtica.*



In Antarctica archaeological sites are rare commodities. Human presence on the continent and its surrounding islands has been brief, infrequent and widely scattered. The range of human activities — exploration, sealing, whaling and scientific activities — has been very limited and sites often relate to a single use at a single point in time. These sites have immense archaeological potential, and at the same time are unique elements of the world's cultural heritage. They are also very expensive to study, given their isolated location and the difficulties in excavating frozen deposits. These considerations dictate that the benefits of archaeological programs in Antarctica need to be clearly demonstrated.

Professional archaeology has been practiced in Antarctica and the sub-Antarctic islands since the late 1970s. Archaeologists from Argentina, Australia, Brazil, Chile, France, New Zealand, South Africa, the United Kingdom and the United States have participated in archaeological programs of survey, recording or excavation. The objective of this work has primarily been the identification and conservation of historic sites, and in particular historic buildings, and, usually coincidentally, the retrieval of artefacts for museum collections.

## ARCHAEOLOGY IN ANTARCTICA

### *Ross Sea*

In the 1960s New Zealand decided to remove accumulated snow and ice from Scott's Discovery Hut (1902) and Cape Evans Hut (1911), and Borchgrevink's hut at Cape Adare (1899), in order to comply with what it saw as its responsibilities to conserve these historic sites under the Antarctic Treaty of 1959. This work, which disturbed many artefacts embedded in the ice that filled the huts, was carried out without archaeological supervision, and recording of the process was very limited. Magnetic observatory huts at Cape Evans were bulldozed and a midden of artefacts from the 1915-16 Ross Sea Party of Shackleton's expedition was removed. Artefacts were re-arranged inside the huts to replicate an often imagined point in time, were sent to museums in Britain, the USA and New Zealand, or were even collected as souvenirs (Harrowfield 2005: 8-9).

The emphasis of this work was on restoration and making the huts snow-proof so they could be entered by visitors. The concept of applying systematic archaeological techniques was not considered. As late as 1971, a large midden of material related to Scott's occupation of Cape Evans was cleared away without proper excavation or recording.

David Harrowfield, who had archaeological training, became involved in the New Zealand Antarctic program on behalf of the Canterbury Museum in Christchurch, and in 1977 began experimenting on the removal of artefacts from ice within the Scott huts (Harrowfield 2005: 11). The objective of the removal was related primarily to the conservation of the huts and their artefacts. Harrowfield also excavated at Borchgrevink's hut at Cape Adare in 1990 as part of the conservation program for the hut (Harrowfield 1991).

The first major systematic professional archaeological excavations of the post 'hut caretaker era' were undertaken by Neville Ritchie and Nelson Cross at Cape Evans in 1987-88 and 1988-89 (Ritchie 1988, 1989a, 1990a ) during which new excavation technologies were introduced – notably the first use of air heaters, heat guns, a chain saw and a Dynadrill for archaeological excavations in ice. Conservation-related work has continued at the huts through to the present day, with the development of evolving techniques,

Stores lying on the slope behind the Cape Evans hut in 1993. (Photo: Paul Chaplin)

Excavation of ice in the stables annex of Scott's Cape Evans Hut, 1992 (photo Michael Pearson)

directed primarily at systematic removal of ice from within and around the huts. (Ritchie 1989b, 1990b; Fyfe 1990a; 1990b; 1992; Ritchie and Fyfe 1995; Ritchie 2005; 2007).

***Commonwealth Bay***

At the same time that New Zealand was starting to use archaeological techniques at its sites, Australia began tentative moves to conserve Douglas Mawson's 1911 hut at Commonwealth Bay. In 1978 an expedition undertook ice removal and roof repairs, but no archaeologist was included in the party (Ledingham 1979). In 1984-85 a private party, 'Project Blizzard', undertook ice removal and recording over two seasons. An archaeologist, Estelle Lazer was a member of the party in the first season (Lazer 1985), and in the 1985-86 season archaeologist Angela McGowan and conservator Janet Hughes worked together at the site, the first time this combination of archaeologist and conservator had occurred in the field in Antarctica. Trenches were excavated in the hut through accumulated snow and ice, to both recover artefacts that had fallen into the room from adjacent collapsed shelving, and to determine the history of ice encroachment (McGowan 1987, 1988). In 1986-87 archaeologist Michael Pearson also undertook recording work at the site for the Australian Heritage Commission, following up on the Project Blizzard work (Pearson 1986), leading to the first conservation management plan for the Mawson's Huts site in 1991 (Pearson 1993).

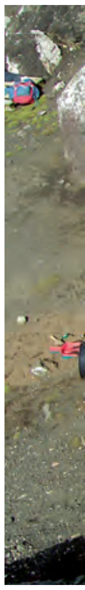
Boots and serge trousers among the scatter of artefacts outside Mawson's Huts, 1986. (photo Michael Pearson)

Estelle Lazer returned to Mawson's Huts with a Mawson's Huts Foundation party in 1997-98, recording and supervising the taking of ice cores and samples, and the removal of ice with electric chainsaws and grinders, based largely on New Zealand's development of these techniques (Lazer 1998). A new conservation management plan was written for the hut by Godden Mackay Logan in 2001 for the Mawson's Huts Foundation (Godden Mackay Logan 2001), and seven Mawson's Huts Foundation works programs at the site have occurred between 2000 and 2010, four of them with archaeologists involved (either Estelle Lazer or Anne McConnell) (Mawson's Huts Foundation 2010).

***Antarctic Peninsula***

Many of the historic sites on the Byers Peninsula of Livingston Island, in the South Shetland Islands, were reported by Ron Lewis-Smith and Hugh Simpson for the British Antarctic Survey in 1981, recording sites which had been reported by geological parties from the 1950s through to the '80s (Lewis-Smith and Simpson 1987). Archaeologists were not involved in this work, which included the salvage of artefacts from a number of sites (most of which were subsequently discarded by SPRI) (Lewis-Smith, pers. comm. 16/9/10).

Santiago Commerci appears to have excavated artefacts from frozen ground at Otto Nordenskjöld's Hut at Snow Hill Island in 1979-80 and 1980-81 on behalf of Argentina (Commerci 1981, 1983). Ricardo Capdevila, a lawyer by training, worked at Snow Hill Island hut almost every year between 1981 and 2004 (at least), and collected artefacts at the Nordenskjöld party's Paulet Island shelter and Hope Bay shelter, but it



appears that no professional archaeological excavations took place at this time (Capdevila 1990, but report not available to this author). There appears to be little readily available recording of this work, and in recent years there have been questions raised about the standard of the work undertaken. (Harrowfield 2007:87; ICOMOS International Polar Heritage Committee 2010).

The survey and excavation work of Chilean archaeologists Rubén Stehburg and Angel Cabeza on the South Shetland Islands for Chile, beginning in 1983, and was the first professional archaeological work in the Antarctic Peninsula sector (Stehberg 1983; Stehberg & Cabeza 1984, 1987; Stehberg & Lucero 1985a, 1985b, 1995, 1996). In the 1990s this research was extended to include underwater research by Martin Bueno (Spain) to search, unsuccessfully, for the remains of the ship the *SanTelmo* that went missing in 1819 (Martin Bueno 1995; Cabrara 2002). Stehburg has continued survey and excavation of sealing sites to the present time (see below).

Argentine archaeologists Andrés Zarankin and Ximena Senatore started field work in the South Shetlands in 1995, with a research design to investigate the occupation of Antarctica as part of the capitalist expansion towards the edges of the world, and the specific economic strategies used in Antarctica. Their work extended over several seasons to 2000, and intermittently since then, resulting in the survey and excavation of 26 sealer's campsites (Senatore 2002; Senatore and Zarankin 1999; Zarankin and Senatore 1997, 1999a, 1999b, 2005, 2007; Zarankin et al 2007). Subsequent work by associated researchers has resulted in a number of artefact studies that expanded the understanding of the history of the sites (Muñoz 2000; Moreno 1999; Salerno 2006). While not directed primarily at conservation outcomes, the work has highlighted the range and value of the sealing sites, the protection of which is being promoted by Chile through the Antarctic Treaty process.

Field work and excavations in the South Shetland Islands have continued to 2010 and are likely to continue into the future, with both individual and collaborative research involving Stehberg, Senatore, Zarankin and Pearson (Stehberg 1997, 2002, 2003, 2004; Stehberg et al 2008; Pearson & Stehberg 2006; Pearson 2010; Pearson et al 2008, 2009, 2010; Zarankin et al 2007).

In 1991 archaeologist Louwrens Hacquebord of the University of Groningen in the Netherlands surveyed the 1906 whaling

**Left:**
**The excavation of an 1820s sealing site in a cave on Rugged Island, South Shetlands, 2005. (photo Michael Pearson)**

**Over:**
**Andrés Zarankin at a sealer's shelter site on Byers Peninsula, South Shetlands, 2007. (photo Michael Pearson)**

**Left:**
**Rubén Stehburg excavating a sealer's shelter on Rugged Island, South Shetlands, 2005. (photo Michael Pearson)**

station on Deception Island in the South Shetland Islands, also the site of Base B from Britain's Operation Tabarin of 1943-44 (Hacquebord 1992). In the same year American archaeologists Catherine and Robert Spude documented and sampled remains at East Base on Stonington Island off the Antarctic Peninsula, and Noel Broadbent continued the work in 1992. Rubbish dumps were lightly covered with gravel to protect them as archaeological resources during environmental clean-up and conservation works. East Base had been used as the USA's first permanent base by two expeditions from 1940 to 1948 (Spude and Spude 1993; Parfit and Kenrick 1993). Despite these precedents, in 1994-97 the British Antarctic Survey appears to have carried out extensive work at Base A of Operation Tabarin at Port Lockroy on Goudier and Wiencke Islands without the involvement of archaeologists (Harrowfield 2005: 21). The condition of East Base had again deteriorated by 2007, and further action has been recommended (Arenz & Blanchette 2008).

***Sub-Antarctic Islands***

Archaeological research on the sub-Antarctic islands followed the same trajectory as that in Antarctica.

A preliminary archaeological survey of Macquarie Island was undertaken by Australian archaeologist Martin Davies in 1980 (Davies 1982), and this led to a more extensive survey and excavation program carried out by Karen Townrow between 1986 and 1988 (Townrow 1988, 1989).

At Australia's Heard Island a preliminary reconnaissance of historic sites was carried out by biologists during an extended stay on the island in 1984-85 (Burton and Williams 1985). This was followed up with an archaeological survey carried out by Estelle Lazer and Angie McGowan in 1986-87, one of the purposes of which was to provide a basis for an ongoing archaeological research program (Lazer and McGowan 1990; McGowan 2000). Emergency excavation was also carried out at a site threatened by coastal erosion, with the removal of oil barrels (one of which contained a cache of Giant Petrels) for study in Australia. A supplementary survey was carried out in 1987-88 (Robb 1988). The archaeological research value of the remains of the 1947 Atlas Cove scientific base on Heard Island has also been addressed (Hughes and Lazer 2000).

Interest in the historic sites on South Africa's Prince Edward Islands was stimulated by a workshop on a program of study and protection held in Cape Town in 1984. This resulted in the publication of an inventory and documentation of the known historic sites related to sealing and scientific work in the islands (Cooper and Avery 1986). This study indicated that no professional archaeological work had as yet been carried out in the islands, and recommended such a survey be undertaken (Cooper and Avery 1986: 27-28). This resulted in a research thesis on cultural resources management (Graham 1989) and survey of the historic sites on Marion Island (Boshoff et al 1997).

Archaeological work at France's Kerguelen Island commenced in 1993, to produce an inventory of sites and carry out preliminary excavations at shipwrecked whaler John Nunn's 'Hope Cottage'. Jean-François Le Mouël carried out the work, and the sites recorded included Jeanne d'Arc whaling station (1908), other whaling and sealing sites scattered around the coast, scientific stations and pastoral sites relating to the sheep industry. Archaeological work accompanied the restoration of the whaling station buildings (Le Mouël, 2004). In 2006-07 the remains of the British observatory of 1874 and German observatory of 1901-02 were recorded and excavated by a multi-national group (Courbon and Le Mouël 2007).

Excavation of meteorological observatory, Kerguelen Island, 2006-07 (source Courbon and Le Mouël 2007)

Whale oil digester plant, Deception Island, South Shetlands, 2008. (photo Michael Pearson)

In 1989-90 historian Bjørn Basberg and maritime archaeologist Dag Nævestad (as surveyor) made a survey of the whaling stations at Husvik and Stromness on Britain's South Georgia Island. Basberg returned to South Georgia with ethnologist Gustav Rossnes in 1992/93, and surveyed the whaling station at Grytviken, and in 1996/97 Basberg, Nævstad, Rossnes and architect Gisle Løkken returned and surveyed Leith harbour whaling station, and the work has been extended to other sites in more recent years. This work has been limited to the recording of the above-ground evidence, with no archaeological excavation work. The work focused on recording to establish the functions of the various parts of the whaling stations, and determining the functional relationships between them (Nævstad et al 1996; Basberg 2004:25).

## THE RELATIONSHIP OF ARCHAEOLOGICAL RESEARCH TO SITE CONSERVATION

The vast bulk of the archaeological work in Antarctica has been undertaken in relation to the removal of ice from inside and around historic huts, and the excavation, often through ice, of accumulated material inside huts and of stores boxes and caches outside huts. Despite being targeted at practical conservation works, this research has produced an accumulated record of the activities and material culture of, particularly, Heroic Era exploration parties.

In the case of sealing and whaling sites, the focus has been on establishing the presence and form of shelters and work areas, again largely related to the long-term conservation of this heritage resource, but often providing information about sealers' and whalers' domestic subsistence and work activities not available in the usually scant documentary sources.

The range of conservation-related archaeological work has included:

- the retrieval of artefacts related to known historical parties;
- the direct understanding of the construction of buildings and sites, their sequencing and use;
- the understanding of sites in the context of other, like, sites;
- ascertaining the survival of artefacts in the light of extensive 'wallowing' by elephant seals on sub-Antarctic sites (eg Townrow 1989);
- for non-structural sites, such as sealing sites, better understanding their characteristics so other sites can be identified (eg determining if artefact types differ from inside and outside now-collapsed shelters, so former shelter locations can be identified from artefact scatter patterns);
- determining if the archaeological remains provide substantive evidence of heritage significance not available from other sources (such as the lifestyle and experiences of 19$^{th}$ century sealers (eg Lazer and McGowan 1990: 15); or the ethnic origin of sealers (eg McGowan 2000: 69); or the possibility of sites found in different locations originated from the same sealers (eg Hughes and Lazer 2000: 73); or the relationship to global industrial developments (Senatore and Zarankin 1999; Zarankin and Senatore 1999b, 2005, 2007); and
- isolating the factors influencing the deterioration of archaeological sites over time.

## CONCLUSION

The impression gained from this overview of archaeology in Antarctica is that the bulk of past work has been targeted at answering questions about the use and history of specific sites, developing techniques for carrying out archaeology in frozen deposits, and in assisting the salvage or ice-clearing operations relating to hut conservation programs. The work has generally been driven by the needs of practical conservation rather than an academic rationale. It has resulted in a large amount of information and artefacts being available for research, but to date little use has been made of that resource. The work by Andrés Zarankin and Ximena Senatore is the only long-term work based on an academic research design that I can identify.

This paper suggests that archaeology has long been a valuable tool in the understanding and conservation of Antarctic heritage sites. The extent to which academically-oriented archaeological research might further enhance the understanding of the importance of the heritage sites has yet to be clearly demonstrated, as so little academic work has been carried out to date.

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# FACTORS INFLUENCING THE DETERIORATION OF HISTORIC STRUCTURES AT DECEPTION ISLAND, ANTARCTICA

Benjamin W. Held, Brett E. Arenz and Robert A. Blanchette

**Resumen**

La Isla Decepción, parte de las Islas Shetland del Sur en la Antartida, tiene una larga historia de actividad humana. Dicha isla corresponde a un volcán activo y es uno de los sitios donde las embarcaciones pueden ingresar debido a la presencia de una caldera inundada con agua de mar. Aprovechando este accidente geográfico, una estación ballenera fue establecida en la isla en 1906, la cual estuvo operativa hasta 1931. El Estudio Británico en la Antártica (British Antarctic Survey) comenzó a operar desde una base usando parte de la estación ballenera en 1944, y Chile estableció una base en la ensenada Péndulo en 1955 donde se realizaron estudios científicos. Las actividades volcánicas ocurridas en 1967 y 1969 destruyeron la base Chilena y parte de la estación ballenera, las cuales fueron abandonadas. Las estructuras y artefactos remanentes de dichas actividades son considerados Sitios y Monumentos Históricos protegidos (No. 71 & 76). Determinaciones del grado de descomposición de dichas estructuras revelan que está ocurriendo un importante deterioro, y que el mismo se encuentra en un grado de avance mucho mayor que el observado en otros sitios históricos de la Antartida. Curiosamente, además de la podredumbre blanda frecuentemente encontrada en maderas históricas de la Antartida, se encontró la presencia de hongos causales de podredumbre blanca y marrón de la madera. Estos hongos son típicamente encontrados en ecosistemas templados y su presencia en maderas de la Antartida no ha sido previamente descrita. Numerosos factores contribuyen a la creciente tasa y expansión de la descomposición que ocurre actualmente en la Isla Decepción. Estos incluyen a una diversa y agresiva combinación de hongos descomponedores de madera, actividad volcánica que ha cubierto a la madera con lava y suelo, condiciones ambientales favorables para la actividad de los hongos descomponedores, junto con una gran cantidad de madera llevada hacia la Antartida por más de un siglo. El mejor entendimiento de los mecanismos de deterioro que amenazan la permanencia de las estructuras y artefactos en la Antartida es el primer paso para decidir medidas de manejo conservacionista de estos importantes sitios históricos. La información generada en este estudio puede ser utilizada para diseñar un plan de manejo que limite la descomposición y preserve las maderas históricas en el largo plazo.

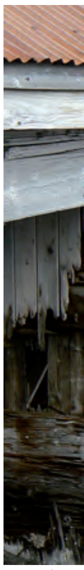
**Introduction**

Deception Island, part of the South Shetland Islands in Antarctica, has a long history of human activity. It is an active volcano and is one of the rare locations where ships may enter a sunken caldera flooded with seawater (Figure 1). This unique geologic feature has provided protection to mariners, which lead to the first human visitation to the island by sealers in the early 1800s. The island later became the site of a whaling station in 1906 (Figure 2). In 1931, whaling operations ceased and in 1944 the British Navy established a wartime base called "Base B" at the site of the whaling station. After WWII, the Falkland Island Dependency Survey (FIDS) operated from the site for many years, followed by occupation by the British Antarctic Survey (BAS). A volcanic eruption in 1969 forced the site to be abandoned. Many structures and remnants from the whaling station and various bases are still present today and are deteriorating.

Three structures: the whalers' barracks, dispensary/store and the magistrate's residence, were built in Whalers Bay by the Norwegian whaling company operating there for use as part of the land-based whaling station. These were prefabricated wooden structures some of which were also used by the British Antarctic Survey in later years. Pine (*Pinus* spp.) and spruce (*Picea* spp.) were the main types of wood used to construct the buildings. Many other artifacts, such as wooden boats, oak barrel remnants and processing equipment remain at the site from the whaling period. The British later added a generator house to the whalers' barracks and renamed it "Biscoe House", built another structure called the "Hunting Lodge" (1955) and also a hangar for the Havilland DHC-3 Otter that was used for conducting survey work. The historical significance of the site was recognized by the international community and the site is now designated under the Antarctic Treaty System as Historic Site and Monument No. 71.

Figure 1. Whalers Bay inside the caldera of Deception Island where structures of the historic whaling station are located along the shore. Photo: Benjamin Held

Figure 2. Structures at the whaling station at Whalers Bay are deteriorating. In addition to historic structures, there are a number of other wooden artifacts and equipment from the whaling period as well as from activities by the British Antarctic Survey located on the island that are also decaying rapidly. Photo: Benjamin Held



The Chilean base, Pedro Aguirre Cerda Station, at Pendulum Cove was established in 1955 where meteorological and volcanological studies were carried out. It consisted of several structures that were used until volcanic eruptions produced lahars (mudflow of pyroclastic material and water) in 1967 and 1969 which demolished the base and forced abandonment. The remains of the station at the site consist primarily of foundation material made of wood and metal. It is now listed as Historic Site and Monument No.76.

Previous research on wooden structures and artifacts in Antarctica has shown that significant deterioration takes place over time and resilient microbes function in this extreme environment albeit at a slow rate (Arenz and Blanchette 2009, Blanchette et al. 2004, Held et al. 2006). Wood decay is occurring at the historic huts located on Ross Island where wood is in contact with the ground. Extensive fungal growth has also occurred inside the historic structures where deterioration of wood and other cultural properties has taken place (Held et al. 2005). The wooden materials at the Deception Island site are situated in a unique and hostile environment and are also being significantly affected by a diverse and aggressive assemblage of wood decay fungi. This, coupled with the volcanic activity on the island, has had a profound influence on the deterioration of the structures and artifacts. Comparisons made with results from investigations of decay occurring at other polar locations indicate that the historical structures and artifacts at Deception Island are being affected by a larger number of more diverse microorganisms causing different forms of degradation and a more rapid rate of wood decay is taking place. This paper provides new information about the factors influencing deterioration of this important historic polar heritage site.

**Condition of historic woods at Deception Island**

The wooden buildings and artifacts at Whalers Bay and wood remnants at Pendulum Cove have deteriorated extensively. In most areas where wood is in contact with the ground, significant decay has resulted. The decay commonly extends up from the soil to about a meter in the standing structures (Figure 3). Sufficient moisture and the presence of aggressive decay fungi have resulted in extensive damage. One structure exhibiting significant decay is the north side of the whalers' barracks (Biscoe House). This location has advanced stages of decay that have resulted in large holes formed in several areas of the wall (Figure 3). Many other parts of this structure are also affected and the damage is so severe that the structure is likely to collapse in the near future. A significant amount of mud has also entered the north side of the structure and filled many areas. Much of the wood in contact with the soil is being affected by decay fungi.

Figure 3. Left: The north side of Biscoe House showing advanced decay of the wall boards. Right: Decay is occurring in many areas well above the soil line, as shown in these wall boards of the dispensary structure. Photos: Benjamin Held

The dispensary/store was partially destroyed and buried by a lahar resulting from the volcanic eruption in 1969. Sections of the structure have collapsed and others are also precariously close to collapse. Mud has also filled in and around the structure which has led to significant decay of wood in contact with the soil as well as in the wood well above ground level. Support posts in this structure are also severely decayed.

The Magistrate's residence and the Hunting Lodge, a prefabricated hut built by the British in 1955, are structures at the site that are in comparatively better condition than the others. This is in part because the buildings are on foundations that are above the soil (Figure 4). Without contact of the wood to the soil, decay is limited by reduced moisture and less contact with nutrients and soil microbes. Neither of these structures suffered from major damage from the lahar. However, the ground on the northwest corner of the hunting lodge


Figure 4. The Magistrate's residence has a solid foundation that has aided in avoiding deterioration by keeping the structure well above the soil. However, the roof has blown off exposing the interior to moisture. Photo: Benjamin Held

Figure 5. Left: One of several large areas where remnants of barrels are located along the shore at Whalers Bay. Along with other wooden structures and artifacts, these areas serve as an enormous nutrient source for decay fungi. Right: One of several water boats that remain on the beach area that is partially buried and showing advanced deterioration. Photos: Benjamin Held

has been cut away by soil erosion and that part of the building is in danger of collapse. The roof of the Magistrate's residence has blown off and is lying nearby. The inside of this building is now exposed to the elements.

