Filling the gaps | National Heritage Science Forum | Filling the gaps

An initial survey to identify research since 2010 that matches the gaps in the heritage science landscape

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Executive summary

This report was commissioned by the National Heritage Science Forum to try to establish how far the sector has addressed the gaps identified by the National Heritage Science Strategy evidence reports of 2009. It is a snapshot report which looks at targeted areas across the reports and, by searching the Gateway to Research Portal[1] (Research Gateway hereafter) only, aims to map research programmes to gaps identified to establish which areas are thriving and which are not.

It is based on *NHSS REPORT 1: The role of science in the management of the UK's heritage*. It focusses specifically on two of the three themes within that report - *understanding material behaviour* and *understanding environments*. It sets out each theme and lists the gaps in the theme for all three heritage sub sectors (moveable heritage, the built historic environment and archaeology). A search of the research gateway attempts to identify relevant research for each gap and, where identified, map this back to each gap as applicable.

All 64 gaps in NHSS1 were searched and relevant search returns mapped against them. There were fewer than 30 matches thought relevant. The majority of the gaps were in the built historic environment and moveable heritage sectors, but fewer than a third of these attracted a result. For the archaeology sub-sector, less than a quarter of gaps attracted a result.

Thematically, understanding materials (including modern materials) returned results relevant to 26% of its identified gaps. Understanding the environment (including climate change) returned results relevant to 29% of its identified gaps

The projects of the Science and Heritage Programme comprise most of the returns.

[1] The Gateway to Research Portal is a website developed by Research Councils UK which collates information about publicly funded research from a variety of source systems, enabling access to current and past research programmes.

Introduction

NHSS REPORT 1: The role of science in the management of the UK's heritage (hereafter NHSS1) was the first of three reports produced to underpin the development of the National Heritage Science Strategy. It identifies gaps in knowledge and practice in heritage science through three themes, the first two of which form the basis of this report. Theme One in NHSS1 is *Understanding Material Behaviour.* It has two topics, *understanding decay mechanisms and rates of decay* and *modern materials.* Theme Two in NHSS1 is *Understanding the Environment.* It, too, is split into two topics - *creating appropriate environments* and *adapting to a changing climate.* As part of the consultation from which the NHSS reports were formed, a series of very specific topics emerged within these four topics in each of the three sub-sectors, about which it was felt more knowledge and/or a greater understanding was needed. It is these which are identified as 'gaps' in knowledge (or practice) and it is these which this piece of work attempts to map against research undertaken since 2010.

Methodology

Gaps and Classification

The topics above were isolated and called Topics A-D. Under each topic, all of the gaps were listed, numbered and given the NHSS classification of the subsector in which they were identified. The classifications given were as follows:

- M = moveable heritage (museums and galleries, archives and libraries) note: where applicable this is further categorised in this report as M(MG) and M(LA) to differentiate between moveable heritage sectors
- BHE = built historic environment
- A = archaeology

Searching the Gateway[2]

- *defining the data set*
  The search term 'heritage science' was entered into the gateway. All advanced parameters were checked (left on) - project abstract, project title, and project reference. The search returned 6,664 projects. The .CSV file of this return was downloaded and converted into Excel to aid data management. The projects were sorted by start date and all projects with start date of 2009 or earlier were removed, leaving 4,063.

- *search vocabulary*
  A search vocabulary was built based on the wording of each gap, identifying words which it was though would best return relevant data. Depending on the wording of each gap, one or more words were chosen and entered as search terms.

[2] The Gateway to Research Portal is a website developed by Research Councils UK which collates information about publicly funded research from a variety of source systems, enabling access to current and past research programmes. As a tool for identifying gaps it has limitations in that it does not include literature or grey literature, but as a central repository for current and recent publicly funded projects it provides an accessible start point for any gap matching exercise.

- *recording search returns*
  The Excel data set was searched through its title information using the words of the vocabulary. The number of nil returns for each search was recorded for each gap. Positive returns (project titles) highlighted on the spread sheet were scrutinised and where the information was clearly not relevant (the subject and/or sector) these were discounted. For returns which were, or which might be relevant, the project details were recorded. In the case of the former, these were assigned to the gap being scrutinised. In the case of the latter, projects were reviewed on the gateway for more details and a judgement made as to their relevance. If returned projects were or are part of the science and heritage research programme, this was noted. The same project may appear against more than one gap.

- *search integrity*
  random search terms from the Excel spread sheet were also entered directly into the gateway, to establish the integrity of data in Excel compared to the original data on the Gateway.

