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THE SOUTH GEORGIA ISLAND SHORE-BASED WHALING STATIONS SURVEY PROJECT

RUSSELL GIBB AND DANIEL MCCURDY
GEOMETRIA LTD

Introduction

The ‘modern’ Antarctic whaling industry of the twentieth century began with the establishment of shore-based whaling stations on South Georgia Island. From 1904 through to 1965 six shore-based whaling stations operated on South Georgia Island (Figure 1), beginning with the establishment of Grytviken in 1904 and ending with the last station, Leith, ceasing operations in 1965. The development of the stations into small industrial towns created a remarkable industrial landscape as the abandoned stations slowly succumbed to the elements in the subantarctic. The stations are vast, complex industrial sites that contain numerous buildings and structures, many with production and processing equipment still in situ, as well as residential facilities and related detritus.

Today the stations are in various states of disrepair and the condition of the extant buildings is poor, with ongoing loss of cladding from steel-framed buildings and partial or total collapse of many of the timber structures. The presence of asbestos continues to be a major environmental hazard, with significant concentrations in several stations. To facilitate better long-term management, conservation planning and wider interpretation of the sites, a two-year project to survey the stations and their immediate environs has been commissioned by the Government of South Georgia and the South Sandwich Islands (GSGSSI). Geometria are undertaking surveys to laser scan the entirety of the stations with the aim to produce multiple outputs for a community of interested parties. This project follows on from the work of Bjorn Basberg, who undertook a large industrial archaeology project on South Georgia during the 1990s.

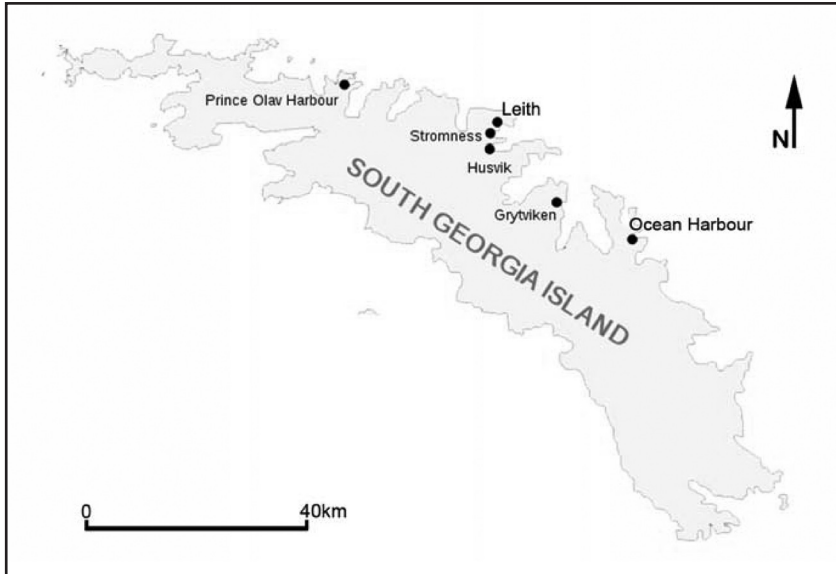


Figure 1. Location of the shore-based whaling stations, South Georgia Island.

Historical overview

It is thought that a London merchant named Antoine de la Roche discovered South Georgia in 1675 when the ship he was on travelling from Chile to Europe was blown off course, eventually reaching a mountainous island in the Southern Ocean. After staying around the island for two weeks Roche's ship sailed north and on to Europe, having never set ashore. The next recorded ship visit was 80 years later in 1756, but it was not until James Cook on HMS Resolution reached South Georgia in January 1775, during his expedition to explore the Southern Continent, that the island was explored in detail. Cook declared the island British, naming it Isle of Georgia.

Cook's account of his second voyage was published in London in 1777. His description of fur seal populations at South Georgia resulted in an influx of British sealers beginning around 1786, and soon more sealers followed from the United States and elsewhere. Sealing developed rapidly, having already been established on the Falkland Islands from 1766, and by 1791 over 100 vessels were engaged in harvesting fur seal pelts and securing elephant seal oil in the Southern Ocean, with many of these operating at South Georgia. Accommodation ashore for the seamen was in stone houses or caves, with some ships overwintering at South Georgia. Whalers were also attracted to the area and by 1787 whaling ships had started arriving. Between 1787 and 1790 the whaling

vessel Lucas made several journeys from London, hunting both whales and seals around the Falklands and South Georgia.