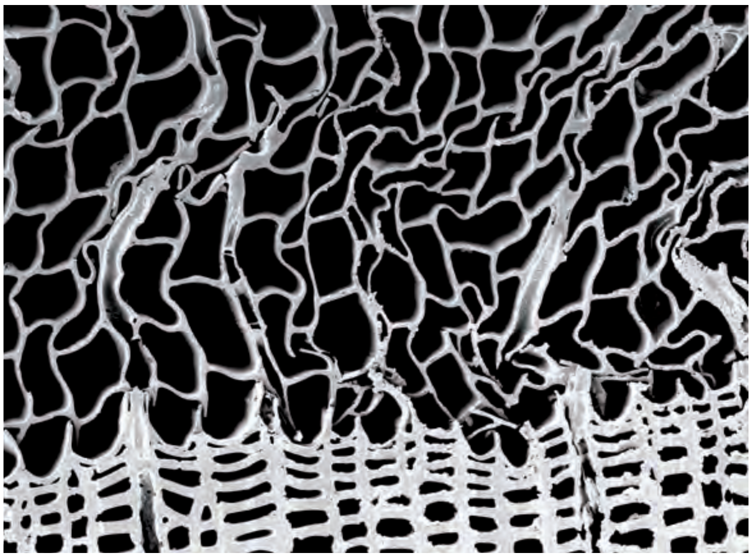
In a southeasterly direction from the buildings along the beach a number of different wooden artifacts can be found (Figure 5). Many of them are half buried in the soil. Most notable are a number of small boats (used by whalers for transporting freshwater to whale processing ships) and wooden barrel depots. The boats are located in a wide area along the beach and are half buried in soil. The boats are extensively decayed not only in areas that are below ground but also in areas well above the soil. There are also several large areas with remnants of oak barrels and this wood is also decaying.

The Chilean station at Pendulum Cove was completely destroyed by lahars in 1967 and 1969 and only a foundation of metal and wood structural elements remain. The wooden remains at this site have decay that is similar to the wood degradation taking place at Whalers Bay with significant decay in wood at ground contact and wood that has been buried.

**Decay and fungi present**

Scanning electron microscopy was used to examine samples obtained from the site and ascertain what forms of degradation were present. The results show that several types of decay are occurring in affected woods, with many samples displaying an extensive soft rot type of attack and others a brown rot form of wood degradation (Figure 6). Soft rot fungi are known to function in very harsh environments which exclude other types of decay fungi (Blanchette 2003). Brown rot fungi degrade wood differently from soft-rotters and are well known to cause severe strength loss early in the decay process. Brown rot fungi cause a rapid depolymerization of wood constituents primarily targeting cellulose which causes the rapid loss of strength (Eriksson et al. 1990, Zabel and Morrell, 1992). Brown rot decay fungi commonly affect wooden structures in temperate climates and are very important in forest ecosystems as decomposers of organic material. However, it is not common in polar environments, but at Deception Island many of the woods inspected had advanced stages of brown rot. A third type of wood decay found was a white rot affecting buried wood from the destroyed Chilean station at Pendulum Cove. Extensive mycelial cords formed white rhizomorphs on the wood. White rot fungi can degrade all cell wall components and some cause a preferential attack on lignin. The white rot found at Deception Island appears to cause a selective attack on the wood resulting in a bleached appearance and a white-pocket rot form of decay. Generally, strength loss is not significant until advanced stages of decay are reached. No previous evidence of brown or white rot fungi has been reported from other historic wooden structures in Antarctica and both forms of decay by these basidiomycetes on Deception Island are an unusual occurrence in a polar environment.

Determination of the species of fungi attacking the wood was made by isolating from samples and sequencing rDNA from pure cultures. Small wood sections were aseptically placed on various culturing growth media. Fungi that grew out from these sections were transferred and pure cultures obtained. Identification of the cultures was done by extracting rDNA and sequencing the ITS (internal transcribed spacer) region using previously described techniques (Arenz 2009, Gardes and Bruns 1993). Fungi that were isolated that are known to cause a soft rot in wood include species of *Cadophora, Lecythophora, Phialocephala* and *Phiolophora*. *Cadophora* is a common fungus isolated and identified from wood in many polar environments



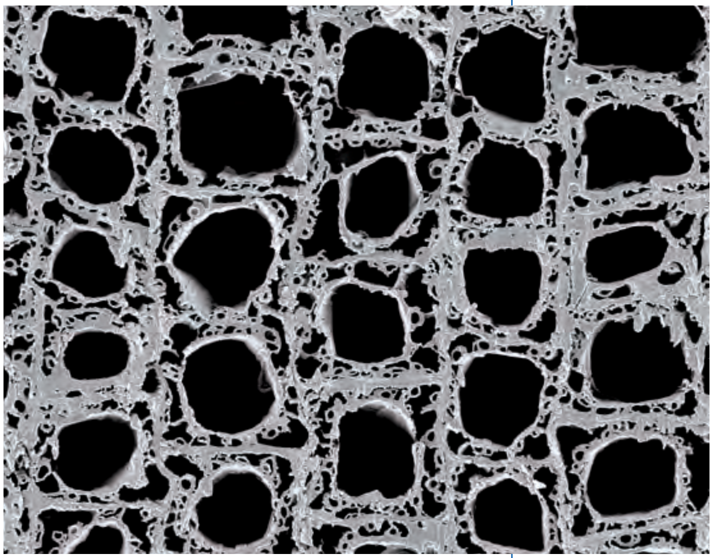


Figure 6. Scanning electron micrographs of transverse sections of wood from the whalers' barracks at Whalers Bay affected by fungal decay. Left: Brown rot in spruce wood showing the severe degradation and attack on the cell walls resulting in significant reduction in wood strength and loss of structural integrity of the timbers. Right: Soft rot decay showing cavities in the wood cells caused by the fungus. Many cavities occur in the cell walls and as they enlarge the cavities coalesce causing large holes and significant degradation of the wood substrate. Photos: Benjamin Held

(Arenz and Blanchette 2009, Arenz et al. 2006, Blanchette et al. 2010, Held et al. 2006). Phylogenetic analysis of *Cadophora* isolates cultured from wood at Deception Island revealed that a very diverse species population (data not shown) was present. The most prevalent brown rot fungus obtained does not match other sequences in GenBank and cultural characteristics suggest this may be a previously unreported species. The white rot fungus is related to other *Pholiota* species and also appears to represent an undescribed species.

**Factors influencing decay**

As previously mentioned, the extent and severity of wood decay identified in the wooden structures and artifacts at Deception Island are much more extensive than has been found in historic structures located in other Antarctic locations (Arenz et al. 2009, Blanchette et al. 2010, Blanchette et al. 2004, Held et al. 2006). There are several primary factors that are contributing to the rapid and extensive decay taking place at Deception Island including:

1. Diverse population of decay fungi
2. Environmental conditions conducive for decay
3. Volcanic activity that has covered historic woods with soil
4. Large amounts of exotic wood from many different areas brought to the island during the last century

**Diverse fungi in Deception Island's unique ecosystem**

A unique ecosystem exists on Deception Island. Active volcanoes are rare in Antarctica and only two, Mt. Erebus and Deception Island, have had activity with recent eruptions. Deception island is home to exceptionally rare flora including eighteen species of plants not found elsewhere in the Antarctic (Deception Island Management Package 2005). Our investigations show that microbial diversity is also remarkably diverse and unusual. The research we carried out has identified approximately 71 taxa of fungi including what appear to be many previously undescribed species. In addition, wood decay fungi have been found that cause three major types of wood degradation; white, brown and soft rots. While the damage caused by the white rot fungi does not appear to be widespread among the wooden materials, the fungi causing brown and soft rot are active and very aggressive causing extensive damage to many woods. Past research suggests that soft rot fungi should be the dominate decay organisms at this Antarctic location, but the diversity of decay fungal species, coupled with moderate temperatures and moisture at the site, has lead to significant decomposition in the historic woods (Blanchette et al. 2010, Held et al. 2006). The origin of the many different decay fungi at Deception Island is not clear. A strong case could be made that fungi were introduced on the timbers or were carried to the island on other materials brought by the many inhabitants over the past decades. They could also be brought in on birds or as wind disseminated spores. However, with many isolates found being genetically different from known species there is a strong possibility that some of these fungi are endemic to Antarctica. Whatever the mode of introduction to the island has been, one underlying factor fueling the decay is the abundant carbon source (coming from all the introduced woods) and conducive temperature and moisture conditions available for colonization and continued survival of the fungi and decomposition of the substrates.

Arenz and Blanchette (2009) described fungal diversity and deterioration at 9 different historic sites on the Antarctic Peninsula with wood structures. While these sites have similar environmental conditions to Deception Island, the diversity profile of fungi (including decay fungi) isolated from wood is quite different. In addition, less decay was observed in wood at these other Peninsula sites as compared to Deception Island.

**Environmental Conditions**

Deception Island has a polar maritime climate with a mean annual temperature of -3°C. Temperature ranges from -28°C to +11°C and an average high temperature during the months from October to April is 1°C. The mean annual precipitation is 560mm. Comparing Deception Island to that of Ross Island where the historic huts of Scott and Shackleton are located shows considerable differences in climatic conditions (Table 1). At Ross Island, the average yearly temperature is -19°C, average high temperature from October to April is -8°C and there is an average yearly precipitation of 190 mm. The maritime conditions of Deception Island favor warmer temperatures and increased precipitation. Since adequate moisture and temperatures above freezing are necessary for fungi to function, the conditions at Deception Island are allowing microbes to be active many more days per year than at Ross Island. In addition, the precipitation that occurs will likely be a heavier wet snow or rain/snow mix at Deception Island. Observations at the site during our assessment showed that a heavy wet snow accumulated on siding of the structures during storms and subsequent melting leaves considerable moisture on the wall boards and other above ground woods (Figure 7). It was apparent that this moisture absorbing into the wood was providing sufficient moisture for fungal growth and is the reason why decay extends up from the soil into the above ground wood structures. In areas where the bases of structures are buried in mud, decay begins and advances from the ground upward into the structure. Once decay occurs, the porosity of wood changes and the wood becomes more absorbent leading to even more water retention. This exacerbates the problem and allows for increased decay.

**Table 1**. A comparison of climatic data between Deception Island and Ross Island, Antarctica. Deception Island has much higher precipitation and higher temperatures when compared to Ross Island, enabling decay fungi to function for a longer period of time.

| | CLIMATIC DATA | | | |
|---|---|---|---|---|
| Location | Ave. Yearly Temp. | Ave. High Oct-April (°C) | Months Ave. High Temp >=0°C | Annual Precipitation (mm) |
| Deception Island | -3 | 1 | 5 | 560 |
| Ross Island | -17 | -8 | 0 | 190 |

Figure 7. The north side of the dispensary at the end of a precipitation event showing accumulation of snow sticking to the wall boards. When this snow melts it is sufficient moisture to support fungal growth and decay. Photo: Benjamin Held

### Volcanic Activity

Lahars, specific to areas of volcanic activity, can cause dramatic destruction. Lahars occurred with recent eruptions in 1967 and 1969 and damaged structures at Whalers Bay and destroyed the Chilean base buildings at Pendulum Cove. There are clear implications that this phenomenon has contributed to the severe degradation and condition of the structures. There is a two-fold effect from lahars; first is the destructive force behind the flowing mud and water that damages or obliterates objects in its path and second, there is a change of environment that affects degradation processes in wood. The process of partially burying structures and artifacts brings soil, moisture and microbes that inhabit the soil into contact with the wood substrate and creates an environment conducive for decay by microorganisms (Figure 8). This has led to advanced decay in buried wood and also leads to decay occurring in wood above ground where there is sufficient moisture. These damaging effects are also evident on other artifacts like the barrel remnants and wooden boats on the shore. Several boats are nearly buried and are breaking apart due to the loss of structural integrity caused by decay fungi. In contrast, the Magistrate's residence and Hunting Lodge were largely unaffected by the lahars have far less decay occurring. Generally, the wood of these structures is above the soil line and little to no decay is taking place. However, the Magistrate's residence has soil in contact with wood on the north side of the building that has allowed decay to occur in that area.

There are several areas on the island that have heated geothermal soils with abundant and rare bryophyte communities (Lewis Smith 2005). It is possible that these areas are harboring some of the decay fungi that are normally found functioning in more temperate ecosystems (white and brown rot fungi). Since there is abundant plant material and a range of soil temperatures, these fungi (exotic or indigenous) could be thriving in this area and have spread from these sites to the locations with historic wood. In addition, a report of a mushroom fruiting in one of the large bryophyte stands indicates that there is a resident population of basdiomycetes that exist among the live and dead bryophytes (Lewis Smith 2005).

Figure 8. The dispensary/store has been inundated with mud from a lahar. The mud holds moisture and microbes which creates a conducive environment for decay to take place. Photo: Benjamin Held

### Abundant Nutrient Source

Wood is an introduced substrate to Deception Island and Antarctica and the amount of wood present at Whalers Bay is substantial. This abundance of wood from many different places around the world brought in over more than a century has allowed populations of wood decay fungi to become established and proliferate. Fungal populations have most likely changed dramatically since the introduction of wood material and human activity on the island. The addition of wood substrate in the volcanic ecosystem of Deception Island adds a tremendous amount of nutrients to an otherwise very nutrient poor environment. Although it is not yet known what fungi are indigenous to Antarctica and which were brought in on the wood or on other materials, these sites constitute some of the most significantly diverse areas in Antarctica for fungi. It is clear that the decay fungi found are well adapted to the site, capable of degrading wood and are extremely efficient decomposers.

**Management Considerations**

Many of the wooden resources at Deception Island are so deteriorated that very little can be done to preserve them. Among them, Biscoe House and the dispensary are precipitously close to collapse. Removing soil away from the base of the structures and artifacts where feasible is recommended to help arrest decay by limiting contact with soil moisture. Perhaps the most appropriate procedures are those that focus resources where conservation work could be feasibly carried out. For instance, repairing the roof of the Magistrate's residence would help protect one of the original structures at the site that is still in relatively good condition. Replacing the roof would protect the interior from further damage and the structure could possibly be used to house interpretive material. Also repairing the foundation of the Hunting Lodge that has washed away would greatly improve the structural stability of this building (Figure 9).

Figure 9. The Hunting Lodge has significantly less deterioration than other structures at the site partly due to a high foundation keeping the wood well above the soil. However the left corner shows erosion of the foundation that is in danger of collapse. Photo: Benjamin Held

The use of preservatives on the wood to stop fungal attack is not an option for several reasons. Most of the effective preservatives contain heavy metals or other compounds that can be toxic in the environment and should not be used in Antarctica. Also, some of the fungi causing decay, such as the *Cadophora* species, are tolerant of preservatives (Daniel and Nilsson 1988) and they would not be effectively controlled by them. Conservation standards would also not allow treatments that are not reversible to be used and the long term effect of material treated with preservatives is unclear. Finally, it would be difficult to successfully treat and infiltrate wood at Deception Island under the extreme Antarctic conditions that can occur there. At the present time, the only effective method of control is to reduce moisture. Therefore, wherever possible conservation measures should work to reduce moisture in wood to limit the rate and extent of decay.

The wooden structures and artifacts at Deception Island provide a legacy of rich polar history that warrants preservation efforts by the international community. The factors influencing decay described in this paper indicate why rapid deterioration has taken place over the last few decades. Understanding decay mechanisms threatening the wood resources is the first step to making informed conservation decisions to protect these and other important polar historic sites. The information provided here can be used to provide more precise management plans to limit decay and preserve the historic woods long into the future.

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# PREVENTIVE METHODS AGAINST BIODETERIORATION OF PROTECTED BUILDING MATERIALS IN SVALBARD

Johan Mattsson and Anne-Cathrine Flyen

### Background

In Svalbard, all structures and artefacts related to human activity from before 1946 are considered worthy of preservation, and are automatically protected through the Svalbard Environmental Protection Act (2002). In addition to historical relics and many remains from the mining industry in the early 1900s, much of Svalbard's cultural heritage consists of the remains of structures from the whaling industry in the $17^{th}$ and $18^{th}$ centuries and many small trapper huts from the $19^{th}$ and $20^{th}$ centuries. These historic buildings are mostly made from wood. Due to the general climate conditions in Svalbard, fungal decay in cultural heritage has previously been regarded as a non-existing problem. The occurrence and result of decomposition of wooden materials in Svalbard has previously been little known and documented. This lack of knowledge has influenced the understanding and management of listed buildings and building materials. However, recent research during 2002-2009 has shown that this is not the case (Mattsson and Flyen 2008, Mattsson et al. 2010).


### Resumen

En Svalbard, todas las estructuras y artefactos relativos a actividad humana anterior a 1946 están automáticamente protegidos por el Svalbard Environmental Protection Act (2002). Estas estructuras incluyen muchos restos de la industria minera de los comienzos del siglo XX, vestigios de la industria ballenera de los siglos XVII y XVIII, además de muchas trampas pequeñas de caza de los siglos XIX y XX. Estos edificios históricos son mayoritariamente confeccionados en madera y, aunque se pensó anteriormente que la descomposición de los hongos no tenía tratamiento, la investigación durante las últimas décadas han probado que si tiene.

En el curso de los trabajos de campo que se llevan a cabo desde el año 2002, más de 100 edificios, trampas de caza y otras estructuras protegidas de madera han sido reconocidas y muestreadas. Este artículo resume los resultados y las conclusiones obtenidos en estos estudios.


### Materials and methods

During fieldwork in 2002-2008, we examined about 100 buildings and building remains, while 24 trappers' huts and other protected wooden structures in Svalbard were examined during field work in 2009. All surveys have followed the general guidelines of the Norwegian standard of building survey (NS 3424). During this work, we estimated climatic exposure, recorded visible damages, performed moisture measurements (relative humidity and wood moisture content), and collected samples of decayed wood and moulded surfaces for analysis. In all 191 wooden samples and 171 tape lifts have been analysed. Furthermore, 178 air samples have been taken from outdoor and indoor air with respect to viable mould spores (Mattsson et al 2010).

### Results

The analyses of the wooden samples showed that of the 191 wooden samples, wood-decaying fungi were identified in 109 cases, soft-rot fungi in 89 and unidentified brown rot fungi in 25 cases (Mattsson et al. 2010). The total amount of cases is more than 191 due to the occurrence of several species in some samples. These results show that wood-decaying fungi are commonly found in the building materials in Svalbard, although the actual species that are found in Svalbard vary from what is commonly found in the damage caused by wood-decaying fungi on the mainland of Norway (Alfredsen et al. 2005, Mattsson et al. 2010).

The damage occurred in areas with leakages (roof and walls), in materials with direct soil contact and in constructions with high relative humidity (Mattsson et al. 2010). By the tape lifts mould fungi were found growing on surfaces, while the air samples showed that the indoor air was severely influenced by the established mould growth inside the buildings (Mattsson & Flyen 2008).

Air sampling in one building before restoration showed high numbers of viable mould spores in the indoor air compared with the reference samples outdoors. Samples taken inside the same building after restoration showed no improvement of the indoor air quality (Fig. 1 and 2).

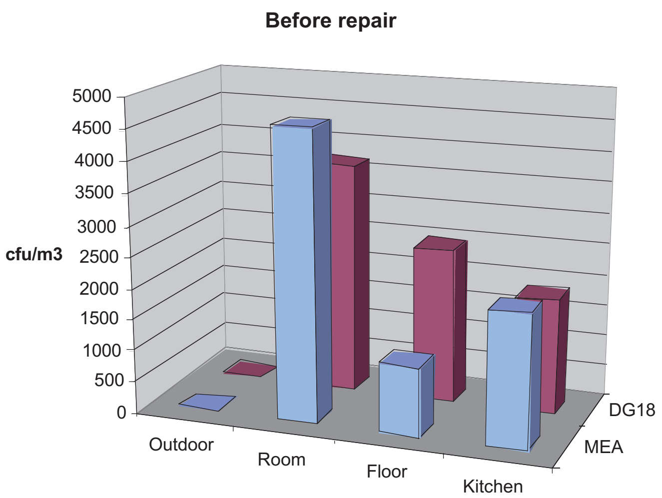


Fig. 1. Viable mould spores in old trappers' hut before repair.

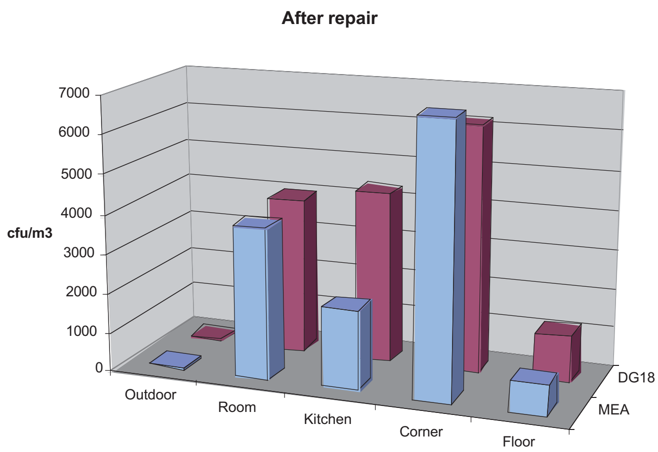


Fig. 2. Viable mould spores in old trappers' hut after repair.

## DISCUSSION

### *Occurrence and predictability of damage*

Our studies have shown that biodeterioration of wood caused by both wood-decaying fungi and mould fungi in building and building remains occurs in Svalbard. This is different from the wooden materials in Antarctica, where wood-decaying fungi have not been found (Arenz et al. 2006, Arenz & Blanchette 2009, Blanchette et al 2004, Held 2005. However, see Deception Island - Held et al., this volume). The established damages are a result of long-term exposure to humid conditions at relatively suitable growth conditions for both mould fungi and wood-decaying fungi (Mattsson et al. 2010, Mattsson 1995). Under the assumption that future exposure will continue at the same level as in the past, the coming rate of biodeterioration can be predictable. Preventive actions against such decay can therefore be done by ordinary maintenance.

On the other hand, if there is a change of climatic exposure – whether caused by natural causes or man made – the rate of biodeterioration can be different and for that reason unpredictable. In such a case, preventive actions would be hard to perform due to uncertainty concerning the climate and extent of exposure.

### *Established damages - source of information*

Established damages are a result of long-term exposure. By understanding the causes and result of this exposure, future damage is predictable. For that reason it is necessary to identify and evaluate established damage through thorough building surveys. This will identify the need for repair and evaluate the risk for future decay.

Gobakken et al. (2008) showed the importance of microclimate, defined as "critical in-situ conditions", with respect to the risk of biodeterioration in wooden materials (Fig. 3).

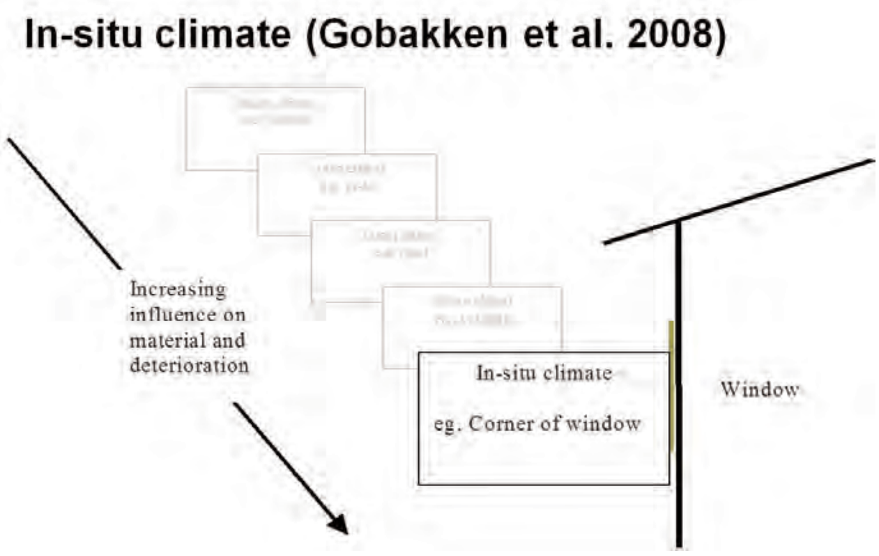


Fig. 3. In-situ climate is the microclimatic conditions in a limited area or material. (Gobakken et al. 2008).

By observations, short- and long-term measurements, the exposure can be documented. This might answer how the micro-climate can be understood and explained. In the future exposure can alter for various reasons. As we are dealing with protected buildings and artefacts it is crucial to answer what the minimum needed change is for avoiding future damage.

The most obvious way to avoid a negative development is to change the moisture condition and the temperature. This will avoid further deterioration. However, it might be difficult to avoid changing the historic structure as well. Some parts of these changes might be acceptable, whereas some parts may not.