Results Theme A: Understanding material behaviour - 25 gaps

A: Understanding material behaviour [NHSS topic 1A]	#	sub sector	number of relevant projects identified	includes SHRP project?[3]
to improve understanding of....				
acceptable limits of RH & temperature in degradation of organic materials and metals	1	M	2	2
the impact of cumulative light exposure on different materials	2	M	3	3
the effectiveness of low oxygen/anoxic conditions for storage and display	3	M		
tolerable levels of particulate and gaseous pollutants	4	M		
the effects of high pressure water mist for fire control on organic materials	5	M		
vibration impacts from increased visitor numbers and during transport	6	M		
the degradation mechanisms of metal polyphenol dyes (black dyes i.e. iron gall inks	7	M	1	1
the degradation mechanisms of leather	8	M		
the deterioration of biological molecular structure of natural history collections	9	M		
methods to control of soluble/insoluble salts in collections (ceramics, glass and stone)	10	M		
how often cleaning of dust should take place - there is a need to balance impact of cleaning with philosophical and cultural issues such as perceptions of cleanliness vs. a sense of antiquity.	11	M		
the behaviour and methods of control of soluble salts in buildings	12	BHE		
the impact of multi-pollutant urban environments and nitrogen oxides in particular on building fabric	13	BHE	1	0
the impact of the use of inappropriate materials for repair	14	BHE		
the impact of non-conservation stone cleaning which can lead to acid decay and increased microbial growth	15	BHE		
the interaction between moisture, microbes (e.g. biofilms) and salts in stone degradation, vibration damage to historic monuments	16	BHE		
the impact of fire resistant treatments on the longevity of organic materials (i.e. thatch)	17	BHE		
to determine...				
the response of organic and inorganic archaeological materials to short, and long term fluctuations in water level	18	A	1	1
the rate of degradation of organic materials following de-watering,	19	A		
the impact of chemical agents (contamination, fertilisers) on artefacts	20	A		
the role of micro-organisms in degradation of waterlogged buried material and factors causing increased activity	21	A		
the impact of compression on artefacts (from construction)	22	A		
post-excavation changes to archaeological materials and mitigate their affects	23	A		
the deterioration of archaeological soil samples; what information is lost during long-term storage	24	A		
the impacts of exposure of marine archaeological remains	25	A		

[3] SHRP refers to the research projects of the Science and Heritage Programme

Theme B: Understanding modern materials behaviour - 20 gaps

B: Understanding modern materials behaviour [NHSS topic 1B]	#	sub sector	number of relevant projects identified	includes SHRP project?
general issues are..				
defining appropriate storage conditions	1	M		
understanding the impacts of different cleaning regimes and improved methods of cleaning	2	M	2	0
investigation of new treatment methods and assessment of their long-term impacts,	3	M		
standardisation of methods of condition assessment (ways to record extent and rate of deterioration) for plastics. Some work underway in EU POPART project	4	M		
improved monitoring of degradation	5	M	1	1
a lack of equipment/access to equipment for identification of plastics	6	M		
specific issues include...				
a need for better understanding of the future management and storage requirements of contemporary art, created using mixed media and non-artists materials	7	M		
a suitable and safely removed varnish for acrylic paintings	8	M		
methods of storage and improved understanding of the long-term stability of photographs, slides, negatives and cine film	9	M	1	1
the preservation of audio visual media including digital media	10	M	1	
non-damaging recovery/playback methods for degraded audio visual media	11	M		
defining ideal storage conditions for architectural drawing film	12	M		
the conservation and long-term management of acetate and other heat set document laminates	13	M		
further work is needed to...				
understand mechanisms and rate of concrete decay	14	BHE	2	1
reduce/slow concrete decay	15	BHE	1	0
improve in situ treatment of corrosion of concrete reinforcement	16	BHE	1	0
identify more sympathetic methods of concrete repair and replacement	17	BHE	1	0
review the range and stability of aluminium and aluminium alloys used in modern buildings, i.e. windows	18	BHE		
identify treatment options for plated metals	19	BHE		
assess long-term stability of polymers and other materials used in cladding systems	20	BHE		

Theme C: Creating appropriate environments - 6 gaps

C: Creating appropriate environments [NHSS topic 2A]	#	sub sector	number of relevant projects identified	includes SHRP project?
in addition to further research into materials behaviour, additional understanding is needed of...				
how buildings, and historic buildings in particular, perform	1	BHE	1	1
the use of natural ventilation, and other methods of passive environmental control	2	BHE		
the use of microenvironments to reduce deterioration,	3	M		
assess the level of moisture content that is sufficient to retard degradation	4	A		
improve the characterisation of the chemical and biological composition of burial environments (both urban and rural)	5	A	1	1
enhance characterisation of burial environments of maritime sites which are currently poorly understood	6	A	1	1

