Institution: University of Cambridge

Unit of Assessment: UoA17B

Title of case study: Research at the Scott Polar Research Institute (SPRI) and its impacts on wider audiences through the Polar Museum

1. Summary of the impact (indicative maximum 100 words)

Polar research at SPRI has been made accessible to wider audiences through the Polar Museum, which is unique as Britain's only museum dedicated to the Arctic and Antarctic. The Museum's formal plan has at its core the use of displays to communicate SPRI's research findings to a general, non-specialist audience; for example, showing the public how this research is deepening the understanding of environmental problems such as sea-level rise. A complete redesign in 2009-10 utilised SPRI research in polar science and humanities to underpin museum displays (which had previously related only to polar exploration) and to project the significance of the rapidly changing polar environment - climatic, social and cultural - to a diverse audience (c. 50,000 in 2012) with international reach. Research is communicated through captioned museum exhibits, interactive screens and audio-guides, talks and tours, and Internet resources. Wide secondary reach includes substantial media coverage in newspapers, TV and radio. The Polar Museum was shortlisted for the Art Fund's prestigious Museum of the Year Award in 2011 and for European Museum of the Year in 2012.

2. Underpinning research (indicative maximum 500 words)

SPRI is a sub-department within the Department of Geography, University of Cambridge, with **Dowdeswell** as Director. It is explicitly interdisciplinary, with academic staff studying polar natural science (especially ice), northern peoples and cultures, and historical archive records. The Archive is a unique written resource for SPRI's research, representing the most comprehensive documentary collection in the world on British polar exploration, and its holdings have been integrated closely with evolving museum displays. The selection of research-led displays was guided by the following objectives: i) to demonstrate the significance of the polar regions in a global context (e.g. sea-level rise, ocean-circulation change); ii) to explain and clarify areas of public debate or uncertainty; e.g. about polar environmental change and global warming; iii) to mesh with key topics in the National Curriculum to maximise educational impact (e.g. Key Stage 1, Famous Britons – Captain Scott; Key Stage 3, ice and environmental change). Four exemplars of underpinning research projected through the Polar Museum follow – many more have populated the museum's dynamic displays.

(A) ***Sociology and culture of Siberian reindeer herding peoples***. **Vitebsky** (Assistant Director of Research (ADR) 1986-) is unique in having studied the Eveny and Evenki peoples for over two decades, spending a total of two years in Siberia since 1993. This work was brought together in the acclaimed *Reindeer People* (Vitebsky, 2005), and shows how herders interact with their natural environment, and how their material culture and customs evolved through and beyond the era of Soviet centralisation. He and **Rees** (Lecturer, then SL, 1988-) have also shown how changing climate has affected reindeer-migration timing and patterns (Rees et al., 2008).

(B) ***MHz radars to measure ice thickness*****.** SPRI has been a world leader in this work since the first development of ice-penetrating radars by SPRI staff in the 1960s. NERC projects have supported **Dowdeswell** (ADR 1989-94, Prof., 2002-) and **Christoffersen** (Lecturer, then SL, 2007-) to undertake radar data acquisition over polar ice (1994, 2000, 2009, 2011, 2012). Our data on ice thickness are unique, providing a critical boundary condition in ice-sheet numerical modelling. The nature of radar returns from glacier beds enables detection of subglacial conditions, including lakes (Dowdeswell and Evans, 2004). Ice thickness data also allow calculation of ice-sheet discharge, when combined with satellite-derived velocities (Dowdeswell et al., 2008a). This is key to understanding the ice-sheet contribution to sea-level rise.

(C) ***Geological and geophysical records of past ice-sheet growth and decay on polar continental shelves***. **Dowdeswell** has undertaken a number of NERC-funded cruises on the UK ice-strengthened research vessel *James Clark Ross* (1994, 2000, 2002, 2003, 2004, 2006, 2007, 2009). **Christoffersen, Mugford** (PDRA, 2010-12) and **Hogan** (PDRA, 2010-) have also worked with marine-geophysical data from the polar seas. SPRI marine research has allowed the

maximum extent, rate and nature of ice-sheet retreat across polar continental shelves to be reconstructed, and the locations of past ice streams off Greenland, Eurasia and Antarctica to be identified (Dowdeswell et al., 2008b).

(D) ***Archival meteorological records from Royal Navy ships' logs***. Data from more than 30 ships' logs collected during the 19th century exploration of the Canadian Northwest Passage, held in the SPRI archive, were used by **Dowdeswell** in 2005 and 2006 to reconstruct the climate of the Canadian Arctic islands from 1818-59 (Ward and Dowdeswell, 2006); 100 years before the first formal meteorological stations were set up in the Canadian Arctic. The measurements, which have been shown to be both accurate and precise by inter-comparison between independent records from adjacent ships, demonstrate that the climate of the Canadian Arctic at that time, during the cool Little Ice Age, was about 1.5°C colder than today.