Fur seals, though, were the primary targets. By the early 1800s unrestricted harvesting of fur seals resulted in a dramatic population collapse, making it unviable for the sealers to maintain a large industry on South Georgia. This lull in sealing lasted about 15 years until it picked up again, peaking around 1818 when the fur seal population started recovering. However, the population recovery was never to the level required to be able to maintain large-scale activity and as a result the majority of sealers during this period were more active around New Zealand's southern islands. Sealing dramatically increased again in the 1870s until the British Government in the Falkland Islands introduced legislation in 1881 that limited the hunting season from October to April. Unfortunately by this time the population was on the verge of extinction and large-scale commercial sealing on South Georgia was all but over by the end of the 19th century.

American whalers, based largely out of New England, dominated the whaling industry during the 19th century but were less inclined to head to Antarctic waters, favouring instead the hunting grounds of the Pacific, Atlantic and Arctic – whereas the American sealers were constantly voyaging to the subantarctic throughout the 19th century. With the advent of 'modern' whaling in the 1860s – where fast steam-powered whale catcher boats equipped with explosive harpoons were used in conjunction with shore-based processing stations, thus allowing the targeting of larger species of whale – whale stocks came under increased pressure, with over exploitation and declining populations eventually leading to the exploration of new hunting grounds such as in the Southern Ocean and Antarctic. The Norwegians began exploring the southern whaling grounds in 1892, soon followed by the Scots.

The emergence of the shore-based stations at South Georgia coincided with the 1904 prohibition of whaling along the Finnmark coast (the extreme northeast part of Norway). Forced to find new whaling grounds the Norwegians ventured away from traditional areas to new hunting grounds. In 1905, the Norwegian Carl Anton Larson set up a base at Grytviken, in Cumberland Cove on the east coast of South Georgia, establishing a permanent population and introducing modern whaling to South Georgia. Other companies quickly followed, with a second station constructed in 1909 by Norwegian company A/S Ocean at Ocean Harbour, south of Grytviken. The third station was established in 1910 by Scottish firm Chr. Salvesen Ltd. at Leith Harbour, and later that year a station was underway at Husvik. Another station was built at Stromness in

1913 with the last station established in 1916 at Prince Olav Harbour by the aptly named Whaling and Sealing Co. from South Africa.

With the sudden growth of the shore-based stations at South Georgia, Britain (who by now had declared sovereignty over South Georgia and the South Sandwich Islands) took steps to control the whaling industry. Regulations were set and a restricted number of licences made available, all overseen by a magistrate appointed in 1909. Production at the shore stations peaked during the 1920s with 7825 whales killed during the 1925-1926 seasons.

The development of the stern slipway in the early 1920s led to the retrofitting of many old floating factory ships, enabling these ships to operate independently of the shore-based stations. With the shore-based stations no longer being required for processing, large factory ships were able to venture farther afield and process larger numbers of whales. The companies running the South Georgia shore-based stations responded by increasing seal oil production and placing more emphasis on production of guano (whale meal), which required a large amount of space and resources not readily available on the factory ships.

The recession of the 1930s reduced demand for whale oil at a time when production was at record levels, resulting in most of the fleet suspending operations during the 1931-1932 season. The stations at Stromness, Husvik and Prince Olav Harbour were closed, with Leith following suit the following season. The stabilising world economy of the late 1930s allowed the whaling industry to recover somewhat but the industry at South Georgia never fully recovered. The whaling operations at Stromness and Prince Olav never reopened and Husvik remained closed until 1945. Stromness continued to operate but only as a repair yard for the station at Leith Harbour.