Theme D: Adapting to climate change - 13 gaps

D: Creating appropriate environments [NHSS topic 2B]	#	sub sector	number of relevant projects	includes SHRP project?
modelling of predicted change is needed to inform adaptation to...				
greater incidence and intensity of rainfall events on permeable structures	1	BHE		
the impact of wind-driven rain	2	BHE	1	1
the impact of increased storminess on salt spray	3	BHE		
the removal of water on individual buildings due to an increase in extreme rainwater events, i.e. capacity of rain water goods, drainage and roofs to cope with predicted storminess	4	BHE		
the impact of ground heave and shrinkage on traditional structures	5	BHE		
the impact of flooding and drying out on traditional materials and construction methods	6	BHE		
further research needed to facilitate more appropriate responses to...				
an improved understanding of thermal transmittance (U-values) of historic materials and constructions	7	BHE		
better methods to understand and quantify moisture movements within permeable structures (including internal environment as well as that within walls, floors etc.)	8	BHE		
enhanced knowledge of how historic buildings actually behave and were originally intended to behave, including resilience to climatic fluctuations	9	BHE	2	2
further calculations of the embodied energy of historic and traditional buildings	10	BHE		
effects of greater seasonality in rainfall or increased drought conditions on wetland sites	11	A		
effects of increased salinity from coastal inundation	12	A		
effects of increased temperature around coastal waters which influences the spread of woodborers on in situ maritime timbers	13	A		