In Svalbard, higher temperature would have a major impact on the risk of biodeterioration. This is due to the fact that the rough climate offers the wood-decaying fungi and the mould fungi difficult conditions. They are living on the edge of favourable conditions. Better living conditions, which means higher temperature and increased access to water in a liquid state, brings more biodeterioration. Longer periods with temperatures above 0ºC lead to more thawing of the permafrost than previously and, as the historic buildings and building remains in Svalbard are standing more or less in direct soil contact, this will have a great impact on the service life of wooden materials.

A definition of different risk areas for biodeterioration is showed in Fig. 4. The five main zones of microclimate are defined as follows:

1. **Permafrost**. This brings stable frozen conditions. Here is it too cold and with a lack of accessible water for fungi.
2. **Thaw zone**. During parts of the year, both temperature and humidity bring suitable conditions for microorganisms, even if the temperature is low.
3. **Soil contact**. The combination of wet soil and higher temperature caused by the air temperature and periods with sun radiation, might give relatively long periods of favourable growth conditions.
4. **Precipitation and relative humidity**. Facades and roofs have periods with high temperature due to sun radiation. Mattsson and Flyen (2008) showed that surface temperatures above +40ºC could occur in Svalbard. Under these conditions the humidity would be the limiting factor for growth as the influence of precipitation and relative humidity are crucial for biodeterioration.
5. **Leakage and relative humidity**. Even if the temperature might be favourable inside materials, constructions and inside the buildings, the access of water will be a limiting factor for biodeterioration. Inside building structures, leakages and a general high relative humidity are the most common sources of water. One example of fungal activity is connected to condensation of water vapour on cold surfaces. This gives at least good growth conditions for mould fungi


Fig. 4. Practical definition of various micro-climates in Svalbard.

### *Limitations on building surveys in Svalbard*

Due to various practical problems, it might be difficult to implement a good building survey in the archipelago of Svalbard. This includes clear limitations in the availability due to geographical distance and lack of communications. The historic structures are spread all over the archipelago, and there are no roads outside the four settlements.

A good survey of an historic building assumes a thorough inspection of closed structures like crawl spaces, floors, walls and roof structures. As the buildings are listed, there are strict regulations connected to the investigations. In addition, applications for appropriate measures have to be made in advance of the actual building survey, which means that it is difficult to make revised decisions during the investigation.

It is important to underline that these constraints are understandable and important. A strict regulation ensures that random and ill-considered actions will not be made in the name of science. However, it is important to note that this situation is limiting the performance of a building survey. The result might be a lack of understanding of the physical conditions. Furthermore, the samples of materials collected throughout a building survey might be too few to provide other than an uncertain assessment of the situation. This can be handled by the preparations including planning and a good description of the application for necessary permits.

One must then consider the principles and regulations for the conservation of protected structures against the potential increased lifetime of the materials, structures and buildings such a change can lead to. These are fundamental questions that cannot easily be clarified, but based on experience of the results of various measures; this should be admitted to a serious discussion and consideration in the future.

### *"The same procedure as last time"?*

The prevailing attitude concerning maintenance and repair of historic structures in Svalbard is that any action is to be done with the same methods and materials as were used originally. In addition, there should be as few changes as possible to the original structures.

Most of the historic structures throughout the archipelago are built in an unsophisticated way, due to available material and financial resources, and some of the wooden constructions have been highly exposed to water and high relative humidity. When repairing or maintaining these structures with the same methods and materials as originally, this gives a clear risk of repeating the problems and development of attack by mould fungi and wood-decaying fungi.

A constructive way to deal with this could be to use a more pragmatic approach: to allow improving the structures in order to reduce the risk of new fungal attack; an approach that could be called «pragmatic authenticity».

**Fig. 5.** A thorough survey cannot be done without dismantling the ceiling.

### *Preventive measures*

A good understanding of the structures and the climate they are exposed to, makes it possible to predict the damages that can occur. Such understanding also makes it possible to make an assessment of which remedial actions and preventive measures are appropriate.

Ideally, preventive actions should lead to a markedly reduced risk of developing biodeterioration. Some of these measures are part of the normal maintenance and traditional repair and restoration work, such as regular inspection and minor repair. Other measures require a clear change of structures. This applies primarily to improving a basically poor technical solution, such as where the wood is located directly on the ground or where there has been an extensive use of soil against the outside walls (Fig. 5).

Fig. 6. A common decay area under the floor cannot be examined without dismantling.

In addition, it may be appropriate to undertake measures to meet the effects from changes of use or climate. These effects might for instance be increased access of water due to increased humidity and more precipitation in the form of rain, more thawing of frozen soil and long periods of favourable growth temperature for the fungus. Current preventive measures might consist of mounting air slots, lifting the building from the ground or setting up a layer of inorganic material between the wood and the soil.

Such changes could lead to a physical alteration of the original construction. One must then consider the principles and regulations for the conservation of protected structures against the potential increased lifetime of the materials, structures and buildings such a change can lead to. These are fundamental questions that can not easily be clarified, but based on experience of the results of various measures; this should be admitted to a serious discussion and consideration in the future.

By removing local sources of fungal spores, one can achieve an effective reduction in the risk of establishing new damage by biodeterioration. One must also remember that almost all the timber used for repairs comes from the Norwegian mainland, where the risk of contamination by mould and wood-decaying fungi is significantly greater than in Svalbard; particularly with respect to decay fungi (Mattsson et al 2010). This means that in addition to local preventive measures at the building site, preventive measures in connection with the new materials which have been transported from the mainland have to be done. To achieve this, one must take the following actions:

- Keep the new materials dry in the production and storage on the mainland.
- A possible heat disinfection of the new materials before transport to or on arrival in Svalbard.
- Keep materials dry during storage in Svalbard.
- Thorough removal of infected material in the protected building.
- Moisture protection of the new materials, primarily by avoiding ground contact, wetting from precipitation and from high relative humidity caused by use of the building.

### *Small measures with great impact*

Because there are such extreme climatic conditions in Svalbard, the favourable conditions for biodeterioration can be changed even by small efforts. For that reason is it important to take as many measures as possible in order to reduce the risk of fungal growth. This can for instance be achieved by making a small gap between the floor beams and the soil, because the moisture content then would get below the critical level for fungal growth. This could be of great importance under normal conditions. Given that the climate changes are likely to give both more thawing of the soil and longer periods of thawed soil, it is particularly important to consider the possibility of securing the wood from moisture.

By correcting minor building defects that have developed over time, unwanted moisture exposure can be avoided and thus the development of wood-decaying fungal attack be prevented. Even minor clean-up measures could have a major preventive effect.

Fig. 7. Avoiding further water intrusion into the lower part of walls and the floor is an effective preventive measure.

Fig. 8. Raising the building up from the humid soil is effective way to avoid decay.

Fig. 9. Repair of risk area gives the adjoining wood a long service life.

Fig. 10. Sometimes a simple clearance can have great impact as a preventive action.

***Impact assessment of measures***

By grading the impact that a measure may have on cultural heritage on a four-point scale from 0 (no influence), 1 (little influence), 2 (moderate impact) to 3 (high impact), it is possible to visualize the consequences that different measures might have. Examples of this may be: cleaning a surface to remove mould damage (= no impact), creating an intercepting drainage ditch at a distance from the monument (= little impact), creating a local drainage ditch into the building (= moderate influence), and removing the soil lying against a wall (= large effect).

This impact must be weighed against the expected impact the project will have. The effect can also be divided into four categories, 0 (no effect), 1 (slight effect), 2 (moderate effect) and 3 (great effect). That way one can prioritize measures that have a combination of as little impact as possible with an effect that is as large as possible. This approach may help to clarify the advantages and disadvantages of different measures to a greater extent than has been done previously.

**Conclusions**

Damage caused by mould fungi and wood-decaying fungi are common in old buildings and building remains in Svalbard. Due to strict regulations and the main principle of keeping the authenticity high, the wooden materials are often left to decay further without proactive measures. A number of historic structures are maintained and repaired. Even so it is clear that without improving the physical conditions, there is a clear risk of new problems with biodeterioration similar to the previous damage.

Traditional repair work might reduce the risk of new damage for a while. In order to achieve a reduced risk of developing new problems of biodeterioration, it might be necessary to make changes in the building construction that will reduce the authenticity. If such changes can be accepted, it is possible to achieve a longer life for materials and structures. Furthermore, it is possible to achieve an important improvement of indoor air quality in the huts with respect to mould exposure.

We are planning to continue our scientific work on documenting the effect and clarifying the possibilities and limitations on different actions.

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# WIDENING THE SCOPE OF THE ANTARCTIC HERITAGE: ARCHAEOLOGY AND THE "THE UGLY, THE DIRTY AND THE EVIL" IN ANTARCTIC HISTORY

Maria Ximena Senatore and Andrés Zarankin

**RESUMEN**
La investigación arqueología de la presencia foquera del siglo XIX en las islas Shetland del sur se viene desarrollando hace décadas y en los últimos años se comenzaron a formular estrategias tendientes a su preservación. Sin embargo consideramos que existen limitaciones conceptuales y prácticas para alcanzar su conservación. Este trabajo analiza el origen de esas limitaciones y evalua el rol de la investigación en arqueología histórica para re-pensar la agenda de conservación del patrimonio cultural de Antártida.Persiguiendo este objetivo estudiamos la relación entre a) las versiones más difundidas de la historia de antartida y b) las características de los sitios históricos declarados actualmente. De nuestro análisis surge que actualmente existe una concepción dicotómica de la historia de Antártida -exploración *vs* explotación. En este esquema se "preservan" principalmente las historias de la exploración científica mediante la conmemoración de eventos, fechas y protagonistas específicos en lugares puntuales del espacio (refugios). En contraste otras historias vinculadas a la explotación de recursos queda olvidada y silenciada. Cabe decir que las historias de foqueros y balleneros no tienen protagonistas específicos, ni fechas exactas y ni hechos de "relevancia histórica" para conmemorar. Sin embargo han dejado una gran cantidad y diversidad de restos materiales dispersos en las Shetland del Sur y el continente, que tienen un escaso lugar en la agenda de conservación del patrimonio cultural de Antartida. . Esperamos que estas reflexiones contribuyan a pluralizar los agentes de la historia de Antártida y ampliar el espectro de su patrimonio cultural.

## INTRODUCTION
Archaeological research – focused on the presence of 19th-century sealers in the South Shetland Islands – has been developing for decades and strategies have come forth recently which are aimed at preserving the broad richness and diversity of the material remains associated with these occupations (Stehberg 2004, Stehberg *et al.* 2008, Pearson *et al.* 2010). However, we find that there are both conceptual and practical limitations to achieving this conservation.

This paper refers to these limitations and their possible origin as well as it proposes an active role for historical and archaeological research in setting the agenda for the conservation of the Antarctic cultural heritage. This paper consists of two parts. In Part I, the possible origin of the conceptual and practical limitations has been explored by analyzing the scope of the Antarctic heritage at present. In Part II the contributions of Historical Archaeology to the knowledge about sealers are presented in order to show the potential of Historical Archaeology and the need for it to have a more active role in setting the agenda.

## THE SCOPE OF THE ANTARCTIC HERITAGE AT PRESENT
In order to explore the scope of the Antarctic heritage at present we have studied a) recurrences, emphases and silences in the most widely spread versions of Antarctic history, b) the process for designating Historic Sites and Monuments under the Antarctic Treaty together with the characteristics of the designated sites; and the relationships a) and b) bear to one another.

### The most widely spread versions of Antarctic History
We have analyze the most widely spread stories on Antarctica focusing on the ways the history of Antarctica has been structured by bibliography along time (Landis 2001, Sellick 2001, Rosove 2000, Brandt 2004, among others). This means we have identified recurrences in the way stories are told as well as the emphasis

used in mentioning some facts above others or in omitting some others altogether[1].

The history of Antarctica starts around 1820 with the discovery of the South Shetland Islands – not forgetting to mention Captain Cook's voyages as an important antecedent. All in all, the discovery appears as something controversial and hazardous over which there is no full agreement. There are different versions of the event of the discovery (Miers 1920, Martin 1940, Fitte 1962, Bertrand 1971, Pinochet de la Barra 1992, Campbell 2000, among others). The most widely spread versions associate discovery to an isolated self-contained event occurred by chance[2].

From 1820 onwards Antarctica was explored by those who are now considered famous explorers[3]. It is known that at the beginning of the 19th century explorers´ descriptions of the Antarctic seas aroused other interests linked to the exploitation of the resources in the southern lands and sea[4] (Stackpole 1950). Explorers' reports of great quantities of seals and whales in those high latitudes immediately attracted other characters to the making of the Antarctic history. We are talking about sealers whose presence in Antarctica during the 19th century was contemporary to that of the well-known explorers and even prior to theirs. However, the widely spread versions of the history of Antarctica scarcely mention them[5]. Only very few of these new characters are known by their full names[6], most of them are just anonymous men representing the fast and wild expansion of the capitalist system.

The exploration campaigns organized by different governments continued up to around 1840 charting the Antarctic geography and landscapes[7], when a gap or silence which lasted approximately 50 years (from 1840 to 1890) appeared. However, the presence of sealers and whalers extended – on and off – during the whole of the 19th century, although the starting date for either activity is still uncertain.

It is said that in 1890 after half a century of neglect, interest in Antarctica was revived. The 1890s marked the beginning of the "Heroic Age", a period of extensive Antarctic exploration sponsored by scientific societies. After the resolution adopted by the Sixth International Geographical Congress (London, 1895) exploring expeditions from different countries visited the continent. It was a period of innovation and hardship in an extremely hostile, scarcely-known environment[8]. The early twentieth century was a time of great volume and quality of charts and scientific observations. This period was characterized by long inland journeys and several expeditions – the main objective of which was reaching the South Pole[9].

The most widely spread versions of the history of Antarctica focus their attention on the "Heroic Age", nevertheless it is important to say here that 1890 is also considered as the starting point of the industrial whaling exploitation in Antarctica when Norwegian and Scottish whaling firms sent ships (1892-93) to investigate the possibilities of whaling around the Antarctic Peninsula. This marked the beginning of a new period of exploitation – industrial whaling – which included the settlement of factories in Antarctica. The data officially registered (International Whaling Statistics in Headland 1989) mention imposing figures as regards the whales hunted and the facilities displayed in Antarctica, ie: floating factories, shore factories, factory ships and catchers during the period extending from 1906 to 1930. Such a project meant hundreds of men involved in the making and thousands of individual stories taking place in the Antarctic landscapes in the early 20th

[1] There are exceptions i.e Headland 1989, Steward 1990, among others.

[2] One of the versions of the discovery states that it was the British captain merchant William Smith who discovered the Antarctic islands by chance and another version claims that Spanish survivors of the *San Telmo* wreck were the first men who arrived by accident in these lands. There are some other versions propose that sealing ships frequented this area before the events already mentioned, which would mean a process on the go.

[3] Such as cap. Edward Bransfield sent by the British Royal Navy and cap. Thaddeus von Bellinghausen (Russia's first government sponsored Antarctic expedition).

[4] See Barnard 1829, Fanning 1838, Smith 1844, among others.

[5] See references of sealers in Antarctica at the beginning of 19th century in Baughman 1993, Landis 2001, among others)

[6] Such as the British naturalist James Weddell and the American Nathaniel Palmer – who appear in history as sealers-explorers. That means people who being engaged in seal exploitation decided to include exploration and interest in natural science in their trips. Similar is the case of expeditions such as those of John Biscoe (1830-1833), Peter Kemp and John Balleny (1838-1839) sent by an English whaling firm which are less well known or at least less referred to in the history of the white continent

[7] We can mention capt. Jules Dumont D`Urville from France, the American Charles Wilkes and the British capt. James Clark Ross.

[8] Only to mention some, we can say that different parts of the Antarctic Peninsula and the islands of the Scotia Arc were explored by Adrien de Gerlache (1897-98) from Belgium, the British Southern Cross Expedition led by Carsten E. Borchgrevink (1898-1900), and the Swedish South Polar Expedition under Otto Nordenskjöld (1901-4). There was also the Scottish National Antarctic Expedition led by William S. Bruce (1902-4), two French Antarctic Expeditions led by Jean Baptiste Charcot (1903-5 and 1908-10), the German South Polar Expedition (1901-03) by Erich von Drygalski, the Australasian Antarctic Expedition by Douglas Mawson (1911-1914), Nobu Shirase and the Japanese Antarctic Expedition (1910-12), Wilhelm Filchner and the second German Antarctic Expedition (1911-12).

[9] As capt. Robert F. Scott and The National Antarctic Expedition (1901-4) and Ernest H. Shackleton and the British Antarctic Expedition (1907-9). Symbolically, the arrival at the South Pole by the Norwegian Roald Amundsen (The Norwegian Antarctic Expedition 1910-12) and the British capt. Robert Falcon Scott (The British Antarctic Expedition 1910-13) and The Imperial Transantarctic Expedition (1914-17) of Ernest Shackelton (1917-1922) mark the end of the "Heroic Age".

century which are scarcely mentioned in the history of Antarctica that talks about the voyages of explorers taking place at the same time.

Our analyses suggest there is a conceptualization of Antarctic history in terms of exploration *vs* exploitation. Stories associated with exploration definitely play the leading role, whereas those related to the exploitation of sea resources are subdued or simply omitted. Therefore, the most widely spread history of Antarctica appears as a sequence of events related to well-known characters at precise dates. Such events do not appear within the frame of any process but as isolated self-contained facts. This approach to history gives no opportunity for the insertion of those other stories in which there are no well-known characters, no precise dates or no memorable events: that is to say the stories of sealers and whalers which form part of the process of incorporating this region into the modern world.

**Process for designating Historic Sites and Monuments under the Antarctic Treaty and characteristics of the designated sites**

In the 1970s there awoke an awareness of the need for the preservation of historical sites and measures were taken in this sense. "The need to protect historic sites and monuments became apparent as the number of expeditions to the Antarctic increased". At the Seventh Antarctic Treaty Consultative Meeting (Wellington, 1972) it was agreed that a list of historic sites and monuments be created. So far 84 sites have been identified. All of them are monuments - human artifacts rather than areas - and many of them are in close proximity to scientific stations. Historic Sites and Monuments which have been included in the list may not be damaged, removed, or destroyed[10].

Successive Antarctic Treaty Consultative Meetings have developed guidelines to ensure that the process for designating Historic Sites and Monuments under the Antarctic Treaty fully complies with the objective of identifying, protecting and preserving the historic and cultural values of Antarctica. The 2009 guideline established that "Parties who wish to nominate a particular Historic Site and / or Monument should address in the proposal one or more of the following: A) a particular event of importance in the history of science or exploration of Antarctica occurred at the place; B) a particular association with a person who played an important role in the history of science or exploration in Antarctica; C) a particular association with a notable feat of endurance or achievement; D) be representative of, or forming part of, some wide-ranging activity that has been important in the development and knowledge of Antarctica; E) bear particular technical, historical, cultural or architectural value in its materials, design or method of construction; F) have the potential, through study, to reveal information or to educate people about significant human activities in Antarctica; G) bear symbolic or commemorative value for people of many nations".

Now then, what is the result of the process of designation of historical sites in Antarctica? We have wondered what these sites commemorate and which stories they preserve. In order to answer these questions we analyzed the list of sites designated up to now and we drew a time-line distributing these sites according to the dates mentioned. The number of sites designated has varied along time; at present there are 84 on the list – five of which have been withdrawn for different reasons.

For the purpose of our analysis we focused on the first one hundred years of the history of Antarctica and we assessed the 35 historical sites which were designated to commemorate the period of time extending from 1820 to 1920. We observed a clearly distinctive representation of the different moments; and there appeared a great emphasis placed on the early 20th century. Thirty of the 35 sites commemorate events that took place during the "Heroic Age". Only five of the 35 commemorate previous exploratory expeditions which took place during the 19th century (Nº 36, 37,57, 59,81). None of these sites are related or even mention the sealers' presence and only two refer to whalers' activities during all that period. One of them commemorates Henryk Bull and cap. Leonard Kristensen's whaling expedition on board the *Antarctic* in 1895 (Nº 65) and the other one the Whaling Station on Deception Island (Nº 71). This site also commemorates the longest period of settlement on Antarctic lands which extended from 1912 to 1931.

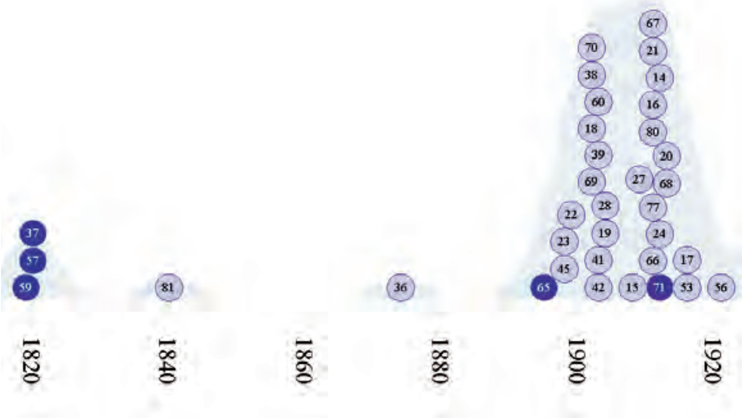



**Figure 1. Distribution of nominated Antarctic Historic Sites and Monuments according to the date of the events commemorated by them (from 1820 to 1920)**

10 For contributions, discussions and management issues of HSMs in Antarctica see: Chaplin 2004, Chaplin and Barr 2004, Pearson 2004, Greenwood and Absolon 2008, Morrison 2008, Roura 2008.

We highlighted three results of our analysis which are relevant to our interest

1 The over-representation of the sites related to the explorations taking place during the "Heroic Age", when compared to events and processes occurring in other periods of time.
2 The precision in dates, characters and events taking place at those precise places designated as historical sites or monuments.
3 The silence about the presence of sealers and whalers.

We consider that the analysis of the list of present historic sites and monuments offers some keys to understanding the conceptual and practical limitations to the preservation of sealers and whalers' sites. The first key is that – generally speaking – the sites designated are meant to preserve a history of Antarctica which feeds back on its most widely spread or known versions. Thus, the idea of a history of heroes, events and dates becomes stronger and in this history there is no place for anonymous whalers and sealers who produced no relevant events at no definite dates. It is interesting to point out that in the last guideline, items d), e) and f) open a door to the designation as historical sites or monuments of the places where material remains of whalers' or sealers' activities were found. However, no example of those items has appeared on the list yet.

Figures 2 and 3. Material remains of whaling activities in Foyn Harbour, Antarctic Peninsula. (Photo M.X. Senatore 2006)

Figure 4. Material remains of sealing or whaling activities in Yankee Harbour, Greenwich Island, South Shetlands. (Photo M.X. Senatore 2006)

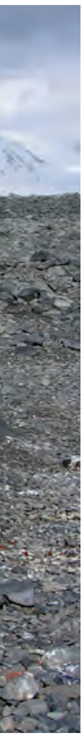
The second key is that the general tendency defines historical sites or monuments as specific places rather than as areas. This becomes a limitation for the chosen historical sites themselves because many spaces around them bearing potential interest for future archeological research are left uncared (an example of this are the trash deposits associated to the huts)[11].Yet an exception should be mentioned: site Nº 77. This site was also declared an ASPA. Management Activities to protect the values of the area include programs of archaeological work on the huts and a 5 m. buffer zone around them. This could be considered the first step in a new tendency.

On the other hand sealers' and whalers' activities cannot be conceived as developed in a definite spot in the landscape: they cover areas. Bearing this in mind, some steps have been taken for their preservation by including them in the Antarctic Specially Protected Areas Management Plans. Examples of these are the Byers Peninsula and Fildes Peninsula cases[12]. This means that efforts for preservation of such areas are seeking other alternatives to that of going through the process of designation of these areas as Antarctic Historic Sites and Monuments. This topic will be developed in Part II of this paper when referring to the contributions Historical Archeology made to knowledge about sealers in the South Shetland Islands.

