

# LIGHTFADING TESTING AT THE NLA

**Susanne Wullen**

National Library of Australia

On two occasions over the last 18 months the National Library of Australia has asked Bruce Ford to carry out lightfastness testing of selected collection material that had been chosen for exhibition in the Library's new Treasures Gallery. Due to the limited nature of funds and available time, only material which was considered potentially high-risk was selected for testing. This included highly significant, mostly original, historic watercolours which had had little or no exhibition history, modern material with known problematic lightfastness such as highlighter pen, and some Priority 1 materials of unknown sensitivity which were desired for permanent exhibition.

Testing revealed that indeed some of the selected materials were highly susceptible to light damage, so much so that even just one iteration of 4 months under exhibition lighting conditions would have caused noticeable fading. Testing allowed the Library to make informed decisions about permissible exhibition length for individual high priority items, and also indirectly led to the formulation of an illumination policy that defined for the first time the period of time in which an object is allowed to suffer one 'Just Noticeable Fade'.

## INTRODUCTION

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As you might be aware, the National Library of Australia has recently opened its Treasures Gallery. For the first time, we have a gallery where some of the Library's treasures will be on permanent or semi-permanent display. As we all know, light exposure can cause irreversible damage. In the past, we have relied on the literature to make educated guesses about the likely sensitivity of materials to light. For example, we might say that watercolours in general are likely to contain 'sensitive' pigments. In practical terms, this was often translated into a guess at sensitivity being around BW2, i.e. halfway between BW1 and BW3, which defines the 'sensitive' range. Blue Wool ratings correlate to precise figures in terms of how many accumulated lux hours are likely to lead to fading, and display length was limited in accordance with those figures. However, this process is far from precise or accurate. We therefore decided that we needed a better process and clearer policies to help guide decisions regarding how long and how often potentially vulnerable high priority items can be on display.

We were aware of the work Bruce Ford was doing at the National Museum of Australia. He uses a spectrophotometer attached to a very bright xenon

light source to measure fading in real time. This allows fading rates to be precisely determined for items as they are today, i.e. independent of exhibition history, and it does not require identification of pigments or media. The technical details behind the technology and the process are described in the literature, so I will not be going into any more detail here.

## OBJECTS TESTED

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We decided that a total of sixteen high priority items would be tested for light sensitivity. All were of the highest significance, and many were considered to have a high likelihood of containing fugitive pigments. Some were desired for potentially lengthy display periods. For this paper I have selected items that are both interesting in terms of the results, as well as photogenic!

### *Drawings by Eddie Mabo*

The first items Bruce tested were a series of four felt tip and highlighter pen drawings by Eddie Mabo. As you might be aware, Eddie Mabo was the lead plaintiff in the most important land rights case in Australian history – when in 1992 the High Court decided, after ten years of proceedings, that Australia had not been in fact “unoccupied” when

European settlers first arrived. The Library is fortunate enough to own the papers of Eddie Mabo's lawyer, Bryan Keon-Cohen. The entire manuscript collection was inscribed on the UNESCO Memory of the World Register in 2001.

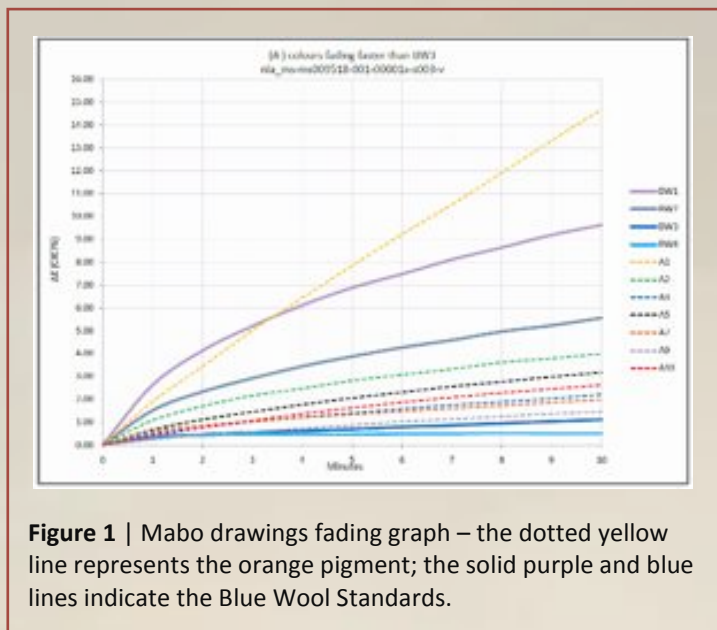
The maps are of the highest importance, most likely highly vulnerable to fading, and potentially desired for long-term display. We therefore decided that these maps would be ideal candidates for light fading testing, and we approached Bruce and the National Museum of Australia for permission to have it done.