3. References to the research (indicative maximum of six references)

The following are examples of books and peer-reviewed papers by SPRI staff (**in bold**) in ISI-listed scientific journals, keyed to research examples A-D in Section 2:

(A) Rees, W.G., Stammler, F., Danks, F., **Vitebsky, P.**, 2008. Vulnerability of European reindeer husbandry to global change. *Climatic Change*, 87, 199-217, doi:10.1007/s10584-007-9345-1.

(A) Vitebsky, P., 2005. *Reindeer People: living with animals and spirits in Siberia*. (HarperCollins, London, 464 pp). Awarded the Kiriyama Prize for non-fiction and shortlisted for the Victor Turner Prize of the American Anthropological Society.

(B) Dowdeswell, J.A. and Evans, S., 2004. Investigations of the form and flow of ice sheets and glaciers using radio-echo sounding. *Reports on Progress in Physics*, 67, 1821-1861.

(B) Dowdeswell, J.A., Benham, T.J., Strozzi, T. and Hagen, J.O., 2008a. Iceberg calving flux and mass balance of the Austfonna ice cap on Nordaustlandet, Svalbard. *Journal of Geophysical Research*, 113, F03022, doi:10.1029/ 2007JF000905.

(C) Dowdeswell, J.A., Ottesen, D., Evans, J., Ó Cofaigh, C. and Anderson, J.B., 2008b. Submarine glacial landforms and rates of ice-stream collapse. *Geology*, 36, 819-822, doi: 10.1130/G24808A.1.

(C) Christoffersen, P., Mugford, R., Heywood, K., Joughin, I., **Dowdeswell, J.A.**, Syvitski, J., Luckman, A. and Benham, T., 2011. Warming of waters in an East Greenland fjord prior to glacier retreat: mechanisms and connection to large-scale atmospheric forcing. *The Cryosphere*, 5, 701-714, doi:10.5194/tc-5-701-2011.

(D) Ward, C. and **Dowdeswell, J.A.**, 2006. On the meteorological instruments and observations made during the 19th Century exploration of the Canadian Northwest Passage. *Arctic, Antarctic and Alpine Research*, 38, 454-464.

Research Council grants supporting the scientific work projected in the Polar Museum include:

J.A. Dowdeswell, P. Christoffersen, Airborne geophysical investigations of basal conditions at flow transitions of outlet glaciers on the Greenland Ice Sheet, NERC, 2010-13, k£840.

J.A. Dowdeswell, Marine geological processes and sediments beneath floating ice shelves Greenland and Antarctica: investigations using the Autosub AUV. NERC, 2001-07, k£369.

4. Details of the impact (indicative maximum 750 words)

The Polar Museum, which reopened in 2010 after a £1.8M refurbishment supported by the Heritage Lottery Fund and charitable trusts, has been redesigned around the range of SPRI research activities to communicate both the distinctiveness and the holism of the polar regions (e.g. the symbiotic relationship between indigenous Arctic peoples and the ecosystems they live in). Since then it has welcomed about 50,000 visitors each year (recorded by calibrated foot-fall counter according to standard museum practice), compared with 6-7,000 annual visits before the redesign. The museum's interpretation plan has at its core the use of the Museum to deliver SPRI's research findings to a general audience in ways that are accessible and engaging. Impact has been achieved through use of research-based material in museum displays and interactive resources and by direct engagement with the public.

To make SPRI's academic work accessible to a general audience, researchers contributed material to the redesigned Museum as physical exhibits and captions, as text and illustrations for interactive touch screens in the Ice and Climate gallery, and verbally for audio-guides. Within the redesigned spaces, artefacts and text panels illustrate the significance of shamanism for Arctic reindeer herders and also show materials and techniques used to make clothing, food containers, reindeer harnesses and sleds; such techniques have been observed and documented through the detailed field research of **Vitebsky** (Section 2A). Museum displays show radar equipment and explain how the method works, and interactive screens provide explanations of the significance of ice-sheet mass loss for global sea level (Section 2B). The methods used to acquire sediment cores, ocean temperature and salinity data are shown on interactive screens: e.g., coring and water sampling and the deployment of autonomous underwater vehicles (Section 2C). The wider significance of such evidence for understanding ice-sheet history, iceberg melt rates and sea-level change is explained in displays (Section 2C). Ships' logs from 19thC exploration of the Canadian Arctic provide key scientific context for the notorious failure of Sir John Franklin's search for the Northwest Passage (1845-47) (Section 2D). The Head of the Polar Regions Dept. at the Foreign and Commonwealth Office (FCO) comments (see 5.1): 'one area where the new museum is very strong, and innovatively so, is the use of primary research in the well thought-out displays on ice and the polar environment in a warming world'.

The Polar Museum was shortlisted for the prestigious Art Fund Prize for Museum of the Year in 2011 and for European Museum of the Year in 2012. Michael Portillo, Chair of Judges for the Art Fund Prize, comments (see 5.2): 'The imaginative and comprehensive renovation has transformed both the way the unique collections are presented, and the museum's relationship with its audiences.' The formal citation of the European Award Committee states (see 5.3): 'The innovative approach is to link displays on polar exploration with climate-change issues.'