## HISTORICAL ARCHAEOLOGY OF "*THE UGLY, THE DIRTY AND THE EVIL*" IN ANTARCTIC HISTORY

Archaeological research focused on the presence of 19th-century sealers in the South Shetland Islands has been developing for decades and a program of systematic survey of the islands continues (Lewis & Simpson 1987; Stehberg & Cabeza 1987; Stehberg y Lucero 1995a, 1995b; Lucero & Stehberg 1996; Martin Bueno 1996, Senatore & Zarankin 1999, Zarankin & Senatore 1997, 1999, 2000, 2005, 2007; Stehberg 2003; Pearson & Stehberg 2006; Pearson *et al.* 2007; Stehberg *et al.* 2008). Every one of the different projects has its own goals and interests. However, archeologists are working together by sharing information (location of historical sites, lists of archaeological findings, management proposals). A map showing the localization of all the sealers' sites identified up to now is on the make as part of the joint effort of archaeologists from Brazil, Chile, Argentina and Australia. The map shows the magnitude of the sealers' presence in the South Shetland Islands.

We have summarized the contributions made to the knowledge on sealers in the South Shetlands in our research project in several publications (i.e. Zarankin and Senatore 2005, 2007). It started in 1995 and from that moment on, we developed several fieldwork seasons in the islands. We concentrated our efforts on a specific area: Byers Peninsula on Livingston Island. Livingston Island was frequently visited by sealers during the nineteenth century, and – for the time being – it has shown the highest concentrations of sealing camps in the South Shetlands. Byers Peninsula covers an area of 72 square km, and an extension of 80 km from east to west and 3 to 14 km from north to south. Archaeological activities on Byers Peninsula have combined the survey of the area and the excavation of specific locations.



Our perspective is not centered on studying a particular event or experience lived by well-known people. On the contrary, we are devoted to the study of a historical process. We are interested in discussing the first attempts of the modern world to place a hostile region – completely unknown before the nineteenth century – within its economic and political boundaries. We worked on two different but interrelated levels. On a macro level, seeking to understand the nationalist and capitalist network of interests reaching the South Shetlands at the beginning of the century, and on a micro level: by studying the life of the people who occupied and exploited Antarctica for the first time. The reconstruction of sealers' daily practices finally became relevant.

[11] Management Plan for Antarctic Specially Protected Area ASPA Nº 162 (2004) Mawson´s Huts, Cape Denison, Commonwealth Bay, George V Land, East Antarctica (linked with Management Plan for Historic Site and Monument Nº 77 and Antarctic Specially Managed Area Nº 3) includes as part of the aims and objectives to "Maintain the historic values of the Area through planned conservation and archaeological work programs". "The artifacts form a rich resource of material available for research and interpretation, and potentially yielding information about aspects of expeditioner life not included in official written accounts" (2004: 154).

[12] For more information see Pearson et al. (2010: 63): "Options for protection of sealing sites in the South Shetlands were discussed by the authors at the First Regional Meeting of the International Polar Heritage Committee of ICOMOS (International Council of Monuments and Sites) representatives of the Southern Hemisphere at Viña del Mar, Chile, in February 2007. The meeting decided to prepare a list of the historic sites on the Fildes Peninsula on King George Island, and on the Byers Peninsula on Livingston Island. These lists, containing the basic information about the location and nature of cultural resources that need to be protected, with brief recommendations on the basic preservation actions considered necessary, were submitted by the Chilean Antarctic Institute (INACH) to the meeting of the Committee for the Environment (CEP) to the Antarctic Treaty Organization in April, 2007, and the need to consider the sealing sites in the context of the Byers Peninsula ASPA Management Plan, and possible protective measures or site guidelines for the Fildes Peninsula was recognized (see CEP website http://cep.ats.aq/cep/documentarchive.shtm). These issues will be pursued and further developed by Chile".

Figure 5. Archaeological surveys, Byers Peninsula, Livingston Island, South Shetlands, (Photo M.X. Senatore & A. Zarankin 1995-96)

Figure 6. Archaeological Excavations, Playa Sur-Site, Byers Peninsula, Livingston Island, South Shetlands. (Photo M.X. Senatore & A. Zarankin 1995-96)

The study of the sealers' presence is not limited to the study of one particular site. In Byers Peninsula alone more than twenty archaeological sites have been reported. Sealers' camps are formed by stone fenced areas in the shape of enclosures: that is spaces limited by piled stone walls and also by other structures in various shapes. In all cases they were built using rocks or whale bones. With the archeological tasks carried out in Byers Peninsula the characteristics of the various sealing camps were studied. The results of such surveys allowed the bringing forward of some general tendencies. None of these sites have any single outstanding historical relevance. All of them give information about a history that is still being built.

According to our theoretical and methodological stand the material world is placed in the centre of our research. Therefore, it is assumed that it is possible to learn about the life of people if we study their material world. Archaeological surveys and excavations have shown that a large number of sealing sites were estab-

Figure 7. Sealers' huts, Byers Peninsula, Livingston Island, South Shetlands. (Photo A. Zarankin 2010)

Figure 8. Sealers' huts, Byers Peninsula, Livingston Island, South Shetlands. (Photo A. Zarankin 2010)

lished in the region. There was variation in the size and spatial organization of these places, as well as in the number of people unboarded and in the social organization of the groups.

Archaeological and historical sources have provided information on different aspects of the sealers' first steps in the South Shetlands. Whereas archaeological evidence proves useful to understand sealers' life on land, historical evidence primarily deals with sealers' life on board the vessels. It is very difficult to find descriptions of sealers' camps or their activities on land. This information is basically given by archaeology. Therefore narratives prove not to be the only or determining tool in the study of the sites and remains left by sealers in Antarctica. Narratives cannot be used to determine the relevance or assess a particular site or to take the measures for its further preservation.

Historical Archaeology appears as a different standpoint focused on the study of processes, working with the material remains and incorporating new characters: "the ugly the dirty and the evil" to the history of Antarctica.

**FINAL WORDS**

Our analyses suggest there is a conceptualization of Antarctic history in terms of exploration *vs* exploitation. The stories related to scientific exploration are "preserved" by means of the commemoration of specific events, dates, or people, in specific locations (e.g. huts) whereas stories associated with the exploitation of Antarctic resources have been and are silenced and forgotten.

It is worth mentioning that many of these stories of sealers and whalers carry no specific protagonists, exact dates, or apparent "historical relevance" to be commemorated. Notwithstanding the fact that there are plenty of material remains widely spread, these are still scarcely considered in the conservation agenda of the Antarctic Cultural Heritage.

We hope the contributions of *archaeological research* will help pluralize the agents of Antarctic history and widen the scope of the Antarctic heritage.

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# FROM EXTRACTION TO EXHIBITION: TOURISM AT A DISUSED MARBLE QUARRY AT NY-LONDON, SVALBARD

Ricardo Roura

**Abstract**

Historic sites in the Polar Regions contain the material remains of past activities of exploration and exploitation. These sites are subject to transformation by cultural and non-cultural (natural) processes from their abandonment to the present. For research and management purposes it is important to monitor and explain these changes. This chapter explores the broad themes of research technology, use of territory, and heritage at the former site of a marble quarry in Ny-London (Port Peirson) (78º 57'49" N, 12º 02'56.5" E), an abandoned marble quarry in the High Arctic archipelago of Svalbard that operated intermittently (and eventually unsuccessfully) between 1911 and 1920. The conceptual basis for this research is primarily drawn from the work of behavioural archaeologist MB Schiffer (1987, 1995) and tourism scholar N Leiper (1990). Currently most structures at Ny-London, except two wood frame buildings, are standing ruins or ruins. Organized tourist landings take place regularly through the summer. The site is automatically protected under the 2001 Svalbard Environmental Protection Act. Fieldwork was conducted at Ny-London during July 2007. Research methods were a pedestrian survey and documentation of the site; direct observations of visitor behaviour; and repeat photography. Management responses appear adequate although more clarity regarding expected visitor behaviour may be required. Cumulative impacts are potentially a cause of concern. To the extent that tourism is a generally accepted use of the polar historic environment – although not necessarily at all sites and at all times – it should be accepted too that some tourism-related changes to destinations are unavoidable and contributing factors to the overall site degradation brought about by other natural and cultural formation processes.

**Resumen en castellano**

El potencial económico del archipiélago de Spitsbergen (Svalbard) para la minería y el turismo se conocen desde hace décadas, y en la actualidad ambas industrias son prioritarias para el desarrollo económico de la región. La interface de estas industrias está representada por el turismo en sitios de explotación minera, tanto activos como abandonados o históricos. Este capítulo explora los métodos de investigación, uso del territorio, y gestión del patrimonio cultural en la cantera de mármol abandonada situada en Ny-London (Port Peirson) (78º 57'49" N, 12º 02'56.5" E), un sitio histórico en el archipiélago ártico de Svalbard. Las preguntas de investigación son:

> ¿Cómo puede evaluarse la condición y el cambio de sitios históricos empleando métodos rápidos y de baja tecnología?
>
> ¿Cómo se diferencian la minería y el turismo en cuanto al uso del territorio en Ny-London?
>
> ¿Cuáles son los procesos formativos que afectan al patrimonio cultural minero en Ny-London y cuál es su incidencia en la gestión del sitio?

El marco teórico de esta investigación deriva de la labor de MB Schiffer (1987, 1995), uno de los fundadores de la arqueología del comportamiento, y del investigador del turismo N Leiper (1990). El turismo se concibe como un sistema de comportamiento que modifica a su entorno. Como tal es un proceso de (trans)formación de los sitios donde se lleva a cabo, en este caso sitios históricos. El trabajo de campo se llevó a cabo en Ny-London entre el 2-7 julio de 2007 en el contexto de una investigación doctoral con el Centro Ártico de la Universidad de Groninga, Países Bajos. Los métodos de trabajo incluyeron el relevamiento y la documentación del sitio; observaciones de actividades turísticas; y la repetición seriada de fotografías con intervalos de aproximadamente una década.

¿Cómo puede evaluarse la condición y el cambio de sitios históricos empleando métodos rápidos y de baja tecnología? Los métodos de investigación empleados en esta investigación permitieron una evaluación rápida de la condición, usos, y los cambios recientes del sitio. Obviamente, métodos de evaluación más

complejos y detallados pueden ser necesarios en para resolver cuestiones más específicas, o en sitios históricos de otras características.

¿Cómo se diferencian la minería y el turismo en cuanto al uso del territorio en Ny-London? Es evidente que la explotación de canteras de mármol y el turismo son actividades sustancialmente diferentes. La minería es una industria extractiva mientras que el turismo no lo es, pero ambas son actividades económicas basadas en el uso regular de ciertos sitios. Sin embargo, el turismo tiende a concentrarse en determinadas partes de los sitios visitados, escogiendo ciertas características que podrían ser concebidas (y descritas en narrativas) como atractivos turísticos. Esto incluye no sólo restos históricos, sino también rasgos naturales como la fauna y flora, y puntos elevados del terreno que sirvan como miradores desde donde examinar el paisaje circundante.

Y ¿cuáles son los procesos formativos que afectan al patrimonio cultural minero en Ny-London y cuál es su incidencia en la gestión del sitio? El turismo tiene el potencial de modificar los restos culturales que resultaron de la minería, así como el entorno - por ejemplo, mediante el desarrollo de senderos. Cabe señalar, sin embargo, que algunos efectos del turismo pueden ser comparables a los causados por procesos de otro tipo. Puede ser difícil de diferenciar de forma inequívoca las huellas reales de comportamiento turístico de los causados por otros procesos culturales contemporáneos o históricos, por procesos ambientales, o por una combinación de procesos. En algunos casos puede que sólo sea posible atribuir un impacto a las visitas turísticas por medio de observación directa. La noción de alcanzar un cierto estado por procesos distintos se denomina “equifinalidad” (Lynman 2004). La ubicación geográfica de Ny-London permite visitas frecuentes, pero también facilita la preservación activa del sitio. Las visitas regulares pueden acelerar la degradación de sitios históricos (o de elementos particulares del mismo). Sin embargo, los sitios históricos de origen industrial son menos vulnerables que otros tipos de sitios históricos, debido a su escala y características.

La gestión actual de Ny Londres parece ser adecuada. Sin embargo, las directrices con respecto a donde es posible caminar o no caminar no son lo suficientemente claras. No es fácil evitar caminar sobre artefactos en un lugar que está cubierto de ellos – en particular si muchos de ellos son fragmentos que resultan de la degradación del sitio y que, si bien están protegidos por ley, no son fácilmente reconocibles como “artefactos” para un visitante ocasional. En este marco debería considerarse la posibilidad de cerrar el acceso a los visitantes a algunas zonas con una alta densidad de artefactos como a fin de preservar el registro arqueológico y el valor del patrimonio del lugar. Además podrían establecerse senderos uniendo los elementos históricos de Ny-London que son visitados con más frecuencia.

La explotación comercial por parte de intereses privados de un patrimonio natural y cultural común, la que puede causar la degradación de ese patrimonio, es una de las problemáticas actuales en las regiones polares.

No obstante, si los sitios históricos polares no se conservan activamente es inevitable que decaigan, ya sea en forma paulatina o rápida, por efecto de procesos de degradación naturales o culturales independientemente de que sean o no destinos turísticos. En la medida en que el turismo se considere uno de los usos aceptados de los sitios históricos polares – aunque no necesariamente en todos los sitios y en todo momento – se debe aceptar que es inevitable que el turismo dé lugar a algunos cambios. Esta es una evaluación más realista que considerar que el turismo, por medio de regulación y supervisión, no causará ningún cambio en los sitios donde se lleva a cabo. El desafío – y la alternativa a la prohibición del turismo en determinados sitios – es cómo gestionar el turismo a fin de que no se acelere el proceso de degradación y con ello disminuya el valor del registro arqueológico, el patrimonio cultural, y otros valores intrínsecos de los sitios históricos polares. El ejemplo de Ny-London sugiere que la exhibición de restos culturales industriales con propósitos turísticos es compatible con su protección y conservación. Sin embargo, no existen soluciones de gestión perfectas para regular el comportamiento humano, que es inherentemente imperfecto.

**Introduction**

> *“Spitsbergen bids fair to become not only a great mining country but the grandest [tourism] playground in Europe” (Brown 1919)*

The economic potential of both mining and tourism in the High Arctic archipelago of Spitsbergen[1] has long been recognised (Brown 1919; Conway 1919) and both industries remain priority areas for the economic

[1] The Archipelago of Spitsbergen (Spitzbergen) is now usually known by its Norwegian name of Svalbard.

Fig. 1 – Ny-London in its heyday. Photo: Trømso Polar Museum. Reproduced with permission.

development of the region (Viken and Jørgensen 1998; Norway 2004: 3). The interface of these two industries is represented by organised tourism at mining sites, both active and inactive. This chapter explores the broad themes of research technology, use of territory, and heritage at the former site of a marble quarry in Ny-London (78º 57’49” N, 12º 02’56.5” E), also known as London. Ny-London is located on the Blomstrand Island[2] in the Kongsfjord in NW Svalbard. The site contains the remains of a marble quarry and associated facilities established in 1911 by Ernest Mansfield of the Northern Exploration Company Ltd. of England (Fig.1).

The chapter aims to answer the following questions with respect to the assessment, use, and management of this historic site: What opportunistic, low technology research methods can be used to assess the status and change of polar historic sites and the effects of tourism at those sites? How does mining and tourism compare with respect to the use of territory at Ny-London? And what are the processes of site formation affecting Ny-London, and their implication for site management? The conceptual basis for this research is primarily drawn from the work of behavioural archaeologist M.B. Schiffer (1987, 1995) and tourism scholar N. Leiper (1990 and refs.). Polar tourism is conceived as a behavioural system, i.e. as a set of patterned behaviours that link specific activities with the environment – in this instance, the historic environment. There are different ways in which visitors may interact with the historic environment, such as visually, physically and through the use of narratives. In a physical sense tourism results in specific traces – usually ephemeral but sometimes lasting – at the sites it visits, and from that perspective tourism is a cultural process of historic site (trans)formation. Narratives about a specific site or features and associated historic events enable the creation of tourism attractions. The example of tourism at a former mining site illustrates in a practical sense these theoretical considerations.

The Northern Exploration Company was primarily interested in prospecting and claiming resource-rich areas and then selling them to third parties for a profit (Avango and others, 2010). However, a substantial camp was established at Ny-London containing machinery, transport infrastructure, workshops, stores, and living quarters (Figs. 1 and 2). Ny-London appeared to be promising due to the quantity and quality of marble. Marble – metamorphic crystallized limestone – occurs in different locations of West Spitsbergen, and the bedrock of Blomstrand Island consists predominantly of medium to high-grade metamorphic marbles of

[2] Formerly believed to be a peninsula.

Fig. 2. Ny-London in 2007. 1. Harbour; 2. Fixed crane; 3. Living quarters with standing buildings and building foundations; 4. Machinery hall; 5. Rail bed; 6. Lookout; 7. Quarry area, mobile crane, workshop remains. Photo: R. Roura (2007).

.Fig. 3.
Surface of marble outcrops at Ny-London. The white vein is about 2cm wide. Photo: R. Roura (2007).

Fig. 4.
One of the “London houses” at Ny-Ålesund, with tourists photographing an Arctic fox. Photo: R. Roura (2007).

Palaeozoic age belonging to the Generalfjella Formation (Hjelle 1979) – so much so that it has been referred to as “Marble Island” (Brown, 1915). In 1915 an observer noted: “During the last three or four years a great deal of marble-cutting plant has been erected and much marble exported. Besides real marble a great deal of breccia and conglomerate are quarried, but all seem to have a high value. The range of colour is quite extraordinary.” (Brown, 1915). However, quarried marble blocks crumbled during storage due to the effect of frost on microfractures (Fig. 3) (Governor of Svalbard, undated). Activities were suspended during World War I and the venture closed in 1920. Before World War II Ny-London was used briefly to experiment with the drying of cod. The site was eventually sold to the Norwegian Government in 1932, that is, after the entry into force in 1925 of the 1920 Treaty Concerning the Archipelago of Spitsbergen, which grants the sovereignty of the archipelago to Norway.[3] Some of the wood frame buildings were relocated to Ny-Ålesund in the 1950s, where they are still in use – including the building used as the Netherlands Arctic Station – and known as the “London houses” (Fig. 4).

The first tourism cruise to Spitsbergen was organised in 1871 (Conway, 1906: 302). It was a popular activity in the first part of the 20th century with regular visits by cruise ships, the establishment of some hotels, and great expectations for future developments (Conway, 1919; Brown, 1919). Tourism in Svalbard came to a halt during World War I and II, but it experienced a new boom in between the wars. More recently, tourism began to increase following the opening of an airport in Svalbard in 1975, and then with the Norwegian government designation of tourism as one of three priority areas for Svalbard in 1990, along with mining, and education and science (Viken and Jørgensen 1998; Norway 2004: 3; Kolltveit 2006). The Norwegian government enforces a restrictive preservation policy complemented by industry self-regulation (Viken and Jørgensen 1998; Norway 2004). Restrictions on tourism traffic have now been introduced on the eastern part of the archipelago, including a general traffic prohibition at eight protected cultural heritage sites (Governor of Svalbard 2009).

Organised tourist groups call into Ny-London periodically. This reflects the growth and expansion of polar tourism in the past decades, and the interest that polar historic sites generate as tourism destinations and attractions (Roura 2009; in press). Other visitors, including Ny-Ålesund residents and Svalbard government officials, also visit Ny-London for recreation, accommodation, and other purposes. Overall, in recent years annual visitor numbers have increased from less than 100 visitors in 1996 to more than 1500 in 2006 (Geitz 2004; Governor of Svalbard 2006).

**Methods**

Fieldwork was conducted at Ny-London during July 2-7, 2007 in the context of doctoral research with the Arctic Centre, University of Groningen, The Netherlands. The Governor of Svalbard granted the use of one of the remaining buildings in Ny-London as field accommodation. Data collection methods were a pedestrian survey and documentation of the site; direct observations; and repeat photography (methods further described in Roura 2008, 2009, 2010, in press; Roura and Loonen 2009). An integration of these methods enabled a rapid appraisal of the status and recent change of key historic features, the main pressures (or site formation processes) affecting the site, and management responses.

[3] Now usually referred to as “Svalbard Treaty”. As with other British companies operating in Svalbard, the Northern Exploration Company lobbied for Britain to claim the sovereignty of Svalbard but it did not receive any support from its national government (Avango and others, 2010).

Key historic features were surveyed and documented during a pedestrian survey of the site. It was not the purpose of this work to obtain information about historic activities, but rather to describe the site as the “scenario” in which contemporary tourism takes place. Notes were made of evidence of site formation processes affecting specific features, including contemporary traces of behaviour and activity. Four small groups of visitors landed at Ny-London during fieldwork (Table 1). Observations were made of the behaviour of individuals and groups and of their spatial and functional use of the site. Finally, the changes experienced by specific features in the recent past (ca. 10 years) were assessed by means of repeat photography. The earlier or “before” photographs were collected from a brochure about Ny-London produced by the Government of Svalbard in the late 1990s (Governor of Svalbard undated). Each of these photographs was reproduced as accurately as possible to obtain a later or “after” photograph. “Before” and “after” photographs were then compared, based on Roura (2010).

## RESULTS AND DISCUSSION

### Rapid site appraisal using low-technology methods: Status and change

There are numerous features of different sizes and functions at and around Ny-London, which illustrate the historic process of resource extraction, the establishment of a mining settlement, and the staking of mining claims (Fig. 2). The main features include two standing wood frame buildings, three standing ruins, eight foundations, and the remains of a machinery hall. In addition, there are two quarries, a spoil dump, a fixed crane and a movable crane. A gravel rail bed connects the quarry area with the machinery hall and with a crane by the shore, which was used to transfer cargo to and from ships. There is also a water supply system and a number of collapsed claim boards extending away from the camp. Several dumps are located around the site, as well as artefact scatters, and the remains of a radio antenna. The standing buildings are maintained and used periodically. Government field officers use the building known as “Camp Mansfield” as field accommodation, while the welfare club of Ny-Ålesund uses the second building for recreational purposes. The buildings are kept locked so that only authorised visitors can use them.

The condition of most features is poor, but it should be noted that already in the 1930s and 1940s London had been described as a “ghost town” (Polunin 1941). Natural site formation processes affecting the site include wind, fluvial action and animal activity (e.g. reindeer and polar bears). Landslide erosion is apparent along a low cliff on the southern part of the site. Coastal processes affect some remains by the beach. Snow accumulation and meltdown are likely to be influential too, although during fieldwork the ground was snow free.

Recent changes to several features were assessed through repeat photography (Figs. 5 and 6). The features re-photographed between the late 1990s and 2007 were too few and random to assess changes to the site as a whole, but they illustrate several key historic features, including those that attract visitors. The most common changes affected small metal and wood items. Most changes occurred in situ (i.e. within the location that appears in the photographic frame), followed by the removal of objects from the frame, and the addition of objects to the frame. Changes of position were the most common in situ change, although some objects had also fragmented. Overall, none of the features monitored appeared to have changed substantially in a period of eight to ten years although numerous small changes have taken place (Roura 2008; 2010).