The results basically confirmed what we had suspected. Felt tip pen and highlighter are not media that are robust when it comes to fading.

The results of the testing are expressed in terms of Blue Wool Standards, which as you might know are a measure of the sensitivity to fading of materials, with Blue Wool 1 (BW1) representing the most sensitive, and BW8 the most robust. The scale is logarithmic, in other words the number of lux hours needed to cause noticeable fading increases roughly by a factor of three with each increase. In other words, materials which are rated BW1 will fade noticeably after 300,000 lux hours, materials which are rated BW2 will not fade noticeably until around

1,000,000 lux hrs, and BW3 not until 3,000,000 lux hours. BW4 takes us to 10,000,000 lux hrs, and for practical purposes is the most robust level of lightfastness indicated in Bruce's results.

In terms of our results for the Mabo maps, a lot of colours ranged in sensitivity between BW1 and 2, many others were situated between BW2 and BW3. However, one orange pigment proved to be significantly more fugitive than even BW1. From the graph in Figure 1 we can see that the fading curve is



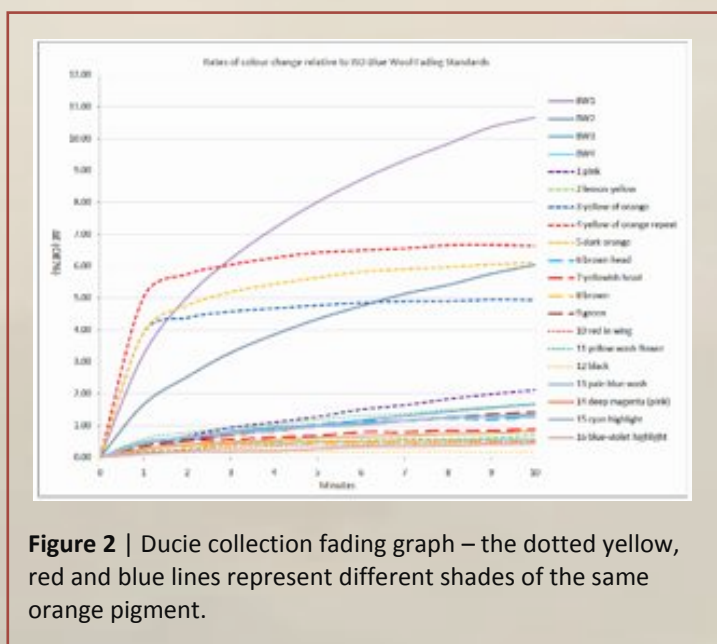
**Figure 1** | Mabo drawings fading graph – the dotted yellow line represents the orange pigment; the solid purple and blue lines indicate the Blue Wool Standards.

unusual in that it doesn't level off over time as most other pigments do. Having the hard data to back up our claims that the material was very sensitive to light made the subsequent decision-making process much easier, as we could ask collection managers to decide how much fading they were prepared to accept over a given period of time. So, given that we want these maps to be available for other exhibitions in the future, it has been decided that for now these maps will only be on display for two weeks each

(there are a total of eight maps, four of which were tested).

## The Ducie collection

This collection was acquired by the Library in 2005, and consists of watercolour drawings of birds and flowers painted in the very early life of the colony, most likely during the First Fleet's visit to



**Figure 2** | Ducie collection fading graph – the dotted yellow, red and blue lines represent different shades of the same orange pigment.