During World War II operations at South Georgia were greatly reduced as ships were relocated for wartime use, with Leith and Grytviken only operating during the 1941-1942 season. Following the war, the facilities at Leith, Husvik and Grytviken resumed operations and prolific catch numbers were recorded well into the 1950s, but by the early 1960s, stocks had been depleted and catches were well down, such that most of the countries whaling in the region closed their operations for good. Japanese whaling companies continued on at South Georgia for a while, leasing Leith and Grytviken until the economic reality of diminishing returns forced them to cease operations. Grytviken was closed in 1964 and Leith the following year bringing an end to a sixty-year enterprise.

The stations

Today the stations are in varying states of disrepair after years of neglect, vandalism, looting and a constant battering from the subantarctic weather

(Figure 2). Two hundred metre exclusion zones protect all the stations except Grytviken. An environmental clean up during 2004 resulted in the removal of the bulk of the asbestos from Grytviken and the site is now open for visitation. Unfortunately the removal of the asbestos required the deconstruction of a number of unstable buildings, resulting in a less than sympathetic transformation of the site. The safety hazards are numerous: asbestos used as lagging for pipes and insulation on equipment is found throughout the stations; many of the buildings have collapsed or are near to collapse, or have been taken down for safety reasons; snow and ice obscure surfaces; and melt-water undermines building foundations and creates soft spots in the ice. The subantarctic climate can be unforgiving with rainfall and high winds the norm at South Georgia. Debris is constantly dislodged and blown about.

The design and functionality of the three main stations Husvik, Leith and Grytviken varied, influenced by the station locations and the how each station evolved their processing operations (Morrison 2011). These stations contained production and processing facilities such as a flensing plant, guano factory, blubbery cookery, meat separating plant, meat cookery, pump house, laboratory, generator plant and marine and engineering facilities. The support facilities included offices, barracks, kitchen, stores, laundries, workshops, animal pens and (at Grytviken) a church. The layout of Stromness was different, reflecting the site's transformation from whaling station to repair yard, while the short period of operations for Prince Olav Harbour and Ocean Harbour stations meant that they did not grow to the extent of the three main stations. Leith is the largest and best-preserved station, and the one station where the production and process facilities are largely intact.

Basberg's industrial archaeology study

Basberg's team spent four seasons (1990, 1993, 1996 and 1999) surveying at South Georgia. Even with four seasons guaranteed, Basberg acknowledged that time and resource limitations would dictate their survey design and documenting the total context of the sites would not be possible. He settled on focusing on the functional relationships of the various elements of the site so that different stages of the industrial process were demonstrated and the context of the stations operation and influence on social life could be better understood. His team used a combination of photogrammetry, theodolite survey and photography to produce station maps, building plans and to photo-archive the interiors and exteriors of the buildings (Basberg 2004).



Figure 2. Contemporary views of Grytviken (a), Leith (b), Stromness (c), Prince Olav Harbour (d) and Husvik (e). Ocean Harbour was dismantled in the 1920s.

Survey methodology

The survey program has been designed so that we can build on Basberg’s research. The time and resource constraints are similar but by utilising laser scanners we can record an enormous amount of detail in a limited time. The laser scan data can then be integrated with previous information collected by Basberg (and others) into a larger project database.

The surveys have been designed with five main objectives:

- To capture as much data as possible within a limited timeframe while

operating in marginal conditions.

- To capture the essential components of each site to create a detailed three-dimensional as-built record of the stations before further deterioration occurs.
- To record the immediate landscape at each site.
- To record the production and processing areas at Leith in high resolution to facilitate further analysis and interpretation of the historic whale production process.
- To disseminate the data and survey output to a wide range of project partners and interested parties.

Season 1 surveys were conducted during October 2012 at Grytviken, Husvik and Stromness. Season 2 will focus solely on Leith. Two laser scanners were utilised for the surveys: a Leica C10 time of flight scanner and a Faro FOCUS 120 phase scanner, the Leica offering longer range (approximately 300 m) while the Faro is a smaller unit with a useful range up to approximately 100 m. The scanner operators act independently of each other: one focusing on plant and high-resolution recording; the other focusing on large exteriors and landscape recording. There is a simple rationale behind this survey methodology – if one dataset is corrupted or found to be lacking in specific detail, the second can provide enough supplementary information to sufficiently replicate the lost data. The overlap between survey data also increases the overall recording resolution of the surveys. Independently collected datasets are later merged to create a unified master.