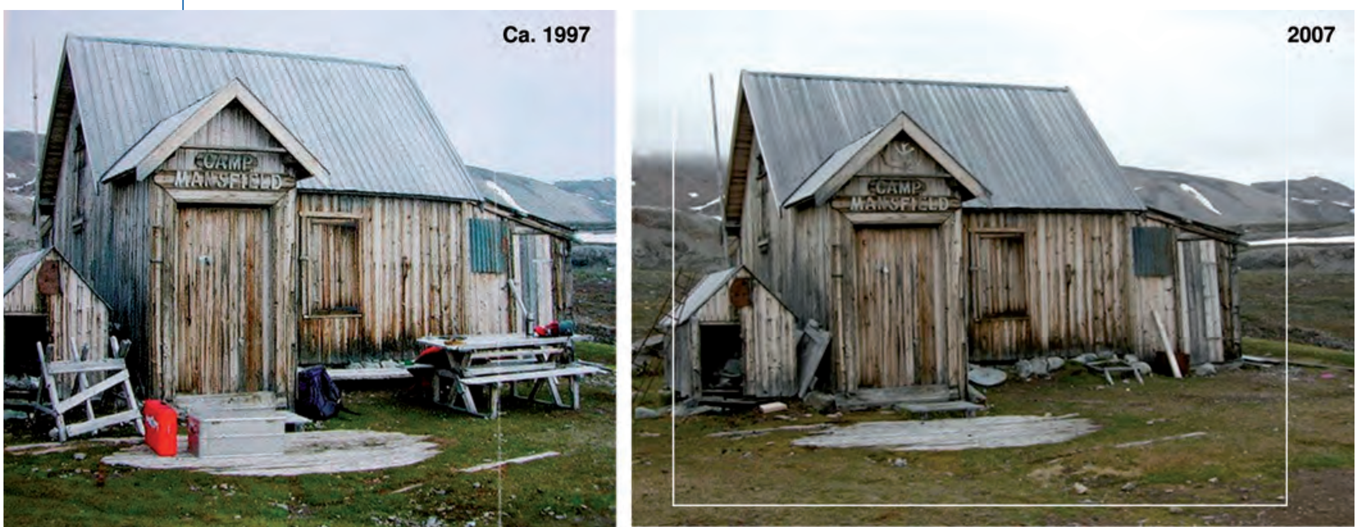


Fig. 5. An example of repeat photography. The white rectangle in the 2007 photograph shows the framing of the late 1990s photograph. From the late 1990s to 2007 the changes have included the removal of a table and a wood rack, which in 2007 was lying nearby broken into pieces; the addition of a metal antenna fragment and a wood board, which were stored near the dog hutch; and a reindeer antler that has been hung above the door. In addition, there have been a number of minor changes in features that have been removed from or added to the frame, or that have changed in situ. Left photo Governor of Svalbard, right photo R. Roura (2007).

These changes were interpreted in view of the likely site formation affecting specific processes (Table 2). However, in most instances it was not possible to ascertain unambiguously the cause of the changes (Roura 2008). As observed in other polar historic sites (Roura 2010) some of the changes had decreased, rather than increased, the disorder (the formal, spatial and relational arrangement of material cultural elements) suggesting active preservation.

**Territory: Use patterns by visitors**

Ny-London is a coastal site with a relatively sheltered harbour, Port Peirson – described as "… an ideal harbour…perhaps the best in all Spitsbergen" (Brown 1912) – ; a nearby water supply; and a gentle topography in coastal areas. The marble outcrops cover much of the area and suitable quarrying sites can be found a short distance from the shore. These characteristics enabled the establishment of a substantial mining camp adjacent to the quarries and the point of embarking and disembarking cargo and quarry products.

Many of the characteristics that made London a suitable site for the establishment of a mining settlement are also suitable for its development as a tourism destination. The site is located at about 7 km across the fjord from Ny-Ålesund, which is a key tourism destination in Svalbard, so that it can be used as a complement or as an alternative to visits to that site. Port Peirson is sheltered from the predominant along-fjord winds. The gently sloping beach enables landings by organised tourism groups. Furthermore, the key historic elements are a short, easy walk from the landing site. Had the mining remains been located further inland or uphill they would not have been so easily accessible, for instance, and it is likely that there would be fewer visitors.[4] While the site is largely derelict, the extant historic remains serve to illustrate the quarrying process (Figs. 7 and 8). In a protected wilderness like Svalbard, the attraction of a former mining site lies in part on the juxtaposition of images between the industrial and non-industrial landscapes (Cole 2004). The interest generated by this contrast has been apparent in some of the visits observed here. Narratives about the site's history can be used to complement visual attractions – for instance, a detailed account of the process of extraction and processing of marble was the subject of tourism narratives in one of the visits observed. In addition, the site has many attractive natural features.

**Site management**

Ny-London is automatically protected under the 2001 Svalbard Environmental Protection Act, which protects all sites pre-dating 1946. According to the Act, "No person may damage, dig up, move, remove, alter, cover up, conceal or disfigure protected structures and sites or movable historical objects, including any security zone, or initiate measures that may entail a risk of this happening."[5] Furthermore, in the security zone "…it is not permitted to erect tents, light fires or undertake similar activities."[6] Ny-London has been identified as a priority site in the cultural heritage Strategic Plan 2000-2010 and the action plan for the site includes the maintenance of machinery and equipment, and site monitoring (Governor of Svalbard 2000: 57-58).

The Svalbard Cruise Handbook, produced by the Norwegian Polar Institute in consultation with the Governor of Svalbard, Norway's Directorate for Cultural Heritage and Directorate for Nature Management, highlights the vulnerable elements of key landing sites and contains general and site-specific behavioural guidelines for visitors. It is worth examining how these regulations are put into action by the four visitor landings observed during fieldwork (Table 3). These visits will be described briefly below:

The first group landed from a commercial sailing vessel at the promontory situated to the W of Port Peirson, where there are some remains from the transport system of the mine. The group of eleven tourists and one guide moved slowly and systematically, visiting one feature after the other. The guide was obviously very knowledgeable and described to the tourists the industrial process of marble extraction and cutting. In turn, the tourists asked many questions about the site and how the quarrying process had worked. After visiting the main structures in the camp the group walked to a tarn located some 500 meters to the E of the settlement, making detours along the way to look at wildlife, soil polygons, a collapsed claim board, and a waterfall where the old water supply pipelines are connected.

The second group, with six passengers and one guide, landed at the E end of the beach while

[4] The distances walked by different groups of organised tourists observed in Svalbard during July and August 2007, both at Ny-London and elsewhere, usually were below 2 km – even those advertised as "extended walks" – and in most cases below 1 km. This suggests that visitor numbers to a historic site located more than a kilometre away from the landing site would drop considerably.

[5] Det Kongelige Miljøverndepartement (2001): Chapter V. The cultural heritage, § 42 (the substance of protection).

[6] Ibid.

kayaking around the island where Ny-London is located. The group visited the most emblematic elements of the site – the two buildings and steam boiler room, and the quarries and crane – before heading to a nearby hilltop. Overall, the group looked cursorily at historic features and took most interest in natural features – for instance, they spent some time watching a fox being chased by Arctic terns. In contrast to other groups observed in Svalbard, this group spread quite widely over the area.[7]

Then, three biologists landed briefly at Ny-London. They were not conducting research specifically at that site but simply "being tourists" – as one of them said – while waiting from some scientific equipment to arrive at Ny-Ålesund. They wanted photographs of a long-tailed skua *Stercorarius longicaudus*, which they knew was nesting among the cultural remains. In their visit they briefly examined the standing buildings, located and photographed the long-tailed skua nest, and departed.

Finally, one man was briefly seen running along the beach and onto the hills to the west of the harbour. It is not known how this person came to be there, what he was doing or where he was going.

The visits were generally unremarkable, although some observations of visitor behaviour are relevant to site management:

- One of the guides instructed the tourists where to walk so as to minimise their impact. Another guide did not appear to have instructed the tourists beforehand, but three times during the visit requested them to modify their behaviour when some of them walked on the path leading to the houses, approached the nest of an eider duck, or walked on a building foundation.[8]
- The instructions as to where to walk differed. One of the guides recommended walking on existing paths and to avoid stepping on vegetation, and another advised to do the opposite so as to not to widen existing paths, as recommended in the Svalbard Cruise Handbook. This is somewhat counter-intuitive – the view of the buildings from the beach does not immediately suggest that walking off paths is the best option (Fig. 7).
- Visitors tended to concentrate around features of interest, some of which were surrounded by patches of bare ground, suggesting erosion (to which repeated trampling may be a contributor).
- While approaching historic features visitors need to make a judgment as to the appropriate distance from where to stand from a historic feature. However, the sensitivity boundaries – the boundary beyond which behaviour may result in some disturbance to cultural remains – are not necessarily obvious to casual visitors. This is particularly the case since many artefacts at Ny-London are composed of fragments of wood, metal, brick and other materials resulting from the decay of the site (Fig. 8). What distinguishes them from other natural or cultural substrates is that that these cultural features are legally protected. As a result, visitors sometimes were seen to step on the artefacts lying around historic features.
- One of the guides picked up a small ceramic bottle that was lying on a stream bed in order to photograph it; when he did the same with an adjacent glass vial it broke (Fig. 9). "It was already busted" – he remarked – but it was apparent that the bottle broke while being lifted.
- There are some minor traces of contemporary activity, including traces of visitor trampling around parts of Ny-London. For instance, the rail bed connecting various features of the sites has evidence of visitors walking up or down its sides as visitors move to and from the most visited parts of the site i.e. the standing buildings, the quarries, and the machinery hall (Fig. 10).
- To the extent that the original and contemporary uses of the site are different (i.e. mining and tourism), the areas of activity of the original and contemporary activities overlap only partly (Fig. 11). The tourism activity area, as assessed here, was less extensive than the original mining activity area, that is, not all historic mining remains appear to be used as tourism attractions.
- As observed at other polar sites (Roura 2009; in press), tourism visits to polar historic sites focus not solely on historic elements alone but also on the various natural and cultural elements at the site. These include flowering plants, opportunistic sightings of wildlife, and elevated points that serve as lookouts. In addition, they may engage on a range of activities beside sightseeing.
- The direct impact of these few visits on the condition and integrity of the historic site could be regarded as negligible. However, a repetition of low-intensity direct impacts could result in cumulative effects on specific elements or parts of the sites.

[7] Observations of other tourist groups elsewhere in Svalbard suggest that guides prefer keep tourists in tight groups for greater protection against polar bears. For instance, a guide instructed his group not to walk more than twenty to thirty meters from the armed polar bear guards, a point he repeated frequently during a weeklong observation period.

[8] Here there may be issues of reactivity – that is, people altering their behaviour in the knowledge that they are being observed.

These limited examples and observations illustrate the range and frequency of visitors at Ny-London, some common forms of behaviour, and some of the resulting traces of visitation. However, other visits to the site may have a different pattern than those described here. For instance, shortly after the brief stay at Ny-London described here a group of 25 Ny-Ålesund residents held a barbeque at the site,[9] and subsequently a small group spent a weekend there – a recurrent activity during summer.

Fig. 6 – Visitors at one of the marble quarries. Photo: R. Roura (2007).

Fig. 7 – Visitors standing around artifacts. Photos: R. Roura (2007).

Fig. 8 – Visitor picking up an artifact (left); artifact that has just been broken (right). Photos: R. Roura (2007).

Fig. 9 – Access to the Ny-London buildings from the beach. Photo: R. Roura (2007).

[9] Curiously, the fireplace is located at 62 m from the buildings, closer than the 100 m stated in the Svalbard Environmental Protection Law as a mandatory distance to keep from cultural heritage. It is speculated that the fireplace itself pre-dates the law. The content of the ashes included tins and wood fragments, none of which appeared to be 'historic'.

Fig. 10. Footprint erosion. Visitors walking across the historic rail bed at Ny-London have caused localized erosion on its sides. Photo: R. Roura (2007).

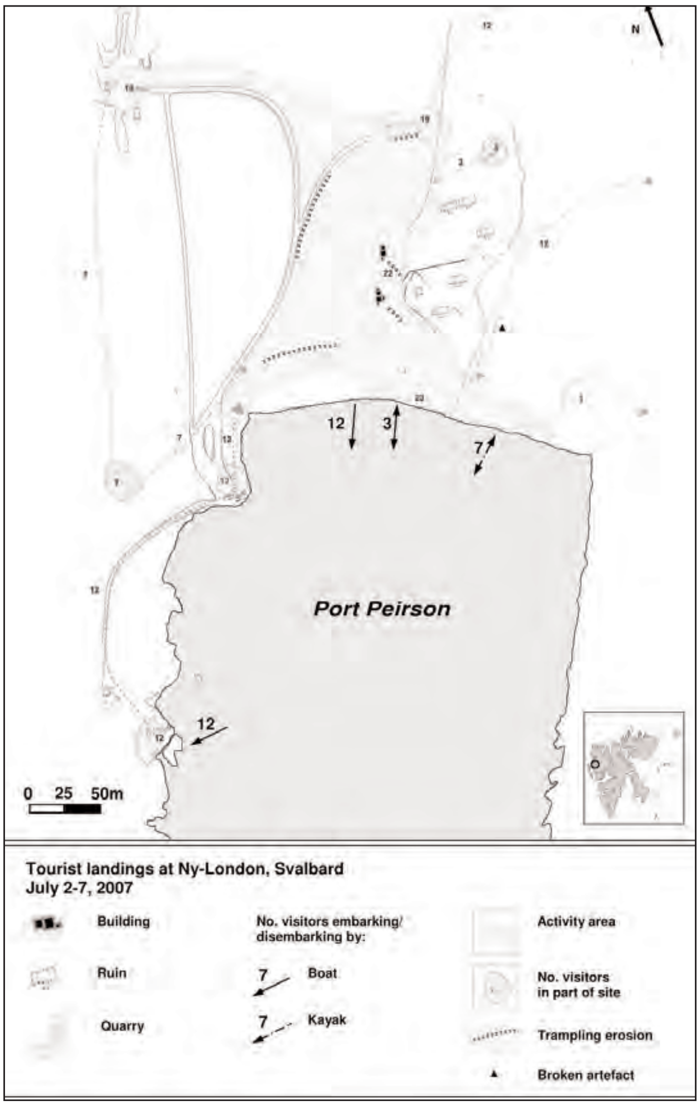


Fig. 11. Sketch showing tourism landings at Ny-London, Svalbard, July 2-7, 2007, outlining the movements of visitors and the estimated activity area. Sketch by R. Roura. Base map by Nash and Løkken (1990).

**Conclusions**

Many sites of past activities in the polar regions look like abandoned places. Some sites are in ruins; others are well preserved and are described in some narratives as “time capsules” (Roura, 2010). Yet this appearance is deceptive: many historic sites have become an arena where contemporary activities take place, notably tourism. These activities contribute to site transformation and add to the changes brought about by other natural and cultural site formation processes. The outcome is a dynamic balance between decay and preservation. This chapter has examined three broad themes relevant to the assessment, contemporary use and management of a former marble quarry in NW Svalbard. The questions posed at the outset will be reviewed below.

What opportunistic, low technology research methods can be used to assess the status and change of polar historic sites and the effects of tourism at those sites? Assessing the status and change of polar historic sites may be a complex and expensive task (e.g. Governor of Svalbard, 1999). The methods used in this research, while simple and low technology, allowed producing a rapid and reasonably informed appraisal of a site's status, recent change, tourism modalities, and management needs. In its conception, albeit not necessarily in specific methods, the approach used here is based on the tradition of rapid appraisal used in some disciplines of applied social sciences (e.g. Kumar, 1993; Beebe, 1995). This approach is appropriate to the polar regions, where site visits may be infrequent, opportunistic, and brief. Naturally, more comprehensive assessment methods may be required for different (or more specific) research or management needs.

How does mining and tourism compare with respect to the use of territory at Ny-London? Plainly marble quarrying and tourism are substantially different activities – mining is an extractive industry while tourism is not. Rather, mining tourism "...reflects a change in the perception of what constitutes a resource – from a productive raw material to a consumptive viewing of the past" (Pretes 2002: 447). In addition, both are industries based on the sustained use of particular sites. However, tourism tends to focus on specific parts of the site, "cherry-picking" certain features that could be conceived (and narrated) as attractions. This includes not only historic features but also natural features such as flowering plants, passing wildlife and lookouts from where to examine the surrounding landscape. As a consequence, the activity areas of historic mining and contemporary tourism overlap but are not identical. It should be noted that narratives (or the absence of narratives) are related to the use of territory. Tourism narratives influence behaviour, in that they direct visitors towards (or away from) specific features or parts of a site, and encourage (or discourage) some forms of interaction with the site's attractions. In addition, narratives about a site's history and uses are important to create "tourism attraction systems" in certain sites that may appear unremarkable to the casual visitor (Roura, 2009). Conversely, an absence of narratives may result in tourists missing out on important elements of a site, visiting areas that are off-limits, or behaving in ways that are not recommended.

And what are the processes of site formation affecting Ny-London, and their implication for site management? Judging from the monitoring of a limited number of features, there has not been substantive change in a period of about a decade, but this assessment does not hold for the site as a whole. Tourism has the potential to modify the cultural remains that resulted from mining as well as the surrounding environment – for instance, through the establishment of paths or localised footprint erosion. It should be noted, however, that some traces of visitation would be comparable to those of other site formation processes – a concept described as ¨equifinality¨ (Lyman, 2004; Roura, 2010). In some instances it may only be possible to attribute an impact to visitation by direct observation. While regular visitation may accelerate the degradation of historic sites (or particular features therein), industrial sites are as a whole less vulnerable than other kinds of historic sites, on account of their large scale and hard-wearing nature. In addition, it is apparent that Ny-London's accessible location not only enables frequent visitation but also facilitates active preservation.

Current site management of Ny-London appears to be adequate. Compliance with guidelines, as assessed in a limited set of observations, was generally adequate. However, guidelines concerning where to walk/not to walk are not immediately clear, and it is not easy to avoid stepping on artefacts in a place that is littered with them. A casual visitor would not immediately recognize many artefacts as such since many of them are fragments that originate from the ongoing decay of movable and unmovable site features. In addition, many artefacts are obscured by vegetation or half buried in the ground. Consideration should be given to identify and set aside some areas with a high density of artefacts as off limits for visitors so as to preserve the information and heritage value of the site, and to establish routes joining the most visited features.

The commercial exploitation by private interests of a common natural and cultural heritage, which may result in the degradation of that heritage, is an issue of increasing concern across the polar regions. Nevertheless, if polar historic sites that are legally protected are not actively preserved and consistently managed they will eventually decay, gracefully or otherwise, regardless of whether or not they are tourism destinations. To the extent that tourism is a generally accepted use of the polar historic environment – although not necessarily at all sites and at all times – it should be accepted too that some tourism-related changes to destinations are unavoidable, and a contributing factor to site decay caused by other site formation processes. This is a more realistic assessment than assuming that tourism, if regulated and supervised, will cause no changes at the sites it visits. The challenge – and the alternative to closing off the sites entirely to visitation – is how to manage tourism so that it does not accelerate the decay process and in doing so diminishes the information, heritage and other intrinsic values of polar historic sites. The example of Ny-London suggests that the exhibition of industrial cultural remains is compatible with their protection and preservation, but that there are no perfect management solutions to regulate the inherently flawed human behaviour.

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## TABLES

**Table 1 – Visits observed at Ny-London, Svalbard, 2-7 July 2007**

| Date | Transport | Landing | No. visitors | Visit duration (AM/PM) | Itinerary | Distance walked |
|---|---|---|---|---|---|---|
| 2 July 2007 | Sailing vessel; inflatable boat | Headland W of Port Peirson; central part of beach | 11 tourists 1 guide | <2hr (PM) | Crane, road on E of site, buildings, quarries, boiler room, waterfall, tarn, claim board, polygons, | 2300m |
| 3 July 2007 | 4 kayaks | E end of beach | 6 tourists 1 guide | 1hr (PM) | Two buildings, boiler room, quarries and crane | 1300m |
| 3 July 2007 | Rigid hull boat | Beach, central part | 3 scientists | <1hr (PM) | Two buildings, area to W of site | 400m |
| 3 July 2007 | ? | ? | 1 visitor | <1 minute (PM) (observed) | Running eastwards along beach, climbing over headland. | 300m (observed) |

**Table 3 – Observations of compliance with guidelines from the Svalbard Visitor Handbook[11]**

| Guideline | Group 1 | Group 2 | Group 3 | Comments |
|---|---|---|---|---|
| Cultural remains must not be disfigured or destroyed. | O | π | π | Accidental breakage of artifact |
| Avoid walking and standing in the cultural remains (does not apply to the cabins). | O | π | π | Numerous artefact fragments scattered through area, many may not be recognised as “artefacts” and be stood on. |
| Do not remove any cultural remains from the site. | π | π | π | |
| Leave the objects in place. Do not move the items. | O | π | π | Artefact held by visitor to be photographed |
| Avoid walking where you may enhance erosion of the ground in the area between the beach and the houses. | π | O | O | It is not immediately clear how to apply the rule |

[11] These guidelines appear in narrative form as a listing of vulnerable elements, and as a listing of expected behaviour.

**Table 2 – Repeat photography: Feature characteristics, main changes, and interpretation**

| Feature description (as in late 1990s photograph) | Main changes during monitoring period | Interpretation |
|---|---|---|
| **Machinery shed ruins – S aspect** | | |
| Detail showing metal cylinder in upright position[10] | A few heavy items e.g. segment of iron rail added or removed from frame or changed position within frame. | Handling |
| **Machinery shed ruins – S aspect** | | |
| Three metal cylinders in upright position and one in a horizontal position. Some scrap metal. | Large metal box, use unknown, has apparently changed position. | Handling |
| **“Camp Mansfield” hut - S aspect** | | |
| Pre-fabricated woodframe building with a south-facing porch and extensions. | Some heavy items e.g. metal antenna fragment stored next to building; reindeer horns hung above door. Several large objects (e.g. garden table) removed from frame; saw rack is broken, located outside the photograph frame. Metal lid added to frame. | Site management Wind action |
| **Machinery shed ruins – NE aspect** | | |
| Detail of standing ruins containing wood fragments and scrap metal of different sizes shapes; and drum barrel-shaped block (chalk?), with the drum itself no longer present. Larger items partly stored orderly inside and outside the feature, and partly lying about on the ground. | Pieces of wood, metal, ca. 40-50cm long, added to frame. Some pieces of metal and a wooden board have been removed from frame or changed position. Half broken box containing metal scrap collapsed | Handling, trampling; Wind, snow and accumulation (?) |
| **Building foundations** | | |
| Consisting mostly of unmovable wooden beams and some loose wood fragments. | Fragment of wood ca. 30-40 cm now visible; some beams of the foundation changed position slightly. | Handling; trampling? |
| **Building foundations** | | |
| Containing an iron cooking stove, brick chimney remains, and brick and wood fragments less than ca. 50 cm long. Several metal artefacts are on display above stove. | Artefacts on display on top of stove removed from frame. Small to medium brick, wood, and metal objects moved within the frame. | Site management, visitation, trampling. Wind. |
| **Waste dump adjacent to the “Welfare” hut** | | |
| Containing an assortment of metal and glass artefacts from primary deposition. | Metal plate added to dump; iron bar, fragment of metal coil removed from frame. Several small metal objects have changed position. | Cultural deposition/ removal; wind action; gravity/slope processes. |
| **Half barrel partly buried in the ground** | | |
| | Circular piece of metal added to frame; four staves broken, remaining fragments *in situ.* | Wind and weathering; cultural deposition? |
| **Wheelbarrow with a metal wheel** | | |
| | Large nail stored inside wheelbarrow. Wheelbarrow moved to different location. | Site management |

[10] This structure was formerly described to be a shed for “steam engines” but later research suggests that it consists of the remains of so-called channelers, which are the machines used for mechanically cutting the marble prior to extracting the blocks (Aalders and others, 2008).

# FOR THE RECORD: THE USE OF HIGH DEFINITION DIGITAL SCANNING TECHNOLOGIES TO RECORD AND GUIDE CONSERVATION AND INTERPRETATION OF HISTORIC SITES.

Adam Wild and Russell Gibb

**Abstract**

This paper extends the application of high definition laser scanning (HDS) introduced at the 2007 IPHC conference at Barrow, Alaska, and its use on heritage sites including those in polar regions. In this paper we examine the use of HDS in establishing an accurate and reliable electronic three-dimensional database of physical heritage, examine its application across landscape and interior contexts in hand with other recording technologies available through examples, and explore the opportunity of extending the use of the data gathered through multidisciplinary collaborations and interpretations using other virtual media.

HDS is not limited to building surveys, but can be (should be) applied to sites and objects collectively to better record and guide conservation. With this technology the topographic context can be recorded with equal weighting to that given to the exterior fabric and interior context of a building and to a scale relevant to the local context of each site and those factors that lend distinctiveness and value to such places.

HDS data provides a digital record which can provide baseline data linking ancillary investigations such as geophysical survey, sonar imaging, or other scientific study associated with sites. With this data we can accurately measure those physical factors that may be affecting a place, record change over time, and trace the efficacy of conservation work to both the built item and to its particular context. One of the many extensions of the core data record is found in its use for interpretation. The draping of high resolution digital imagery over laser scan data provides photorealistic three-dimensional models of objects and contexts and scan data can be modelled to create digital educational media, including interactive media using underlying gaming engines. This output can then be made accessible to an international audience in managed formats.