Results - profile by theme

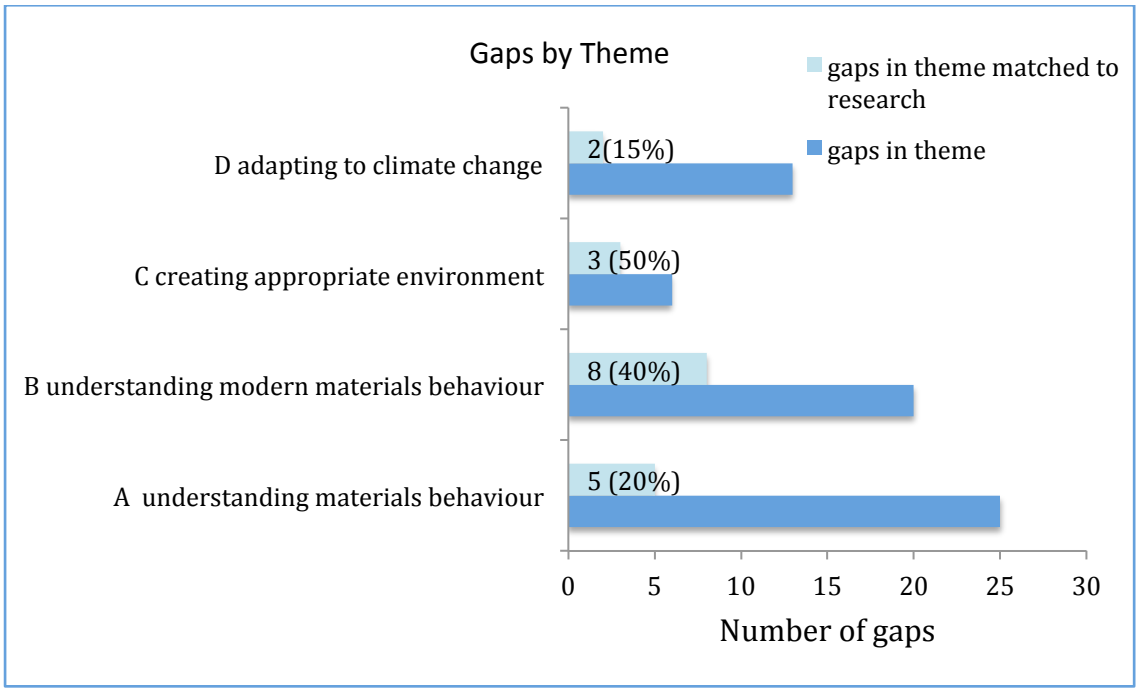

Figure 1. Gaps by theme

Results - profile by heritage sub-sector

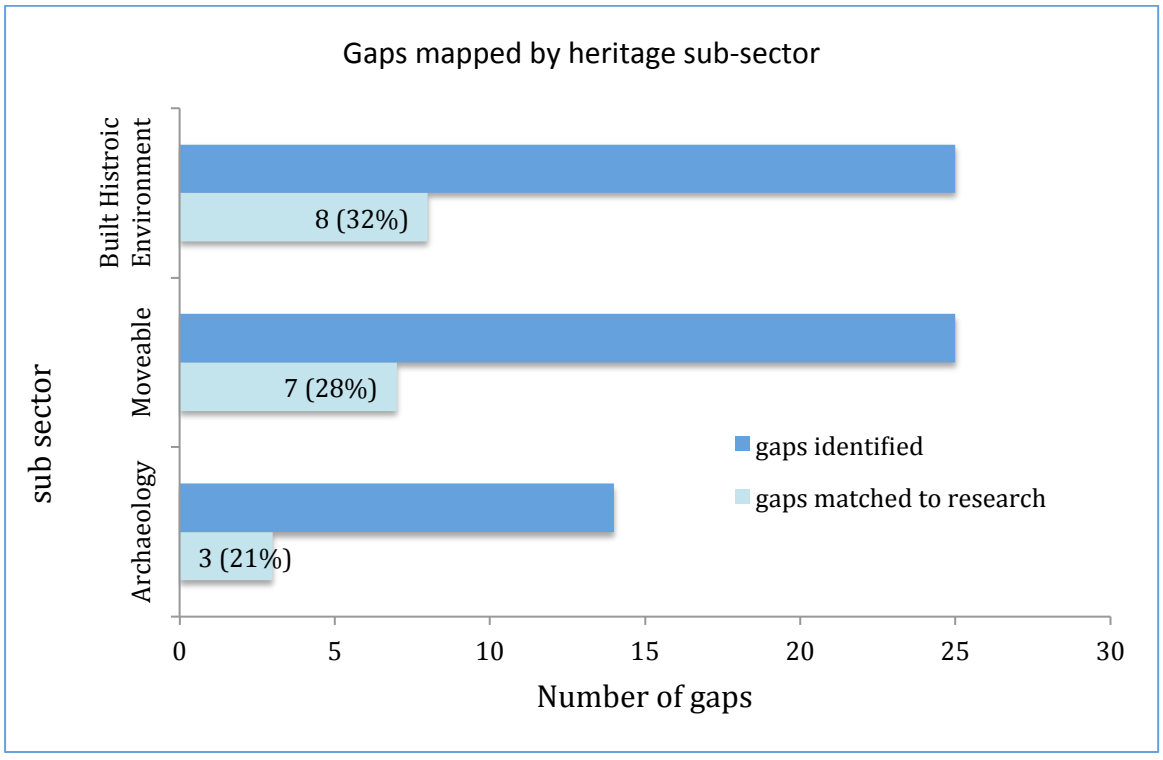

Figure 2 Gaps by sub-sector

Conclusion

In total the NHSS1 report identified 64 'gaps' - areas where it was felt more knowledge and understanding was needed. All 64 gaps were analysed and the topic searched by one or more search terms. It can be seen that results are not abundant and a number of factors may be considered here - for example, the very specific nature of the gaps; the interpretation of search returns, for which there was no scientific methodology applied. Equally, research projects are generally 2-4 years long so it is not unrealistic, perhaps, to anticipate a limited number of results.

Notwithstanding, it can be seen that the bulk of the gaps identified are in the moveable heritage and built environment sectors, but fewer than a third of these attracted a research return. The case was worse for the archaeology sub-sector, where less than a quarter of gaps here attracted a result.

With regard to the themes (topics) of gaps, understanding materials, including modern materials, is the theme where most gaps have been identified (45) - more than double those of the other theme - climate and environment (19). They yielded similar results, however, with 26% of gaps in understanding materials and 29% of gaps in understanding the environment attracting results.

If the results show clearly one thing it is the role of the Science and Heritage Programme, the projects of which form the bulk of the returns. Out of sector research results were significant, but nearly always discounted for not being relevant enough to the very specific nature of the gaps identified. That is not to say that they do not have the potential to be. For example, several of the gaps identified in NHSS1 relate to understanding modern materials, in particular plastics. For a search of 'Plastics AND polymers' on the research gateway, thirty industry-based projects are returned starting form 2010 or later. One of these is a project lead by the University of Reading "Multi-scale modelling of branched polymer melts in plastics. This is an active project funded by the EPSRC (Engineering and Physical Sciences Research Council). While not specific to any gap, with its research subject 100% materials science and research topic 100% materials characterisation, it is possible that some of the outcomes may be of relevance.

These results can only be a suggestion of which areas and which themes are attracting research, for in fact they pose more questions than they answer.
For example

- when is a gap deemed to be filled/addressed effectively (is it the number of projects it attracts or the quality and nature of the outcomes)?
- can it ever be?
- who is the arbiter of this?
- who monitors this?
- how is this information shared to avoid repetition/to develop research?

These are not insignificant questions and if and how they are answered will be of value in informing the continued delivery of the National Heritage Science Strategy and how far it is directed to addressing perceived gaps in knowledge and understanding in the heritage science sector.