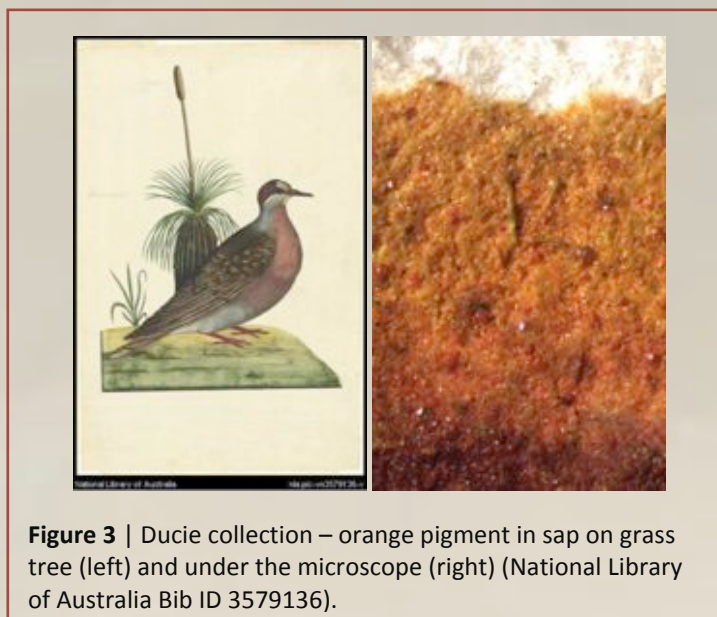


Sydney Cove in 1788. Many images are strikingly similar to images in the Hunter sketchbook, though much more artistically impressive and detailed. They had never been exhibited, and the colours appear amazingly fresh and bright.

Bruce Ford tested all the colours in the collection of over 50 paintings, but for obvious reasons not every colour on every painting could be tested. In the course of testing, one pigment, also an orange, was identified which was particularly sensitive, initially fading faster than BW1 before levelling off (Figure 2).

We subsequently looked under the microscope at every painting containing orange, in an attempt to visually distinguish the different oranges that were present in the paintings. Thankfully, the problematic orange was quite distinctive under the microscope (Figure 3), and careful checking allowed us to prepare a list of nine paintings that should be protected from light exposure as much as possible.

In general terms, looking at the data this orange was by far the most sensitive pigment. The next most fugitive colour was a cornflower blue that tested at about BW2.5.



**Figure 3** | Ducie collection – orange pigment in sap on grass tree (left) and under the microscope (right) (National Library of Australia Bib ID 3579136).

## The Hunter Sketchbook

The Hunter sketchbook is a collection of watercolours painted by John Hunter, the first governor of the colony of New South Wales. Hunter copied the drawings of many others, including apparently those of George Raper, to whom the Ducie paintings have been attributed.

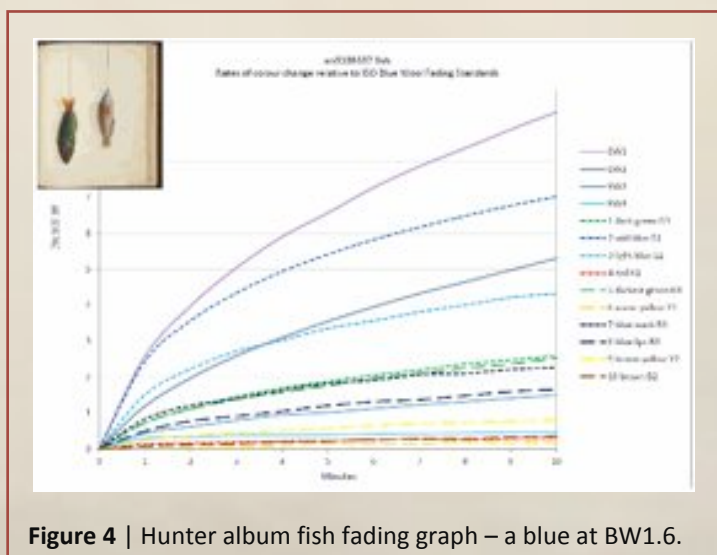
The results for the Hunter sketchbook were different in that the reds and yellows proved to be relatively robust, while a number of blue and green pigments were more sensitive than BW2 (Figure 4).

## The Lycett Album

The Lycett album is an album of watercolours by convicted forger Joseph Lycett. The paintings depict rituals and customs of indigenous people and were painted in around 1820. As in the Ducie collection, the colours look bright and fresh for paintings of their age (Figure 5).