As an electronic database its ability to be shared and enhanced by other disciplines remotely while being managed from a single control point is something we are currently looking at with respect to our partners at the Universities of Waikato, Minnesota, Bath, Cape Town, and Hong Kong and commercial sponsors Leica Geosystems and Breuckmnn GmbH. The exploration of new ways of extending the interpretative values of the data in collaboration with others means that the data can be made available via the World Wide Web to bring polar heritage within the reach of a wider international audience.

**Resumen**

El artículo extiende la aplicación de escaneo láser de alta definición (HDS) que fuera mencionado en la conferencia del IPHC del 2007 en Barrow, Alaska, hacia su empleo en sitios y objetos patrimoniales, incluyendo aquellos de las regiones polares. En este artículo se examina el uso de HDS en el establecimiento de una database tridimensional electrónica certera y confiable del patrimonio físico, examinando su aplicación a lo largo del paisaje, de mano con otras tecnologías de registro disponibles. Se proporcionan ejemplos y se explora la posibilidad de extender el uso de los datos almacenados a través de la colaboración multidisciplinaria y la obtención de nuevas interpretaciones empleando otros medios virtuales.

HDS no solo está limitado a la prospección de edificios, sino que debiera aplicarse a sitios y objetos que requieran un mejor registro y una guía para su conservación. Con esta tecnología, se logra un mejor registro del contexto topográfico y una guía para la conservación, tomando en consideración los factores que distinguen y valoran el lugar. Asimismo, permite construir una línea de base auxiliar para la investigación tal como la prospección geofísica, la imagen sonar o otros estudios científicos asociados con el sitio. Uno de las múltiples extensiones del registro de datos es encontrar su uso para la interpretación.

El mapeo de imágenes de alta resolución digital sobre datos de escáner láser provee modelos tridimensionales fotorealísticos de objetos y contextos y, la data escaneada puede ser manejada para crear

media educativa digital, incluyendo media interactiva. Este output puede hacerse accesible a una audiencia internacional y se ha estado trabajando en esta línea junto a las universidades de Waikato, Minnesota, Bath, Ciudad del Cabo y Hong Kong y a auspiciadotes comerciales como Geosistemas Leica y Breuckman GMBH. La exploración de nuevos caminos que extienda los valores de interpretación de la data e colaboración con otros, implicará que la data esté disponible vía la World Wide Web para llevar el patrimonio polar a una audiencia internacional mucho mayor.

An accurate record of a building and its site is an essential part of the planning and implementation of conservation projects. A reliable and accurate record of the physical characteristics of places of heritage value enables better analysis and interpretation of those values and can reveal the processes of development, decay, and distinctiveness that inform appropriate directions in the conservation decision-making process. Equally, a poorly informed understanding can limit the effectiveness of those processes of conservation, protection, or management and compromise the heritage values for which the place has been recognised. Good decision-making is dependent on proper analysis of the particular characteristics of a place and of those factors affecting its fabric and distinctiveness. Such an understanding should contribute to an integrated approach to objectives of conservation and significance across disciplines.

The fundamentals of architecture are conventionally described through a vocabulary of drawings: plan, section and elevation. From this language two-dimensional images of three-dimensional form and space are described. Importantly, in describing architectural space, we need to acknowledge an outward and inward relationship between built form, materiality and space whose attributes establish a particular context which lends distinctiveness to places of cultural heritage value through the collective contribution of each part to the whole.

According to one infamous observation:

> *There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we now know we don t know. But there are also unknown unknowns. These are things we do not know we don t know.* [1]

If, then, the quality of our recording has a direct influence on our ability to understand a place, what happens when we can't see what we need to record; or when its physical context or condition presents particular constraints to recording; or when we can't touch the thing we need to record? How limiting to our ability to understand significance and those factors that may be affecting it is a constrained recording? If we are left not knowing "what we don't know" what value is the survey and what value is the record it establishes? How can we determine appropriate measures for the conservation of our heritage without appropriate information? Equally when it comes to places of polar heritage how can developing technologies help us record these places and how can they lead to an informed understanding of them? What can these new technologies reveal that conventional recording cannot and what, in the end, do we really know?

**known knowns**

"*Known knowns*" are perhaps most easily represented by the archive formed through recording the physical remains of historic built heritage. Like written histories, they represent a record that itself becomes valuable as an archive. To one extreme, as Ricardo Roura revealed in his paper to the IPHC at Barrow in 2007,[2] even the plaques marking an historic site have become formally "memorialised" as an historic site or monument (HSM). This perhaps suggests a political overtone to how we regard heritage in the polar context, although whether the conjoined nature of politics and heritage is any less or more convoluted in polar regions as it can be elsewhere is another matter. It suggests, however, a fundamental issue in recording heritage and in recording as a means to understanding generally, which has tended to focus on the object rather than providing equal weighting to the recording of the particular local context which lends distinctiveness and meaning.

Scott's 1902 *Discovery* Hut was a prefabricated building constructed in Australia. Without its Antarctic context is it any more than any other "outback"' building?

[1] former US Defence Secretary Donald Rumsfeld on February 12, 2002.

[2] ICOMOS IPHC, *Historical Bases — Preservation and Management,* 2008, pp38-50

Fig 1. Discovery Hut – the Antarctic context. (Photo: Adam Wild)

Fig 2. Discovery Hut – an Australian context. (Photo: Archifact Limited)

Similarly, Shackleton's Nimrod Hut was a catalogue kitset building whose contemporaries can still be found in England today serving as storage sheds and clubrooms. It is not therefore necessarily the physical or technological characteristics of the buildings that make them significant, but rather the collective contribution of context, association, environment and action that lends distinctiveness and value. To recognise this collective value requires a recording of those factors.

So what do we really learn of historic polar settlements: their contexts, technology, heritage and those factors affecting those values from current conventional recording methods? What guides our ability to bring places of cultural heritage value into the world of the "*known known*" and what informs our ability to ensure their conservation is appropriate and effective? In the polar environment our ability to see, to record, and to understand the heritage can be tempered by the physical environment in which we find such places. Equally, the debate rages over the status of now abandoned sites and structures which currently lie within a spectrum spanning everything from historic heritage to rubbish. Our ability to recognise what are often foreign objects and foreign endeavour in the unique context of the polar environment is part of the important process of recognising polar heritage. Whether these are places of polar heritage or not, their recording marks an essential moment in considering them and establishing a record datum from which informed decisions about their futures can be made and against which those decisions can be tracked.

The process of recording historic heritage is, in principle, no different in the polar context than in sites of a more temperate nature, but it can be constrained by a myriad of factors; the first of those constraints being the very nature of that environment. This of course is an environment whose extremes and potentials first drew human exploration, endeavour and occupation and which represents one of the fundamental factors affecting built structures and modified landscapes. Yet it is this environment that also lends distinctiveness to the cultural heritage value recognised in the sites of polar heritage today and which forms an important context to understanding what distinguishes these as places of heritage value from any other. Recording should mark a conscious beginning to regarding this heritage, it should facilitate a collaborative multidisciplinary rigour in understanding, and it should provide accessible interpretative outputs which can be offered to the widest of audiences.

The recording of physical heritage can be an exercise in recording standing ruins including those structural forms that have survived after years of redundancy, lack of care and exposure to the harshest environmental conditions in the world. Without accurate records of these markers and the factors including imperfections that lend distinctiveness, their recognition as places of cultural heritage value and the potency of those values may be lost altogether. At the same time informed strategies for guiding their conservation can be neither planned nor the efficacy of that work measured over time. It is not the object alone however that should warrant our interest, but an understanding of the object in its particular and distinctive context. In the polar environment this can be a significant factor in appreciating the cultural heritage values of the place: building, site and environment together. Such value comes in part from its physical context which attests to the human association and to the distinctive cultural heritage value of the place collectively. Understanding the factors affecting the fabric of these places over time through the recording and analysis of those records affords opportunity to begin to understand the "*known unknowns*" that the effects of time reveal.

**Known unknowns 1**

We have tested some of these assertions in work undertaken using HDS in some of our collaborative projects in more temperate climes.

Fig 3. Engraving of Old Government House, 1856. (Photo: London Weekly News)


Fig 4. 1888 drawing of the main (north) elevation of Old Government House. (Photo: University of Auckland archives)

Fig 5. Old Government House. (Photo: Archifact Limited)

Old Government House is a "temporary" building built in 1856. It stands on the site of New Zealand's first Government House erected in 1840, which was razed to the ground in 1848. Today Old Government House is the highest-ranking historic place in Auckland and is recognised for its distinctive collective values of landscape and building. The survey record of this place, however, can only be described as patchy at best. One of the most comprehensive records remains an incomplete set of drawings prepared in 1888 to replace the original documents, which were lost in the sinking of the ship carrying them from Auckland to the new capital in Wellington in 1865. 154 years after the construction of this temporary building its conservation is recognised as an essential obligation and fundamental opportunity in securing its next 154 years. As a structure the building is a celebration in the use of some of New Zealand's finest building timbers. Knowing this place today is as much about recognising the characteristics of that timber and its construction system and technology as it is the recognition of all those other layers that have contributed to its significance. The consequence of recognising a "temporary" wooden building (doesn't that sound familiar in the polar context) after 154 years is as much about acknowledging a building where plumb, straight and true are terms that can be rarely applied and where these attributes can be embraced as not being detrimental to its value, but part of it. As we start to produce accurate records of this place, starting at the foundations (the venue of some of the greatest untested historic and archaeological speculation), the first and most compelling issue facing its conservation was concerned with the practicalities of its survey.

The realities of some sites can quite literally leave us in the dark. The difficulties in being able to physically survey such spaces: in this case 36.5 metres long by 15 metres wide and commonly no more than 1 metre high, can be if not impossible, then because of these physical constraints, problematic in the way they can present the types of risk errors conventional survey can be prone to. So with little space, no light, and the added constraint of being a registered archaeological site, conventional survey was proving physically difficult, spatially inaccurate, while movement through the area risked compromising the in situ archaeology. HDS resolved these issues and revealed evidence to prove a number of long-held but hitherto unsubstantiated "*unknown* unknowns" (myths). To achieve a reliable solution we used a Leica ScanStation2 laser scanner to record the subfloor area.

**Known unknowns 2**

At the 2007 gathering of the IPHC in Barrow, Alaska we introduced our use of HDS to record the distinctive relationship of historic farm buildings within a series of historic designed landscapes that together constitute the historic place**.** Included within that complexity of historic designed landscapes were a collection of buildings, and within the complex of those buildings was an inspired 50 year old conservation approach to one particular and distinctively bespoke smithy building saved within a 1960 outer shell: a building within a building.

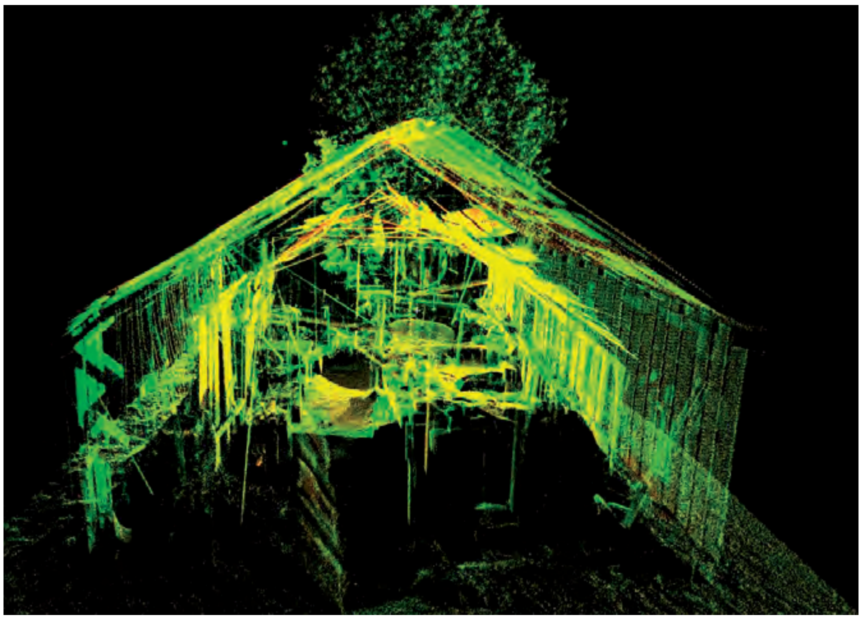

**Fig 6. The Smithy - Wagener Subritzky Homestead 1860. (Photo: Archifact Limited)**

**Fig 7. Laser scan of the Smithy - Wagener Subritzky Homestead 1860, revealing the building within the building. (Photo: Archifact Limited)**

Within some of those buildings existed important artefact collections. In order to understand this special spatial arrangement, to guide its conservation, and to respect its particular heritage values, including those expressed by its imperfections and its distinctive hand-made qualities the structures were scanned using a Leica HDS 3000.

The complexities and compelling richness exhibited in the remnant structure of the original 1860 smithy building and its artefact collection within the 1960 weather-shielding building erected around it presented a series of challenges not uncommon to those faced at many sites of polar heritage. Again, HDS enabled non-destructive survey which provided a degree of accuracy that meant the distinctive nature of the irregular structure was easily recorded as a three-dimensional virtual data model from which conventional drawings including plans and sections at any point could be determined.

**Known unknowns 3**

The adaptive reuse of this listed historic radio and television recording studio building originally built in 1934 included conditions of consent for that adaptation which required the reinstatement or reconstruction of the original entry lighting pylons, which had disappeared some thirty years earlier. Having found the original pylons, but unable to secure their return from private ownership, the option of reconstruction became the focus in order to satisfy the consent conditions. However negotiations with the owners of the original pylons having collapsed rather acrimoniously, and with rumours of the original patterns for the bronze-work surviving being frustrated by the discovery of only some elements, our instructions were to provide documents that would enable the tendering and reconstruction of new pylons based exactly on accurate survey of the originals, but without physically touching them.

A combination of factors including the fact of the original pylons being placed on a public boundary, their inherent symmetry, and our use of HDS meant that we were able to prepare documents describing the work for tendering and construction purposes in a digital format and at a 1:1 scale in hard copy, without touching the originals. Tendering of the new pylons successfully resulted in a tender being let and the commission for the casting of new pylons which now grace the entry of the historic building to the satisfaction of the consenting authorities, the building owner and occupier and passing tour guides.

**Unknown unknowns**

The examples discussed above illustrate a range of scales, recording resolutions, and access and visibility constraints that helped determine HDS suitability. Most laser scanners have the ability to collect billions of points of data in a short period of time; the speed of recording differs depending on the required resolution and type of scanner used. Different scanners have different operating ranges, power requirements, laser power, fields of view, on-board cameras, distance and positional accuracies, operational environmental temperature ranges, atmospheric moisture sensitivities, surface reflectance, and interoperability with other survey equipment[3]. Criteria such as required survey resolution, survey time, and the scale of the target are the common determinant factors in the selection of scanning instruments, which include line-of-sight, structured light, and phase-based scanners. In polar regions the capacity of equipment to function properly in an extreme climate is another critical consideration.

Multidisciplinary research necessitates recording at a range of survey resolutions where the resolution range determines whether one or more instruments might be required. This may be recording at a micron level to measure levels of biological and non-biological deterioration such as the growth of fungal spores or wood defribration; recording portable artefacts and the interior of historic huts with millimetre accuracy; or recording the external context with centimetre accuracy. The trade-off between resolution and available scanning time in the field will often influence survey design. This is particularly apt in polar regions where particular constraints are imposed by the environmental and geographic contexts and operational logistics.

Because scan data recorded at different resolutions can be registered in the same three-dimensional coordinate geometry, the ability to model at different resolutions, and to integrate data from different scanners, permits the investigation of different spatial contexts. This includes the combination of terrestrial and airborne scanner point cloud data. Over time, repeat scanning and modelling introduces the capability to model temporal change at any given scale. The efficacy of previous and future conservation work can be measured against the data and corrections made to inaccurate data. Retrospective modelling is also possible where historic source data such as photographs can be rectified to existing surface scans.

[3] www.pobonline.com/POB/Protected/Files/PDF/POB0506_LaserScanningSurvey.pdf - 2006-05-01

By making a baseline set of accurate high resolution data available through a shared digital repository such as CYARK[4] we hope to encourage the dissemination and use of the data, not only amongst our core group of collaborators, but also to other researchers with common goals in conservation and science. Access to this data can be controlled to protect the data from misuse and the underlying data will always retain its integrity as a source dataset where users can modify iterations of the data to suit their individual purposes, such as reducing the density of points in a point cloud or extracting segments of data specific to a researcher's needs. Data sharing provides accessibility for other experts to model and experiment with the data and reduces the pressure on the heritage resource by reducing the need for repetitive survey by different expeditions.

Production of a high-resolution as-built three-dimensional digital model establishes an archive of the subject over which high-resolution digital photography can be draped to provide photorealistic three-dimensional models for remote and virtual interpretation. Digital photography may be acquired from on-board cameras built in to many scanners or texture mapped from external sensors. The overlay of historic imagery and film into the 3d scan environment extends the interpretative potential beyond the realms of simple photorealistic rendering and allows the (re)introduction of a human context into the modelled environment which extends the model's basic measurement parameters. Because these environments are largely unmodified since the Heroic Era we can incorporate imagery from this period and retain a comparative measure or realism. A virtual environment offers potential for development of a 3d inventory to manage and administer complex heritage spaces that have dense assemblages of artefacts such as the Heroic Era Ross Island huts.

**Conclusion**

It has not been long since the technology that supported the PacMan© game was seen as a sophisticated example of coding and computer graphics. Today we marvel at the graphic detail and interactivity provided in games designed for the home entertainment market. Adding interactivity by building virtual reconstructions using underlying gaming engines to navigate these environments will enable users to explore the sites and structures of polar heritage that were previously out of reach to the majority of people. The level of integration of data into these models is not necessarily limited by the technological challenge of coding and modelling the virtual environment, but more so by the difficulties in locating and accessing artefacts and historical media that could be digitized and included in such models, and issues of copyright that might be encountered. The availability of high bandwidth is an impediment to the fast transmission and accessibility of the data via the Internet, although this is partially offset by the exponential growth in computer graphics power, resulting in faster platforms to explore virtual data models.

HDS provides an ability to quickly and accurately capture high-resolution data with the safety and convenience of remote acquisition and measurement. It is appropriately applied in environments such as in Antarctica, and particularly to sites such as the Heroic Era Huts of the Ross Sea where there is a high density of objects and where the pressure of traditional measurement might impact upon historically important and environmentally fragile environments.

[4] http://archive.cyark.org/

# ROSS SEA HERITAGE RESTORATION PROJECT: TECHNOLOGY, INNOVATION & PUBLIC ENGAGEMENT

Nigel Watson

The historic bases of British explorers Robert Falcon Scott and Ernest Shackleton on Ross Island and Carsten Borchgrevink's huts at Cape Adare still stand after a century of exposure to the Antarctic conditions. New Zealand has cared for these sites for over half a century. Since its creation the New Zealand charity, Antarctic Heritage Trust, has been working on behalf of the international community to conserve this heritage for both current and future generations. As a not-for-profit organisation, its mission is to both conserve and inspire people with this legacy.

As a result of the Trust's efforts, the sites are now protected under the provisions of the Antarctic Treaty System. Anywhere else in the world they would undoubtedly attract World Heritage status but, as the United Nations reach does not extend to the Antarctic, this has prevented their listing. Notwithstanding, the Trust has worked to ensure these remarkable monuments are appreciated internationally. The World Monuments Fund has thrice listed the sites on their 100 Most Endangered Sites on Earth and several famous and high profile supporters from Britain, New Zealand and beyond have spoken publicly on the importance of these sites and the Trust's work. For not only do the sites represent the only examples left on any continent of human's first dwellings, but they also stand as monuments to the values and spirit of adventure, exploration, discovery and scientific endeavour.

By the turn of the 21st century the Trust was faced with the realisation that despite best efforts to date, it was losing the battle to save this heritage and comprehensive action was needed if the buildings and their contents were to survive for the next generation.

In response, in February 2002 on the centenary of the building of Scott's Discovery Hut at Hut Point, HRH The British Princess Royal visited Antarctica specifically to launch the Trust's Ross Sea Heritage Restoration Project to save these sites. Two summers of site surveys and detailed analysis followed with comprehensive conservation plans for the buildings and the contents produced by an international team of leading polar and heritage experts. Funded by The Getty Foundation and the New Zealand Government, and after consultation with the international community, these plans set the platform for the conservation work itself.

Managed in-house by dedicated staff, and with a year-round presence in Antarctica, the project has drawn on teams of conservation and heritage experts from around the world. The Trust's brief to the specialists working on the project has been to provide innovative and world-class solutions to the conservation challenges posed by these internationally significant heritage sites located at high latitude.

**Resumen**

El proyecto de la Fundación de Restauración del Patrimonio del Mar de Ross de la Fundación del Patrimonio Antártico de Nueva Zelanda, incluye las bases históricas de isla Ross de los exploradores Robert Falcon Scott y Ernesto Shackleton (Cabo Royds) y la cabaña de Carsten Borchgrevink´s en Cabo Adare. Tiene por principal objetivo adoptar medidas de salvataje y recuperación de estos sitios. La primera etapa -de un programa de conservación a cuatro años de la cabaña de Shackleton- ha concluído. El edificio se encuentra estructuralmente seguro e impermeabilizado. Hasta el momento, más de 30 profesionales del patrimonio de varios países han permanecido en el hielo durante distintas temporadas.

Por otro lado, en la lista mundial de conservación, aparecen muchos grupos internacionales que han estado trabajando en el Mar de Ross, desde 2006. Se han realizado trabajos de conservación de objetos al interior de las cabañas, durante los meses de verano y, en la base neozelandesa de Scott, los trabajos se han efectuado durante el invierno. Se ha logrado conservar más de 5000 artefactos de la cabaña de Shackleton y 3500 piezas de la cabaña de Scott, en Cabo Evans y se ha implementado un sistema de administración de colecciones. Un proyecto paralelo desarrolla Nueva Zelanda para conservar cerca de 1000 especímenes recuperados de los sitios.

En Cabo Evans, un programa que comenzó en 2008, lleva seis años de intenso trabajo, esperándose que de aquí a tres años la cabaña quede impermeabilizada y estabilizada estructuralmente. Los trabajos incluyen remosión de nieve y hielo, reforzamiento de pilares, reemplazo de vigas colapsadas, instalación de deflectores de nieve, levantamiento del piso interior, reforzamiento de radier y reinstalación del piso y linóleo originales. El blog del Museo Británico de Historia Natural cubre las actividades del equipo de conservadores de la Fundación, desde el año 2006. Asimismo, tours virtuales pueden realizarse en el sitio Web de la Fundación. Mas detalles en www.nzaht.org

**The Trust's Project is well advanced.**

The first stage of the project is complete with an intensive four-year programme of conservation at Shackleton's hut at Cape Royds now finished. The building is structurally secure and weatherproofed. Work included overlaying the modern roof covering with canvas and the original battens re-laid. Conservation and repairs were undertaken on the timber cladding and Mawson's laboratory was relined. Over forty cubic metres of ice was removed from under the building. During the process crates of whiskey and brandy left by Shackleton's men were excavated from under the building sparking global media interest. A waterproof membrane was installed to ensure that summer melt water flows around, rather than underneath, the building. Contemporary windows and a door were replaced using historically accurate materials and based on original architectural drawings. Stacks of decaying expedition provisions located around the exterior walls were temporarily removed for inspection and treatment to be returned to site. The bunks inside the building were reconfigured, based on original photos and diaries, to more accurately reflect Shackleton's occupation. Minor works are planned for the stables and garage area in the coming years.

In a world first for conservation, international teams of conservators have, since 2006, been working year round in Antarctica. They work on site at the huts in summer and at New Zealand's Scott Base in winter, undertaking the planned conservation programme for the artefact collection. Over five thousand objects from Shackleton's hut have been conserved and a collection management system implemented.

A parallel project has run in New Zealand to conserve nearly a thousand objects recovered from the sites in the 1980s.