Positive visitor feedback, both written and informal, is indicative of the impact of the museum's research-based displays (see 5.4). Comments include: 'Excellent presentation. Attention to modern research very interesting'; 'I think the museum gave me a good insight into climate change.' The interactive screens have proved popular across a wide age range, and are particularly well used by one of our main target audiences; young people aged 12-16. Books written for an informed general audience and based on staff research are also sold in the Museum Shop (e.g. *Reindeer People* (2005) by **Vitebsky** and *Islands of the Arctic* (2002) by **Dowdeswell** and Hambrey; global sales of 27,100 and 5,300, respectively, and translation of *Reindeer People* into several languages, indicate wide international reach).

School visits are a major strand of learning provision for the museum. There were 138 formal school visits during 2012 across all key stages, with a total of over 4,500 children. Nearly 1,500 of these pupils received dedicated outreach sessions. Feedback from teachers demonstrates that the museum, through the research it projects, has developed a reputation for high-quality communication of research to school groups. In addition, 'Cool Club' holiday sessions (ten in 2012) enable children aged 7-12 to interact directly with researchers and to learn about their work; **Hogan, Mugford** and **Rees** have taken part. Projecting this innovation widely to other educators, Cool Club was the subject of a recent article by SPRI's Education Officer (Weeks, S., 2012. Polar science is cool. *Primary Science*, 125, 27-29). The Chair of the UK Antarctic Heritage Trust comments (see 5.5): 'The way that you have integrated the contemporary scientific work of the Institute into your education programme and museum displays provides a compelling link that clearly captures the imagination of young people. The return visits from a number of schools are a clear demonstration of the impact of your educational programme and its value to teachers'.

Science Week and *Festival of Science* are also a key part of Museum activity. Over 1,100 visitors came to the museum on the Saturday of 2012 Science Week alone. SPRI scientists communicated their research directly; demonstrations included melting of ice and water-level rise, and the operation of low-power radars. In addition, 290 further and higher education students visited in the year from 6/2011, and University of the Third Age (U3A) activities also take place regularly (see 5.4), demonstrating that the impact of SPRI research through the museum has considerable reach across the generations. The Director of the British Antarctic Survey writes (see 5.6): 'The very varied groups, from UK and abroad, which comprise the 40-50,000 visitors to the museum each year enable wide reach for your research findings'.

The comprehensive documentary collection in the SPRI Library and Archive is used to inform and illustrate SPRI research and museum exhibits. It is also utilised by Institute staff and is open freely to allow its research outputs to inform the work of external scholars writing more generally on the history and scientific findings of polar exploration (e.g. **Dowdeswell** et al., 2012, *Scott of the Antarctic*, Raintree, for Key Stage 1 children; 3,422 sold by June 2013).

SPRI research projected through the Museum. EC President Barroso and HRH the Duke of Edinburgh hear about ice and climate change from Dowdeswell. Right: a member of SPRI's 'Cool Club' holds up a model he has made of Antarctica's bedrock after learning about ice-penetrating radar.

Dowdeswell as SPRI Director also uses the research-based displays in the Polar Museum to inform distinguished and influential visitors about the wider environmental significance of the polar regions during private tours, including: politicians (President Barroso of the European Commission, UK ministers David Willets and Henry Bellingham); members of the UK and other Royal Families (HRHs the Duke of Edinburgh, the Princess Royal, Prince William and Prince Harry, HSH the Prince of Monaco); and leaders of industry in the UK and internationally (through the Judge Business School). **Dowdeswell** has twice spoken by invitation to MPs and Peers in the Westminster on these issues (3/08 and 11/12). The Head of the Polar Regions Dept, FCO, writes (see 5.1): 'I note, too, how you have used the museum displays to engage, and indeed educate, important national and international figures about the significance of environmental changes at the Poles for the policies of lower-latitude countries'.

Secondary outreach for SPRI research staff includes substantial media coverage in UK and overseas broadsheet newspapers (e.g. Guardian, Telegraph, Independent, NYT; see 5.7), BBC Online, television and radio (e.g. **Dowdeswell** on Radio 4 *In Our Time* (6/10) about his Antarctic research). The Polar Museum is a regular venue for filming and recording of news items about polar history and significant contemporary polar science issues, providing further international reach for the research of SPRI staff.

5. Sources to corroborate the impact (indicative maximum of 10 references)

1. Letter from person 1 (Head of the Polar Regions Department, Foreign and Commonwealth Office)
2. Citation for Art Fund Prize – shortlisted for Museum of the Year, 2011
3. Citation for European Museum of the Year – shortlisted for European Museum of the Year, 2012
4. Examples of feedback from school and University of the Third Age (U3A) visitors to the Polar Museum
5. Letter from person 2 (Chair, UK Antarctic Heritage Trust)
6. Letter from person 3 (Director, British Antarctic Survey)
7. Examples of media articles showing the impact and reach of SPRI staff