Results

Husvik and Grytviken were the focus of the first season of surveys, with approximately 11 days spent at each site. One day was also spent at Stromness surveying the manager's villa, where Shackleton first stayed after reaching South Georgia on his rescue voyage from Elephant Island. Overall, weather conditions for the majority of the time were fair with 1.5 days lost due to inclement weather where high winds meant transport from the support ship to shore at Husvik was not possible. Of the 22 survey days spent at South Georgia, four days of rainfall were recorded and snowfall was recorded on seven, two of which were almost blizzard conditions. During periods of rain and snow, surveys were usually moved indoors, with the exception of the last few days of the survey schedule where time limitations necessitated scanning in marginal conditions at Grytviken to complete exterior surveys.

Aside from inclement weather, the presence of wildlife is the main encumbrance when working at South Georgia. Elephants seals, fur seals, reindeer, penguins and other avifauna live and breed around the stations, especially

on the beaches and foreshore areas. Elephant seals are mostly unperturbed by the presence of humans – bulls tend to focus on protecting their herds from amorous males suitors and need only be avoided during sporadic combats. Fur seals are more of a hindrance to the surveys. They start arriving in late October in large numbers, are aggressively territorial, and disperse throughout the stations, obscuring survey targets. The surveys dates are set for October so they can be completed before the seals start arriving en masse. The downside to this is that it is springtime and the weather can be more unpredictable.

Husvik

Husvik has suffered considerable decay. A number of buildings have collapsed due to structural failure from foundations being undermined by fast flowing melt-water flows, or have succumbed to roof collapse (Figure 3). This includes several of the wooden accommodation buildings, and more significantly, the majority of the bone and meat cookery buildings. All exterior surfaces and the immediate environs were scanned at approximately 3 mm resolution. The survey targets comprised 28 complete or near complete buildings, 10 collapsed or partially collapsed buildings, 26 storage tanks, the flensing plan, jetty and various remnant building foundations and ancillary structures. Interior scanning was completed throughout the production and process buildings (Figure 4). Complete internal and external scans were undertaken of the Karrakatta, a whale catcher now sitting on a slipway (Figure 5).



Figure 3. The flensing plant (foreground) and partially collapsed production plant, Husvik.



Figure 4. Interior scan of the guano factory, Husvik.

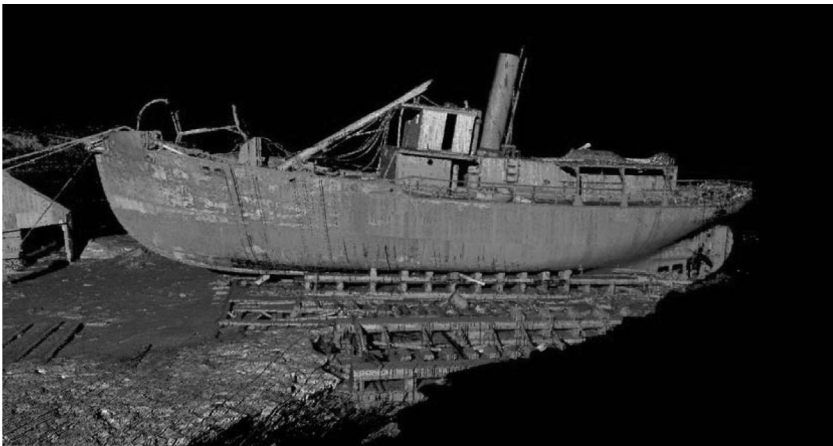


Figure 5. Scan showing the Karrakatta and slipway, Husvik.

Gryviken

The 2004 environmental clean-up at Grytviken significantly altered the appearance of the site when many of the larger production and process buildings were removed due to structural concerns and to simplify the removal of asbestos from in situ plant. Buildings that had previously collapsed were cleared with simple concrete pad foundations usually all that remains. As a result, much of the remaining plant now sits in the open (Figure 6). As with Husvik, all the exterior surfaces and immediate environs were scanned, including the cemetery where Shackleton is interred. Detailed internal scanning was done

on some key buildings to provide data to project partners for future works, including the main barracks Nybrakka, church (Figure 7) and museum. In total, 14 complete buildings, 12 open plant structures, 38 storage tanks, three jetties, ski jump, the remnants of a floating dock and ship hull, and a number of concrete foundations and ancillary structures were scanned. Three ships (*Petrel*, *Albatross* and *Dias*) and two small boats had exterior and partial interior scans completed (Figure 8).