Meanwhile at Cape Evans, the task is more daunting with several more thousand objects and much more difficult conditions. At the height of the problem, ice had turned to water and flowed through the building before refreezing, leaving the wardroom table and many other objects stuck in ice. Water had flowed and refrozen under the building buckling the floor. A wall of snow behind the building was literally burying the building, threatening to push it off its foundations, and had already collapsed rafters in the stables from the massive snow drifts.

An intensive work programme commenced in 2008 and three years on and the hut is structurally sound and weathertight. Work to date includes the installation of weatherproof and waterproof membranes along the southern, eastern and western walls and general repairs to the cladding, particularly around the western wall. Modern windows on the northern and southern aspects have been removed and replaced with the original

**Fig. 1.** An example of the snow and ice build up which has threatened Captain Scott's base at Cape Evans in recent years. South West corner, September 2004. (Photo: AHT)

**Fig. 2.** The Southwest corner of the base following snow and ice clearance and the installation of the generators. February 2009. (Photo: AHT)

Fig. 3. With snow and ice build-up threatening Captain Scott's base, 5 Vortex generators have been installed behind the base at Cape Evans. The generators disturb the wind flow which creates turbulence and the effect is intended to minimise the snow accumulation against the southern and eastern aspects. Although we are in the early stages of the snow and ice mitigation measures, we are already seeing positive results. (Photo: AHT)

windows. The first phase of the long-term snow and ice mitigation measures has been successfully completed. Over a thousand cubic metres of snow and ice have been removed from around the building, the stables have been reinforced and collapsed rafters replaced. Snow deflectors (vortex generators) have been installed to test minimising snow build up around the building. In a major undertaking the internal floor was lifted, over seventy cubic metres of ice removed and the subfloor framing strengthened before the floor was re-laid, including the original linoleum, all in its original position.

Fig. 4. The conservation carpentry team and the custom built drum used to roll the lino and expose the floorboards at Captain Scott's base at Cape Evans. (Photo: AHT/J Stefan)

Fig. 5. With the lino and double skinned timber floor lifted, the wooden sub-floor and accumulated ice is exposed. (Photo: AHT/J Stefan)

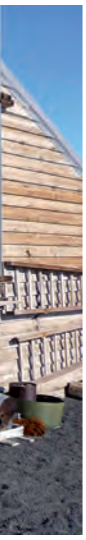

Fig. 6. The same area after an estimated 50 cubic metres of ice has been removed. (Photo: AHT/G Macdonald)

Fig. 7. Conservator Anna Shepherd working from the Trust's custom built mobile conser-vation lab at Captain Scott's base, Cape Evans. (Photo: AHT/G Macdonald)

Fig. 8. Conservator Lucy Skinner working at Scott Base, Antarctica, on a corkscrew from Captain Scott's base, Cape Evans. (Photo: AHT)


Fig. 9. Conserved provisions from Captain Scott's base, Cape Evans. (Photo: AHT)

Since mid 2008, teams of conservators have been woring year round in Antarctica, both on site and at New Zealand's Scott Base, undertaking the planned conservation programme for the more than eight and a half thousand artefact collection from Cape Evans. By May 2010, more than three and a half thousand artefacts have been conserved and returned to site.

To date over thirty heritage professionals from around the world have spent the long dark winters or endless daylight summers on the Ice.

The logistics for the artefact conservation programme have involved carefully sledging caches of objects across the seasonal sea ice to New Zealand's science facility, Scott Base, to enable them to be treated by the Trust staff over the dark winter months. The Trust designed and built a dedicated conservation facility at Scott Base to enable this work to be undertaken. Meanwhile over the summer months the Trust's teams deploy to site. Initially by tracked vehicle across the sea ice, and later in the summer by helicopter when the sea ice to Evans and Royds is unstable, the Trust's teams of conservators and heritage carpenters spend several consecutive weeks on site, working on the collections and building fabric respectively. A dedicated camp with a custom built conservation laboratory and workshop made from converted shipping containers has been positioned on site. Long supply chains, a small team of people, demanding and often dirty work, close quartered living and working conditions, and tenting out for weeks on end in the polar environment, have meant a challenging but exhilarating mix.

The challenge of connecting with the public on this remote project has been made more difficult because of the months of darkness and inaccessibility to the sites for most of the year and limited communication and bandwidth from Antarctica. The Trust has sought to innovate ways to foster public engagement. This has included leveraging the stunning stories, context and imagery and use modern technology to stimulate the public's imagination. Specifically, the Trust has sought to internationalize the appeal of this heritage through working with the likes of The World's Monuments Fund and the British Natural History Museum. The hugely successful British Natural History Museum's blog has followed the life of the Trust's team of conservators living and working in Antarctica since 2006. In detailing their activity and conservation work online it has allowed people to interact with the teams in Antarctica.

The Trust has also created virtual tours on the Trust's website, www.nzaht.org so people can have sense of what the heritage is like and ensured the Trust's work is detailed in a replica site in Auckland. Finally the Trust has leveraged opportunities to fund conservation work with corporates which want to be associated with the Trust's work or Antarctica.

As a charity, the Trust relies on funding to undertake its work. With fantastic support to date from the international community including foundations, governments, corporations and individuals, the Trust is leading the way in cold-climate heritage conservation. There is much left to do.
More details on the Antarctic Heritage Trust's work are available at www.nzaht.org

# GEOGRAPHIC AND TECHNOLOGICAL INFLUENCES ON THE LOCATION, NATURE AND CONSERVATION OF NINETEENTH CENTURY SEALING SITES IN THE SOUTH SHETLAND ISLANDS

Michael Pearson and Rubén Stehberg

**Resumen**
Las islas Shetland del Sur constituyeron el primer lugar del territorio antártico en ser explotado por cazadores de lobos y focas, en busca de sus valiosas pieles y grasa para elaborar aceite. Esta actividad se desarrolló desde 1819 en adelante. Producto de estas ocupaciones, se establecieron instalaciones humanas caracterizadas por construcciones en piedra y ocupación de cavernas. Muchos sitios han sobrevivido y están siendo paulatinamente identificados y estudiados.

**Abstract**
The South Shetland Islands were the location of the first human exploitation of Antarctica, sealers gathering fur seal skins there from 1819 onwards. Many human settlement sites in the form of simple stone hut ruins and occupied caves resulted from sealing. Many of these survive, and are being progressively identified and surveyed.

The location and nature of the sealing sites was influenced by a number of factors:

- The known or suspected location of seal-breeding beaches;
- The degree of danger involved in approaching the beaches from the sea;
- The limited materials and technological aids able to be deployed to sealing locations; and
- The lack of incentive for sealers to move away from the coastal strip.

The paper looks at these factors, and relates them to the nature and location of the sealing settlement sites, the range of conservation threats imposed by locational factors and the original technology available to sealers (such threats include site decay due to animal disturbance, erosion, tourism and scientific party activity, and sea level change), and the range of conservation actions appropriate to these locations and threats.


**Background**
The South Shetland Islands were the site of the first known human habitation and exploitation of Antarctica. The discovery of the archipelago in 1819 opened the way for the exploitation of the fur seals that bred there, bringing the Antarctic into the fur sealing trade which by that date was already global in scale (see Busch, 1985; Headland, 1984; Richards, 1982; Cumpston, 1968; Kerr, 1976).

News of William Smith's discovery of the South Shetland Islands in 1819 was soon the subject of speculation in the ports of Valparaiso and Buenos Aires, and quickly reached New England (USA) and British ports. Even before Smith's discovery was officially confirmed, sealing captains based in Buenos Aires were in search of the new islands (see Stehberg 2003; Pearson and Stehberg 2006; Zarankin & Senatore 2005; Zarankin & Senatore 2007 for a more detailed background to sealing in the South Shetlands).

The intensity of sealing in the summers of 1819-20 and 1820-21 was such that the population of fur seals in the islands was dramatically reduced, and the first phase of sealing effectively ceased by 1827. It has been estimated that 144 ship-based sealing expeditions worked in the South Shetland Islands between 1819 and 1827, 120 of them in the first three seasons 1819-22 (see Pearson and Stehberg 2006 for a detailed analysis). The overwhelming majority of the ships were from either New England ports or from Britain, though at least two came from the Australian colonies.

These ships took a minimum of 300,000 fur seal skins, and perhaps as many as 800,000 or 900,000 skins (see Pearson & Stehberg 2006 for further analysis). There is no estimate of the total amount of elephant seal oil obtained.

A handful of vessels sealed opportunistically in the South Shetlands in the 1830s and 40s while *en route* to other sealing or whaling grounds, and American sealers worked the islands in the early 1850s and again in the 1870s, when in the order of 40,000 skins were taken. Nova Scotian sealers took advantage of the slight recovery of seal numbers by the first decade of the 20th century (see Pearson, Stehberg, Zarankin, Senatore and Gatica, 2008).

**The location and nature of occupation sites**

The South Shetland Islands have coastlines that range from broad flat glacial outwash plains fringed with gravel beaches (as on the Byers Peninsula of Livingston Island), to vertical glacier terminal icefalls and rocky cliffs (most of the island coastline). Between these extremes are areas with small rocky coves flanked by cliffs or glaciers (as on Rugged Island), and narrow wave-washed beaches at the foot of glacier termini or cliffs (as on Elephant Island). The sealers tested all of these locales for fur seals, but surviving habitation sites are restricted to the more protected coasts where shelter could be found a safe distance from the shore and where seals were found to gather in numbers, necessitating the construction of shelters in order to exploit them over time.

To add to the difficulty of sealing, the rugged coasts and wild seas of the South Shetland Islands made safe anchorages for sailing vessels extremely rare. As a result sealing crews were dropped ashore by boat and left for periods ranging from days to months, and on at least two occasions, by mischance, for over a winter (in the case of seal-

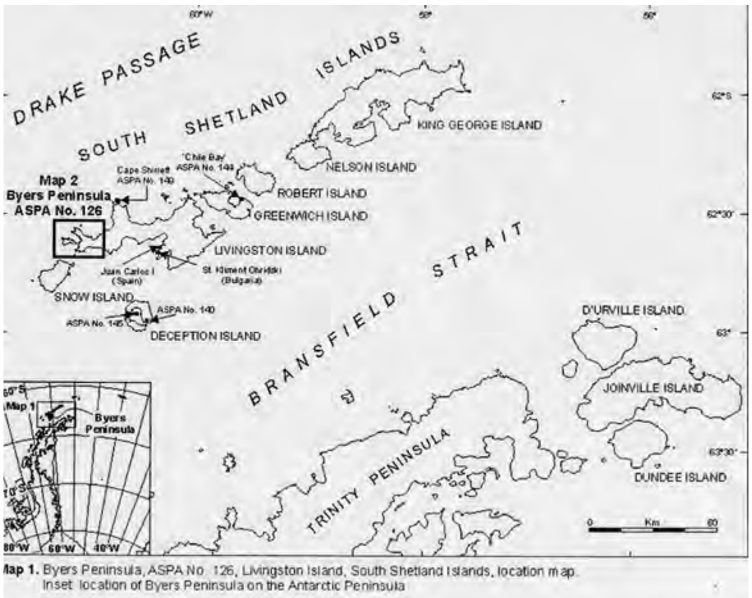


Fig. 1.
South Shetland Islands.

Fig. 2 .
Lima Lima cave, Byers Peninsula. Photo: Michael Pearson

Fig. 3. Inside Lima Lima cave. Photo: Michael Pearson

ing crews from the *Lord Melville* in 1820-21, and the *Florence* in 1876-77). These men were, coincidentally, the first humans to winter in Antarctica, and not the explorers of turn of the century as is generally assumed.

Once ashore the men built shelters in caves, against cliff faces, or on open beaches, piling up dry-stone walls and roofing them with beams made of timber brought ashore from the ship or whale ribs from skeletons scattered on the beaches, the beams being covered with tarpaulins or seal skins. Roofs were formed by simply laying the beams horizontally from wall to wall, with no evidence of any attempt to build frames or trusses, or to use internal posts to support a ridge. This method limited the width of the huts to the length of the available roof beams, the shelters generally having maximum spans of 3m or less, and in a few rare examples the shelters extended up to 5m in length. In some sites there are multiple structures, presumably to house larger crews and their gear. Often coastal voyages were made in whaleboats to hunt small numbers of seals in isolated coves and beaches around the islands, returning to the main camp site to clean and peg out the skins to dry, and to salt them down.

Over 50 sealing sites have been identified by Chilean, Argentine, British and Australian researchers

Fig. 4. Excavation of sledge Punta Diablo, Byers Peninsula. Photo: Michael Pearson

over the past 50 years. Several sealer structures have been excavated, and a program of systematic survey of the islands continues (see Pearson & Stehberg 2006; Stehberg 2003; Zarankin & Senatore 2005; 2007; Pearson, Stehberg, Zarankin, Senatore and Gatica 2008). These occupation sites are almost always located within 100 m of the sea. Surviving sites include occupied caves. On the little-visited Rugged Island, a cave was located that had been totally undisturbed by humans since the 1820s, until located and excavated in 2005. The site had timber artefacts and seal-skin moccasins lying on the surface, and bottles scattered around the fireplaces (Pearson and Stehburg 2006). In more frequented areas (such as at Byers Peninsula) caves are obvious to visiting parties and have been extensively disturbed, as in the case of Lima Lima cave (Zarankin & Senatore 2007). Some caves have stone walls constructed across the rear section to provide more shelter for the occupants. The stone-walled structures against cliff faces and on open beaches are often largely undisturbed (but see below), the cultural deposits and collapsed roofs being buried in wind-blown sand. Occasionally large objects are also found embedded in the sand, such as a wooden sledge excavated in 2007 (Pearson, Stehberg, Zarankin, Senatore and Gatica 2008). The largely undisturbed nature of the sites reflects the isolation of the islands and the very low human visitation after the sealing era.

The factors influencing occupation site location include:

- The proximity to beaches frequented by large numbers of seals;
- Sites for shelters safe from storm waves or ice falls;
- Boat access from the sea;
- Locations with a good view across the beach (to detect both seals and rival gangs);
- Access to drinking water (usually available near every beach)
- Access to stones to build a hut or a cave to occupy;

The land beside the few safe anchorages in the islands were occupied by shore gangs from the ships harboured there, and a number of ships were sunk at anchor by storms and their crews had to survive ashore until rescued.

**The limited materials and technological aids able to be deployed to sealing locations**

A number of factors influenced the form of the occupation sites in the South Shetlands. Many sites were only occupied once for a very brief period, perhaps a couple of weeks, so the time required to build elaborate huts was not an effective use of that time. Even if more sophisticated structures had been desirable, the problem of access to materials prevented it. In almost all cases the supplies landed with the sealing crews had to be

Fig. 5.
Natural material such as whale ribs were used for building.
Photo: Michael Pearson

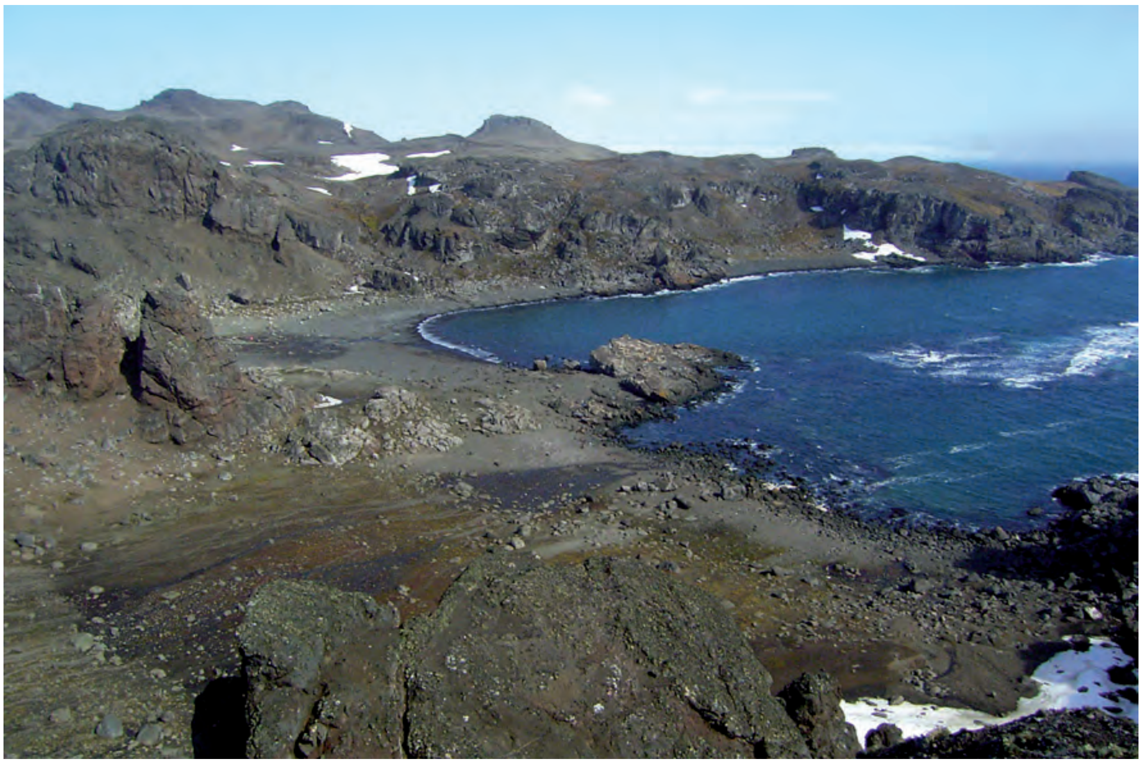

Fig. 6 . Camp beach as seen from the plateau, Rugged Island. Photo: Michael Pearson

shuttled ashore on small and lightweight whaleboats from a sealing ship hove-to at sea beyond the rocks and reefs universally found along these shores. The size and weight of building materials able to be landed was therefore extremely limited. The natural building materials available on the islands were limited to stone, whale ribs and bones, seal skins, and the occasional piece of flotsom and jetsom washed up on the beach.

Furniture was not landed, so whale vertebra were commonly used as seats and tables, and have been found in a number of sites. Sealskins were used as mattresses. Cast iron stoves were heavy and few appear to have been landed, and those landed were clearly highly valued. One has been excavated outside a sealing shelter on Rugged Island, where its location in disassembled pieces between the shelter and the sea is interpreted as suggesting that it was to be transhipped to another site, but left behind as being too heavy (Pearson & Stehberg 2006).

A very limited amount of food was landed with the sealers. Archaeological evidence indicates the butchered bones of domesticated animals, presumably from salt meat, and barrel staves and lids have been found in which salt provisions and possibly flour were stored. Seal meat and penguins provided local food supplies. Elephant seal liver, heart, tongue and flippers were favourites mentioned in the 1820s (Richards 2007: 283). The most common fuel was seal blubber, but coal was landed, probably for forges, and has been found at a few sites.

Clothing was extremely basic by modern polar standards. Leather, canvas, serge and knitted wool have all been found in archaeological contexts, and there is much evidence of the making of moccasins from fur seal skins to replace rotting and worn shoes (Pearson & Stehberg 2006; Zarankin & Senatore 2007; Saleno 2006). The clothing is that of the merchant seaman of the time, and would have resulted in severe hardship in Antarctic conditions.

**The lack of incentive for sealers to move away from the coastal strip**

A characteristic of the evidence of nineteenth century occupation in the South Shetlands is that it is all pretty much limited to the coastal strip. There was no real reason for sealers to move away from the coast. The hinterland of the South Shetland Islands has no resources that were needed for survival or to make a profit. The seals, the reason for the sealers being there at all, were always beside the sea, as was most flat land for pegging out skins to dry. Relief and supplies came by ship, the arrival of which the sealers would not want to miss by being far inland. On the Byers Peninsula historical evidence indicated that at least some gang leaders crossed the peninsula to visit gangs on the other side, a cross-country walk of at least four kilometres and more often five or six, but this is an unusual case where both shores were occupied and the hinterland could be crossed on foot. In most other localities the opportunity to move away from the coast was very limited by icecaps and glaciers.

**The range of conservation threats imposed by locational factors and the original technology available to sealers**

The context, then, for conservation of the sealing sites on the South Shetlands is one characterised by:

- Sites being located on exposed beaches that experience modern human traffic;
- Sites being located in the midst of areas where wildlife comes ashore and breeds;
- Sites being in areas with high natural and wilderness qualities;
- Under the unique Antarctic Treaty system, sites often having no accepted national custodian to take responsibility for their conservation;
- Slowly developing knowledge about the location of sites, and no automatic system to convey that information to tourist or national scientific parties;
- Some sites vulnerable to the impacts of climate change.

Many of the sealing sites are exposed to severe weather conditions on open beaches that are also the home of some very large animals. Some shelter sites get knocked over by passing seals, and are used as rubbing posts by moulting seals. Some are either eroded by or buried by the activities at penguin rookeries. Others get covered and buried in wind-blown sand. Some site are located very close to sea level on the 'soft' shores of protected lagoons, and are very much at risk of rising sea levels and increased storm surge that are the predicted outcomes of climate change.

One of the implications of the coastal focus of the industry is that the sealing sites are located where most of the modern human activities also take place, near the shore. Scientific parties and tourist parties land on beaches from the sea or helicopters, and most scientific base camps are located near the coast. As we have seen, the sealing occupation sites are made of simple local materials, and in many cases have been eroded and broken down over time. These archaeological sites, which are often hard to see without prior knowledge of their existence, are at risk of trampling and disturbance from human traffic and camp-related activities.

A reasonable assumption might be that tourist visitation, which has expanded enormously over the last decade, is a major threat to these vulnerable sites. However, our observations are that at the moment the greater threat is from scientific parties carrying out research on the many islands of the archipelago. The tourist parties are usually very well briefed and aware of sites if that information has been made public. They make very short visits at a limited number of landing places, where management of threatened sites can be undertaken and impacts readily monitored. And tourists are usually escorted in more-or-less supervised groups.

Scientific parties, on the other hand, get to many islands where tourist don't land, they spend much more time ashore, they are not supervised, and despite the supposed access to information about the

Fig. 7. In many cases sites have been eroded over time. Punta Diablo, Byers Peninsula. Photo: Michael Pearson

Fig. 8. Sites are vulnerable to collateral damage. Playa Sur site, Byers Peninsula. Photo: Michael Pearson

protected status under the Antarctic Treaty of many sealing sites, many parties appear to be ignorant of their location, importance and protection. This makes the sites very vulnerable to inadvertent 'colateral' damage from camping and scientific survey work. A case in point in recent years is the use of a shelter site as a pad for geological drilling into a cliff face on Beyers Peninsula (Pearson et al 2010).

**The range of conservation actions appropriate to these locations and threats**

Conservation actions have to be considered in the light of the issues described above. Any physical conservation of sites would have to be low-key for a number of reasons. The sealing sites are simple minimalist shelters that could easily lose their critical connection with their locality by heavy-handed conservation works. Similarly, new structures, such as seal fences or protective shelters, or engineering responses to sea level changes, could also be discordant in an area of high wilderness and scenic value, and could disrupt or be a physical risk to wildlife. Besides which, most sites do not need conservation through physical intervention as much as they need protection from further disturbance.

A major challenge is to get recognition of the sealing sites through the Antarctic Treaty system. None of the sealing camp sites in the South Shetlands are currently included in the List of Antarctic Historic Sites and Monuments identified under the Antarctic Treaty process because no member party has nominated them. Some areas where sealing sites are located are now Antarctic Specially Protected Areas (such as the Byers Peninsula), but while the historic significance of the sealing sites is recognised as one of the values of the ASPA, information provided to visiting scientific parties for the protection of the ASPA does not include maps showing the location of sites. So sites remain at risk because they may not be recognised by parties working or camping around them.

The improvement in information flow, through the ATO system, to tourist operators, station leaders and scientific parties is potentially one of the most worthwhile conservation actions that could be achieved. Nobody visiting or working in Antarctica has the desire to knowingly damage an historic site, but ignorance of their location and importance may well lead to inadvertent or misguided damage. This is where most effort is currently being put, through the publication of reports, and the ongoing efforts by Chile and the ICOMOS International Polar Heritage Committee to improve the recognition of sites and the provision of appropriate information through the Antarctic Treaty System. Efforts are also focussed on making the Antarctic Treaty System more responsive to the management needs of cultural heritage sites, and to introduce a values-based assessment and management regime that parallels the advances in conservation practice elsewhere in the world.

