

Model predicts 'shelf life' for library and archival collections

Heritage scientists at UCL have developed demographic models of decay and loss to predict when a large library or archival collection might age beyond repair.

Lead author, Professor Matija Strlic (UCL Institute for Sustainable Heritage) explained: "Although some library materials might easily survive thousands of years, some have internal clocks triggering faster decay. Using the demographic models, we can now easily predict how much more degradation will be induced by a hotter and more humid climate of the future, and perhaps more importantly, how this can be mitigated."

The three part report '*Damage Function for Historic Paper*' published today in *Heritage Science* explores what makes an historical paper unfit for use, the degradation of historical documents due to handling, and how heritage resources can be managed and stored with more economical and environmental sustainability.

The team developed an equation describing how the length of cellulose, the dominant macromolecule in paper, decreases with time depending on the acidity of paper and the environmental conditions during storage. Another model described how wear and tear accumulates with instances of reading of a book or an archival folder. The scientists looked at more than 600 historic documents from all over Europe to arrive at a general demographic model describing how ageing progresses and fitness is lost. Professor Strlic said: "We considered a heritage collection as a population of people and used census methods and ageing models to predict how a large library or archival collection might age beyond repair.

"In relation to the outcomes of the recent COP 21 climate change conference in Paris, the projected average increase of 2 degrees centigrade in the global climate will increase the rate of degradation of some heritage collections by around 50%, and a 4 degrees centigrade increase would halve their lifetime. We can either pump more energy into indoor climate control, which is evidently unsustainable, or use our demographic models to improve collection conservation and reduce energy use at the same time."

In addition to looking at the wear and tear of historic paper the reports also looked at the public's perception of the documents' fitness for use. Almost 800 members of the public in the UK, the Netherlands and the US were surveyed on what ageing and damage to heritage collections meant to them. Only 10% of those asked believe it is necessary for collection items to remain in a usable state for more than 500 years and about 50% think 100 years is enough. The level of acceptance of degradation was dependent on whether the object had an historical or personal value.

Professor Strlic added: "The public can be quite forgiving, and they often consider that if there are signs of degradation, these are 'signs of the good life the object has had.'"

Nancy Bell, Head of Collection Care for the National Archives, UK said: "We have shown that it is possible to optimise the preservation of a collection while reducing energy consumption, and meeting carbon reduction targets. Using the developed demography models we can manage heat and humidity more smartly during long-term storage."

The Collections Demography project was jointly funded by the UK Arts and Humanities Research Council and the Engineering and Physical Research Council through the Science and Heritage Programme. "This unique project has shown the significant benefits of support

for cross-disciplinary research combining physics, social science, chemistry, conservation, environmental modelling and heritage management” said Professor May Cassar, Director of the Programme.

The project was a partnership of UCL, the UK National Archives, the US Library of Congress, the Dutch National Archives, English Heritage, and University of East Anglia.

Notes to editors:

For a copy of the paper or to speak to the researchers, please contact Rowan Walker in the UCL press office, T: +44 (0) 20 3108 8515/ E: rowan.walker@ucl.ac.uk

The 3 part report Damage Function for Historic Paper. Part 1: Fitness for use, Part II: Wear and Tear and Part III: Isochrones and Demography of Collections are available for download on the journal [Heritage Science](#).

About UCL (University College London)

UCL was founded in 1826. We were the first English university established after Oxford and Cambridge, the first to open up university education to those previously excluded from it, and the first to provide systematic teaching of law, architecture and medicine. We are among the world's top universities, as reflected by performance in a range of international rankings and tables. UCL currently has over 35,000 students from 150 countries and over 11,000 staff. Our annual income is more than £1 billion.

www.ucl.ac.uk | Follow us on Twitter [@uclnews](https://twitter.com/uclnews) | Watch our YouTube channel [YouTube.com/UCLTV](https://www.youtube.com/UCLTV)



Left: Repositories of The National Archives, Kew; right: Library at Brodsworth Hall, English Heritage.



Internal chemical triggers lead to inherent instability of paper and consequently, loss of historic information. Using the collection demography models, resources for preservation and access to collections can now be optimally managed.