Figure 6. Tanks remaining in situ at the blubber cookery, Grytviken.



Figure 7. The church at Grytviken.



*Figure 8. Scan of the Petrel, a 20th century whale catcher.
Stromness*

The manager's villa at Stromness has significance due to its association with Shackleton (Figure 9). The villa is in an advanced state of dilapidation with rotten and collapsed floors and its conservation potential is limited. Scanning was undertaken to record every aspect of the entire structure before it was

boarded up due to its unsafe condition. The data will be used to help assess the building and options for conservation.



Figure 9: Manager's villa at Stromness. With recently bloodied bull elephant Seal (left) and corresponding scan (right).

The scan database for the three sites contains over 1200 individual scan point clouds comprising several hundreds of billion points of 3D geometry and colour information. Data processing is currently underway and once complete we should have a high-resolution coverage with a spatial resolution of approximately 3 mm over 95% of the surfaces we have tried to capture. Small occlusions in the data are inevitable given the complexity of the sites, snow drifts and the limited survey period. Generally these will not compromise the integrity of the data and we have the option of returning to each of the sites to add data during the second season if necessary.

Once the individual point clouds have been registered to form a unified dataset the various project partner requirements will be created. These include site plans, floor plans, sections (Figure 10) and elevations, CAD models, 3D animations and deformation and change monitoring modelling. Ongoing dilapidation surveys and monitoring will also be explored.

The forthcoming field season (September-October 2013) will focus on capturing Leith. Leith is the best preserved and largest of the South Georgia shore-based whaling stations and is probably the best remaining example of a large-scale shore-based whaling operation. The well-preserved state of Leith presents a number of challenges. It is markedly more complex than either Husvik or Grytviken due to both the scale and number of buildings and intact plant. Consequently it has vast amounts of in situ asbestos and other environmental hazards throughout the site.

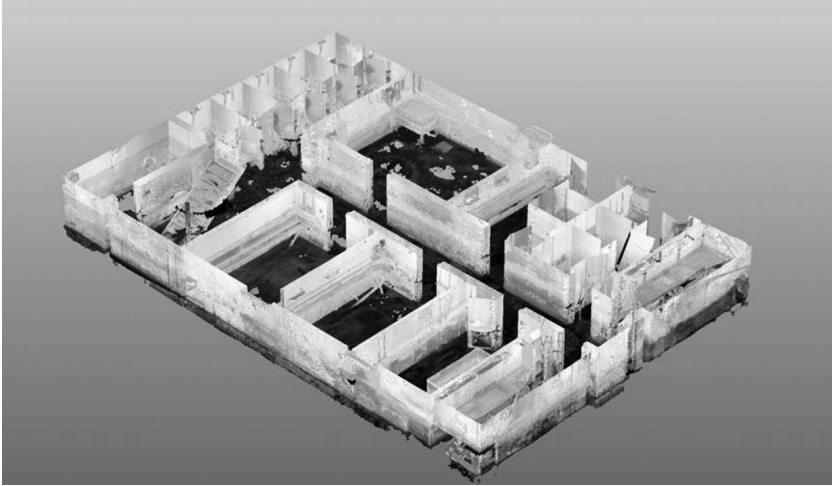


Figure 10. Basement section of barracks building Nybrakka.

Conclusion

The successful first season of laser scanning of the shore-based whaling stations of South Georgia will permit a detailed documentation of this threatened industrial heritage. With data to be collected during a forthcoming second season it is anticipated that the majority of the island's industrial heritage will have been digitally documented using laser scanners. These surveys are seen as a continuation of the photogrammetric surveys and research undertaken by Bjorn Basberg for his seminal Antarctic industrial heritage study. This project is a collaboration between private enterprise, academic institutions and several European government bodies and is funded by the GSGSSI.

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