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# LOG-BUILDING REHABILITATION AT THE HISTORIC STEELE CREEK TOWN SITE, ALASKA

Robin O. Mills

**Summary**

This paper outlines the efforts that the U.S. Bureau of Land Management (BLM) has put into rehabilitating the surviving historic buildings at the Steele Creek town site, an abandoned settlement in Alaska. The site is located at the mouth of Steele Creek, on the main stem of the Fortymile River, inside of the congressionally-designated Fortymile National Wild and Scenic River corridor. Founded in 1898 and largely abandoned by 1951, Steele Creek provided goods and services to travelers moving through this area of eastern interior Alaska. Among the four remaining log buildings at the site is the Steele Creek Roadhouse, a building on the U.S. National Register of Historic Places, and the oldest standing building in Alaska's Fortymile River drainage. Following a condition assessment of all of the buildings in 2002, the BLM initiated a multi-year program of saving the buildings from further degradation and eventual collapse. For much of the remainder of the decade, work crews visited this remote setting to rehabilitate the buildings, including employees from the BLM and other U.S. federal agencies, as well as architectural preservation volunteers associated with the Teacher Restoration Corps and HistoriCorps. Amongst the myriad tasks performed at the site over the years, the most urgent involved replacing the sill logs and lower wall logs of all of the buildings' walls, a feat made more impressive because of the site's isolation which prevented the use of heavy machinery from reaching the locale. Although further work of course needs to be done, the buildings are no longer threatened with imminent collapse.

**Resumen**

Este artículo describe los esfuerzos que el U.S. Bureu of Land Management (BLM) ha puesto en la recuperación de los restos del edificio histórico del sitio Town Steele Creek, una instalación abandonada de Alaska. El sitio está localizado en la desembocadura de estero Creek, un afluente principal del río Fortymile, dentro del área que el congreso ha designado como de corredor escénico y área silvestre nacional Fortymile. Esta instalación fue fundada en 1898 y abandonada alrededor de 1951. Steele Creek proveía bienes y servicios a los viajeros que cruzaban esta área del interior oriental de Alaska. Entre los vestigios de los cuatro edificios principales del sitio está Steele Creek Roadhouse, un edificio del U.S. Nacional Register of Historic Places, y el antiguo edificio aún en pie en el drenaje del río Fortymile. De acuerdo a una evaluación de los edificios efectuada en 2002, el BLM inició un programa de varios años para rescatar los edificios de la degradación y de un eventual colapso. Por más de una década, grupos de tarea junto a empleados del BLM y otras agencias federales americanos, así como voluntarios de conservación arquitectónica asociados con Teacher Restoration Corps e Histróric Corps, visitaron este remoto asentamiento para rehabilitar los edificios. Entre las múltiples tareas desarrolladas en el sitio a través de los años, el tema más urgente consistió en el reemplazo de las vigas dintel y de las vigas en la base de todos los muros del edificio; una hazaña si se tiene en cuenta el aislamiento del sitio que impidió el acceso de maquinaria pesada al lugar. Aunque se requiere mucho más trabajo, los edificios ya no corren riesgo de colapso inminente.

**Historic Background**

Alaska's historic Steele Creek Community (49-EAG-00144) is situated at the confluence of Steele Creek and the Fortymile River, inside of the Fortymile National Wild and Scenic River corridor, managed by the Bureau of Land Management (BLM), a United States federal land managing agency. The site is found in the eastern interior part of Alaska, about 160 miles south of the Arctic Circle.

It lies approximately six miles downstream from the main bridge over the Fortymile River, which is located on Alaska's Taylor Highway at MP 112.7. The principal building at the site, both historically and today, is the roadhouse, which was originally built by a man named Anderson in 1898. He operated the establishment until 1908, when he sold it to John A. Kemp and his wife, who operated the roadhouse and served as postmaster from 1908 to 1932. The roadhouse traded hands several more times between 1932 and 1948, at


Figure 1. Location of the Steele Creek town site in eastern interior Alaska. (Photo: BLM Alaska)

which time it was sold to Robert and Ruth Wilson, who continued to operate the establishment into the early 1950s. The construction of the Taylor Highway, finished in 1951, bypassed the site and signaled the final demise of the roadhouse and what was left of the community. The Wilsons continued to live at the site until the mid-1960s, after which point the roadhouse and other remaining buildings were occupied by a placer gold miner who filed a mineral claim on the lands under and around the site. The lands along the main stem of the Fortymile River became part of the Fortymile National Wild and Scenic River corridor in 1980, after passage of the Alaska National Interest Lands Conservation Act. The Steele Creek mining claim was relinquished to the federal government in 2002 when the last contemporary miners left the site.

In its day, the small settlement at Steele Creek served vital transportation needs along the chief overland trail between the historic towns of Eagle, along the Yukon River, and Chicken in the Fortymile drainage, providing basic services for traders, freighters, and other travelers throughout the first half of the 20th century. The roadhouse also served as an important social gathering place for the local populace during holiday festivities up until around World War II. Along with the roadhouse, the site also had a store and the necessary facilities to handle the travelers' sled dogs and horse teams. A Post Office operated at the site from 1907 until 1951.

The Steele Creek Roadhouse (49-EAG-00019), a site on the U.S. National Register of Historic Places, is the largest building remaining at the site. It is two full stories high, and measures 21 x 52 ft (~6.40 x 15.85 m). A 13 ft single-story shed on the western end of the building brings its total length to 65 ft. The building started out as a one-room, single-story log cabin with a gable roof, originally built in 1898. Historic photographs indicate that an additional ground floor room had been built, end-to-end, onto the original cabin by 1905, and that by 1911 a full second story of logs had been added along the whole length of the building. A gabled domestic cabin and single-story sheds with sloping roofs appear adjoining the south and west sides of the roadhouse in subsequent historic photos through the late-1930s. The roadhouse is the only historic, two-story log building remaining in the Fortymile drainage, and is certainly one of the oldest still standing anywhere in the interior of Alaska.

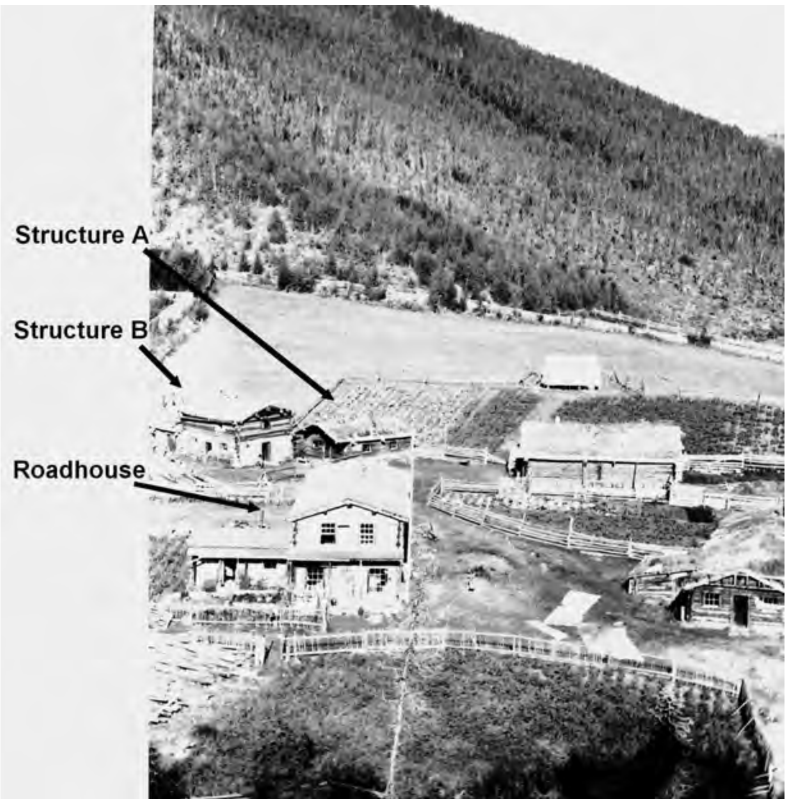


Figure 2. The Steele Creek town site, 1925. Some of the buildings that are still standing at the site are labeled. (Photo: Eagle Historical Society and Museums)

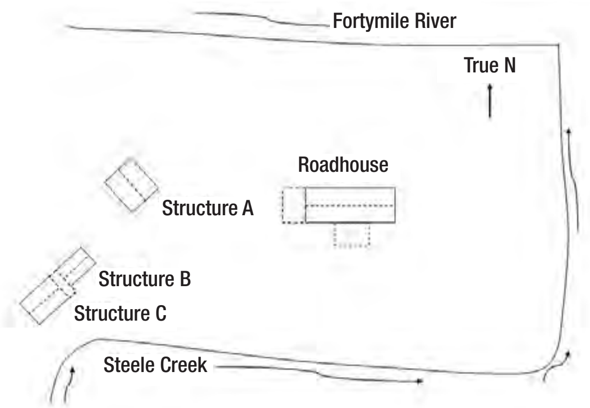


Figure 3. Scale plan view map of the Steele Creek town site, 2010. (Plan: Robin Mills, BLM Alaska)

In addition to the roadhouse itself, three other log buildings are found at the site: "Structure A," "Structure B," and "Structure C," all single-room, single-story log cabins with gable-style roofs.

Structure A measures 20 x 24.5 ft (~6.10 x 7.50 m), and shows up in an historic photograph dating to 1900, indicating that it is at least that old. Structure B is slightly smaller, measuring 13 x 21 ft (~4.00 x 6.40 m). Photographs from 1900 and 1905 do not clearly illustrate the area of the site that Structure B is found, but the cabin *is* seen in one from 1911 as well as those afterwards. Structure C is situated immediately south of Structure B, and measures 17 x 22.5 ft (~5.20 x 6.85 m). While most historic photographs do not illustrate this area of the site, one from 1911 clearly indicates a building in this location *perpendicular to* the extant cabin; i.e., it is not the same building as the one on the site today. Architectural data suggest that Structure C was built much later than the others at the site, probably after the late-1960s. The builder intentionally placed Structure C close to and in line with Structure B, and enclosed the 5 ft space between the two buildings as a shared entryway.

**Rehabilitation Efforts**

Every phase of this multi-year project has been coordinated with Alaska's State Historic Preservation Office (SHPO), a state agency created by the National Historic Preservation Act. Consultation with the SHPO is required of all federal and state agencies regarding different projects' potential impacts to cultural resources on public lands.

During the summer of 2002, Harrison Goodall, a historic architecture preservation specialist, was contracted by the BLM to produce a detailed Condition Assessment Report and Stabilization Plan for the roadhouse and the other standing buildings at the site.

Amongst other things, the report emphasized the extremely deteriorated condition of the lower wall logs of all of the remaining buildings. In short, the cabins' foundations were in terrible shape, as the log walls had been placed directly upon the ground, subjecting them to more than 100 years of rot and insect infestation. In addition, earth had been piled up against the lower outer walls around the sides and back walls of most of the cabins. This was a common practice in the interior of Alaska in the late-19th and early-mid 20th centuries, where it added necessary insulation in a sub-arctic environment, but which unfortunately had less than desirous effects upon the preservation of the logs. The slow creep of soil down the slope adjacent to

Figure 4. The Steele Creek roadhouse in 2009, prior to beginning of the work of replacing the rotten lower wall logs. Western shed in foreground. Note the thick earth berms piled up along the north, long axis wall, and the external braces placed against the north wall in 2003. View from the northwest. (Photo: Robin Mills, BLM Alaska)

Structures A, B, and C also meant that additional sediments became piled up against the western sides of these cabins. As a result, anywhere from one to four wall logs had to be replaced in all of the walls of the three single-room cabins.

The larger roadhouse was in even worst shape. First, the enormous weight of the building had pushed the lower walls logs into the ground as they slowly deteriorated over time. Also, thick earth banks had been purposely built up about 2.5 ft (~75 cm) against the outsides of both long axes of the building, reminiscent of raised garden or flower beds. As a result, at least four, and in one case five, of the lower logs of all long axis walls of the roadhouse were rotten and had to be replaced. And finally, a cabin with a gable roof had been built against the southern long axis wall of the roadhouse by at least 1925, which had been replaced with a sloping roof shed by the late-1930s. This latter shed was still present at the time of our rehabilitation efforts, though in a very dilapidated state. No corresponding structure has apparently ever been built on the opposite, north side of the roadhouse. This continual pressure of pushing against the southern walls for much of the past century, has resulted in the entire roadhouse being pushed northwards, with the top of the second floor displaced about a 1.5 ft (~45 cm) relative to the bottom of the first-floor wall.

Based upon recommendations in the 2002 Condition Assessment Report, the BLM immediately undertook a series of stabilization actions. Prior to beginning actual rehabilitation work on the buildings' foundations, we first sought to arrest the on-going damage and to erect temporary bracing for the roadhouse, the building most threatened with collapse. Work began in the spring of 2003, when all non-historic trash and refuse from the buildings was removed. All of the buildings had been occupied continuously from the late-1960s up to the present time by miners holding valid mineral claims. The roadhouse essentially had become a storage and dump facility, accumulating a huge mass of modern garbage. The amount of refuse in the smaller cabins was little better. Excepting obvious personal items that were set aside, all combustible trash at the site was burned in the spring of 2003, and all non-combustible materials were loaded onto sleds and removed from the site via snowmachines, transported six miles on the frozen river and then several more miles on the closed highway to a staging area, for eventual removal by trucks the following summer. Several days of effort involving five people accomplished this task. At the same time, sled loads full of dimensional lumber were brought in to the site with the snowmachines and sleds, in order to make temporary bracing for the roadhouse later that summer.

Thus, in the summer of 2003 another work crew returned to the site and constructed an intricate and extensive bracing system with this lumber, both inside and outside of the roadhouse, as detailed in the Condition Assessment Report. Other stabilizing efforts accomplished that summer included: resetting the corrugated galvanized metal roof panels on all of the buildings and screwing them down with TrueGrip roofing screws; covering over all existing nail heads and holes in the buildings' roof panels with waterproof caulking; clearing all trees and vegetation away from the buildings; and digging temporary drainage ditches around Structures A, B and C to deflect melt water away from the buildings.

Figure 5. Shoveling away the earth berms and digging a trench to expose the rotten wall logs, north side of the roadhouse, 2009. View from northeast. (Photo: Kevan Cooper, BLM Alaska)

Then began the hard work of rehabilitating the buildings' foundations. In the summers of 2006 and 2007, attention focused on Structures A and B respectively. In 2009 and 2010 work on the actual roadhouse, as well as Structure C, took place. At first, replacement white spruce (*Picea glauca*) trees for the project were harvested locally, but decent-sized trees were quickly exhausted from the site vicinity following the work on Structures A and B. In order to tackle the roadhouse, more than 40 30-ft logs were purchased and hauled to the site, again by pulling them behind snowmachines over the frozen Fortymile River. Although crews changed from year to year (see Acknowledgements), the actual work of replacing the rotten sill and lower wall logs remained essentially the same for all buildings. Succinctly, all earth berms that had been piled up around the lower walls of the buildings had to be dug out and the rotten logs exposed; the buildings were then elevated with hydraulic jacks and screw jacks and supported with temporary wooden cribbing; then, the rotten logs were removed and replaced with newer logs.

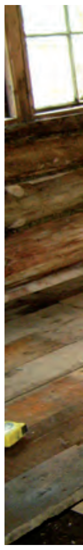

Figure 6. Alaska Fire Service firefighters installing a replacement log under Structure A, 2006. View from the east. (Photo: Collin Cogley, BLM Alaska)

Figure 7. Structure A with replacement wall logs resting upon a pavement of stream cobbles, prior to re-contouring of ground and hiding the cobbles with soil, 2006. View from the northwest. (Photo: Collin Cogley, BLM Alaska)

Replacement logs were treated with BoraCare preservative and Impel Rods to prevent future fungal decay and insect infestation. In the case of Structures A, B and C, all adjacent to a steep slope west of the buildings, the ground around the buildings was re-contoured with shovels to divert melting snow away from them during spring break-up.

The BLM, following consultation with the SHPO, opted not to put the basal wall logs directly back onto the ground surface. In the case of Structure A and the roadhouse, the lowest logs were placed instead upon flat, waterworn river cobbles obtained from nearby Steele Creek. For Structure A, a relatively smaller cabin, a continuous pavement of such cobbles was placed under the new logs.

For the roadhouse, we excavated a series of 2 ft$^3$ (~0.6 m$^3$) pits under the ends and the middle of each separate wall section, filled them up with tightly-fitting creek cobbles to just above the present-day ground surface, and then settled the building down upon them. In the case of Structures B and C we tried something different. Here, we excavated the same series of 2 ft$^3$ pits under the four corners of the cabins and in the middle of each wall, and filled these up to the present-day ground surface with cobbles. Then, a concrete pier block with an 18" length of rebar projecting vertically from each block was positioned on top of the cobble-filled pit, and the building was lowered down onto the blocks, with the rebars fitting into holes drilled into the undersides of the logs.

In this manner these two foundations are presently raised above the ground surface by 8-10 inches (~20-26 cm). All of the cobbles and concrete blocks are hidden from casual view by soil, so as to maintain the original appearance of the cabins. Also, to help prevent the replacement logs from deteriorating, the insulating earth berms of dirt that had been piled up against the lower outsides of the walls were not re-applied.

We performed a host of other rehabilitation efforts at the site. The 1970s-era entryway that was constructed connecting Structures B and C was recorded and dismantled. Rags and modern fiberglass insulation chinking between the wall logs from the 1970s and 1980s has been replaced with historically accurate sphagnum moss (*Sphagnum spp.*) chinking. The extremely dilapidated shed on the south side of the roadhouse was recorded in detail and dismantled. We decided to sacrifice the shed, which was built sometime between 1925 and 1939 based on historical photographs, because of the overarching desire to save the roadhouse. Not only was the shed contributing to the northward lean of the building as mentioned above, but raising the roadhouse with hydraulic jacks and straightening it would have been nearly impossible with this side shed still attached. Other rehabilitative efforts at the site included building a door for the previously empty southern doorway of Structure B, which matches the style of the cabin's existing original north wall door, as well as constructing new "hanging floors" in Structures B and C which do not directly touch the ground (i.e. the floor boards are nailed onto 2" x 8" floor joists set in joist hangers attached to the sill logs).

Finally, because the roadhouse was leaning to the north, it had to be pulled back into a vertical position in order to re-establish the structural integrity of the building. This was accomplished via a system of 11 come-alongs (hand-cable winches) anchored into the ground south of the building. The come-alongs were attached to straps that passed through the building and were attached to 11 vertical logs abutting to the outside of the north wall, as well as another 11 vertical logs placed against the inside of the south wall. In this manner, by simultaneously jacking up the north side of the building and by working all of the come-alongs at once, the crew was able to pull the roadhouse into proper alignment.


Figure 8. Collin Cogley, Eric Yeager, and Kevan Cooper positioning a concrete pier block on top of a cobble-filled pit, under the northwest corner of Structure B, 2007. The block was later hidden from casual view with soil piled up around it. (Photo: Robin Mills, BLM Alaska))

Figure 9. Structure A with replacement lower wall logs atop a (hidden) pavement of river cobbles. The ground on this western side of the building has been re-contoured to deflect water away from it during annual spring break up from the adjacent slope. View from the west. (Photo: Collin Cogley, BLM Alaska)


Figure 10. Tim DuPont and Eric Yeager installing a raised floor in Structure B, necessitated by the raising of the entire cabin up on concrete pier blocks, 2007 (see previous photo). Note that the original floorboards were screwed down onto the hanging joists, thus maintaining the original look of the cabin interior. (Photo: Robin Mills, BLM Alaska)

Figure 11. The roadhouse with replacement lower wall logs atop (hidden) pits full of river cobbles. Note the external braces installed in 2003 on the north side of the building have been re-set and left in place, as a backup against unforeseen shifting of the building. View from the northwest. (Photo: Robin Mills, BLM Alaska)

**Constraints**

The rehabilitation work performed at Steele Creek had to overcome a variety of difficulties and constraints. First amongst these was a general lack of funding. If the project could have been funded in a single year, it would have exceeded the entire, relatively small, annual budget for BLM Alaska's cultural heritage program. The project *had* to be broken up into smaller phases, with funding coming from a host of state and federal sources, cobbled together over the years. The lack of work at the site in 2004, 2005, and 2008 was not by design; no funds were available in those years to get any work done.

Once funds were secured, we had to stretch them as much as possible. While it would have been simpler to hire private contractors to do the work, skilled carpentry labor costs, competitive per diem rates, and the necessity of making a profit by private industry would have been so prohibitive to the project, relative to the amount of funds actually available, that little work would have been accomplished. To overcome this situation, we relied upon mostly "in house" labor to do the project, including (1) BLM employees, (2) skilled employees borrowed "at cost" from other federal agencies (U.S. Fish and Wildlife Service; U.S. Forest Service), and (3) both skilled and unskilled volunteers (see Acknowledgements). By working with mostly in-house labor, we were able eliminate most transportation costs (i.e. these costs were already largely paid for in government overhead), greatly reduce the per diem costs (i.e. food was purchased at cost and not at a set sum per person, per day), and largely restrict the labor costs to overtime, as the base wages for most employees were already paid for in existing program funding. In fact, only two private contractors were hired during the duration of the project: Harrison Goodall, who produced the original Condition Assessment Report in 2002, and Larry Taylor, a local river guide who was repeatedly hired to transport personnel and supplies to and from the site via his open, 18 ft river boat.

And finally, distance and logistical access to the site were the other principal constraints that had to be overcome. As the base for the BLM in the interior of Alaska, Fairbanks served as the hub for the project. Therefore, all personnel, equipment, and supplies had to travel 300 miles by road to get to the main bridge over the Fortymile River, the final 112 miles of which are unpaved. Two choices are available at this point: hire a river boat to take you 6 miles downstream to the site, or travel overland via ATV (All-Terrain Vehicle) on an existing, unimproved 6 mile trail, much of which is across boggy, boreal forest terrain. These two options are only possible, of course, if the river was not too low to travel on, or if it had not rained too much and made the overland route impassable. Either route precluded getting any heavy equipment to the site: all digging, transport of materials, and lifting of buildings had to be performed by hand and with hand tools. Procurement of logs from the site vicinity was performed with the aid of an ATV to pull the trees once they were felled and limbed, and transport of the roadhouse logs to the site could only be accomplished by pulling them by one and twos behind snowmachines over the frozen river ice, months in advance.

**Acknowledgements**

Many dedicated people contributed to the Steele Creek rehabilitation project from 2002 to 2010. The 2002 condition assessment field crew included private contractors Dr. Harrison Goodall and Lee Chavez; BLM employees Bill Aldritch, Kevan Cooper, Robin Mills and Shane Walker; and BLM volunteer Dennis Green. The spring of 2003 snowmachine crew included BLM employees Eric Yeager, Tim DuPont, Collin Cogley, Kevan Cooper and Robin Mills. The summer 2003 crew included BLM employees Heath Emmons, Rusty Morton, Chris Workman, Pat Cotter, Bill Aldritch, Kevan Cooper and Robin Mills; and BLM volunteer John Dubé. The 2006 crew that worked on Structure A included BLM employee Collin Cogley and a team of BLM-Alaska Fire Service Type 2 firefighters (the North Star crew). The 2007 crew that worked on Structure B included Gary Titus of the U.S. Fish and Wildlife Service; and BLM employees Steve Lanford, John Dubé, Tim DuPont, Collin Cogley, Eric Yeager, Evan Glenn, Kevan Cooper, Nathan Dorpalen, Stephanie Costa and Robin Mills. The 2009 crew that worked on the roadhouse included BLM employee Kevan Cooper; USDA Forest Service employees Doug Stephens and Barbara James; and Sky Strom, Ben Kitslarr, Pat Hermans, Sherri McDougal and Dave Dobkoski, all volunteers with the Teacher Restoration Corps. The 2010 crew that worked on the roadhouse and Structure C included BLM employees Kevan Cooper, Nick Moser, Courtney Cooper, Jessica Peterson, Gerad Smith and Robin Mills; USDA Forest Service employees Doug Stephens and Barbara James; and HistoriCorps employees Alexandra VonBieberstein, Rachel Perzel and Luke Jordan.