Many pigments in the Lycett album proved to be more robust than we would have expected. The most sensitive pigment was a light green

(which unfortunately is present in all the paintings) that tested at BW2.5, thus setting the upper limit for exposure (Figure 6).



**Figure 4** | Hunter album fish fading graph – a blue at BW1.6.

## The Doncker Atlas and a Book of Hours

Examples of items that were found to be significantly less sensitive than expected include the Doncker Atlas and a Book of Hours from the Clifford collection. The Doncker atlas was published in Holland in 1659. As a bound item illustrated with watercolour it was thought to be potentially sensitive, however the most fugitive pigment, a thin yellow wash, came in at BW2.9, which was less sensitive than expected.

The Book of Hours is an illuminated manuscript on parchment from the 15<sup>th</sup> century. The most fugitive pigment was a red at BW2.8, while most other pigments were more lightfast than BW3.

## Other results

Two other results are probably worth mentioning.

The Endeavour Journal, i.e. the journal Captain Cook kept on his voyage to Australia and arguably the most important manuscript in Australia, was found to be somewhat more light-sensitive than we might have expected. The iron gall ink used for the text tested on average around BW2, ranging from BW1.7–2.3, while the red ink he used for dates proved to be relatively lightfast, testing at BW3.6 and 3.9.



Figure 5 | Example work from the Lycett Album (National Library of Australia Bib ID 2428221)

The Bligh Notebook, which Captain William Bligh kept after being evicted with some of his men after the famous mutiny on the Bounty, was also written in iron gall ink, which similarly tested at BW2.0 and 2.4. However, the ink used for the title page and signature, and the ink used for the List of Mutineers, appears to

be a different formulation, testing at BW2.8 and 2.9.

## CONCLUSION

We selected items for testing which we believed had a high likelihood of containing very sensitive pigments – i.e. potentially sensitive items which appeared not to have had a lot of light exposure in the past.

Light-fading testing has allowed us to identify several highly sensitive collection items that would have been damaged if displayed even for relatively short periods of time under normal exhibition conditions.

Had we not done the testing, chances are they would have been irreparably damaged during exhibition as that kind of sensitivity is extremely rare, at least in historic materials, and can clearly only be found in

items which, as well as being highly fugitive to start with, have seen minimal light exposure.

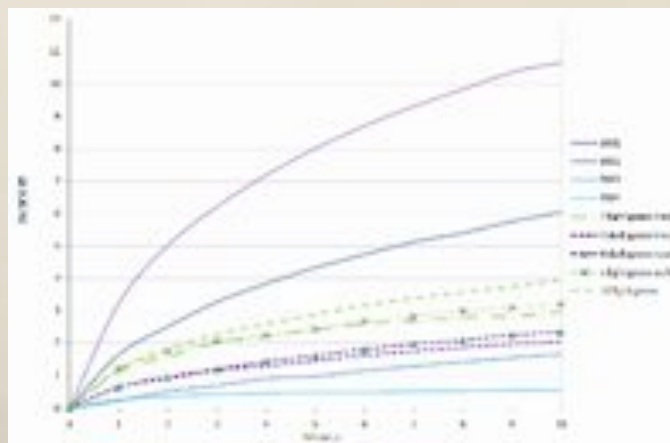


Figure 6 | Lycett album graph – relative rates of colour change and fading curves (greens).



On the other hand, testing also showed that not all the items that we believed were sensitive contained highly fugitive pigments. Quite a few of the objects tested proved to be relatively robust, meaning they can be on display for significantly longer than would have been the case had we been forced to base our display length recommendations on guidelines from the literature only.

Testing has shown that the educated guesswork we have relied upon in the past is not adequate in terms of protecting potentially highly sensitive materials. At the same time, it could also lead to being unnecessarily conservative in exhibiting other materials that are no longer light sensitive, or possibly never were.

Light-fading testing is an important new tool for assessing safe display lengths for our most important collection items.

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## AUTHOR BIOGRAPHY

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**Susanne Wullen** graduated with a Bachelor of Applied Science in Conservation of Cultural Materials from the University of Canberra in 2005. She has been working in Preservation Services at the National Library since 2001. Her interests and responsibilities have included working on the Cellulose Acetate project, environmental monitoring and preventive conservation, exhibitions and lighting, as well as general treatment work.

