PROTECTING THE MOST IMPORTANT, MOST EXHIBITED AND MOST FUGITIVE MUSEUM OBJECTS FROM LIGHT-FADING

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ABSTRACT – In late 2007 the authors were asked to review the National Museum of Australia's lighting guidelines because the Conservation and Finance Managers had serious concerns about the cost of light-driven object replacements. Two underlying factors, both potentially able to be addressed, were found to be responsible for the high replacement rate. The first was a lack of reliable fading-rate data for much of the collection, leading both to conservative and inflexible display restrictions and probable over-exposure of the most fugitive colorants, which could not be reliably identified. The second was an implicit assumption that, for the purposes of setting display periods, all objects are equally likely to be displayed, and therefore equally exposed to light over time.

The Museum subsequently acquired an Oriel® Fading Test System by Spectra Physics that has proven to be a highly cost effective means of distinguishing materials at real risk of unacceptable fading from those for which exhibition times may safely be extended. The micro-fading results inform a lighting regimen in which objects of high significance to the museum, and therefore likely to be in regular demand for exhibition, are given the same or less exposure per exhibition period than before, and the majority of less-used items allowed more exposure when exhibited. This dual approach allows the museum to concentrate its resources on the most important, most displayed, most fugitive – and therefore most vulnerable – colorants in the collection.

PROTECCIÓN DE LOS OBJETOS DE MUSEO MÁS IMPORTANTES, MÁS EXHIBIDOS Y MÁS FUGACES DE LA DECOLORACIÓN POR LA LUZ: RESUMEN – A fines de 2007 se pidió a los autores que revisen las normas de iluminación del Museo Nacional de Australia debido a que los Gerentes de Conservación y Finanzas tenían serias preocupaciones con respecto al costo de reemplazos de objetos afectados por luz. Se determinaron dos factores subyacentes, ambos potencialmente tratables, como los responsables del alto índice de reemplazo. El primero era la falta de datos confiables sobre el índice de decoloración para gran parte de la colección, lo que causaba restricciones de conservación e inflexibilidad de la muestra y probable exposición excesiva de los colorantes más fugaces, que no podían ser confiablemente identificados. El segundo era una presunción implícita de que, a los efectos de establecer periodos de exhibición, todos los objetos se exhiben de igual manera, y por lo tanto se exponen de igual manera a la luz con el paso del tiempo.

El Museo posteriormente adquirió un Sistema de Prueba de Decoloración Oriel® de Spectra Physics que demostró ser un medio sumamente rentable para distinguir materiales en riesgo real de decoloración inaceptable de aquellos para los cuales se podría prolongar con seguridad los tiempos de exhibición. Los resultados de la microdecoloración advierten de un régimen de iluminación en el cual los objetos de mayor importancia para el museo, y que tienden a tener una demanda regular de exhibición, reciben la misma exposición o menos por cada periodo de exhibición que antes, y la mayoría de los artículos menos utilizados reciben mayor exposición al ser exhibidos. Este doble enfoque hace que el museo concentre sus recursos en los colorantes más importantes, más exhibidos, más fugaces; y por lo tanto, más vulnerables de la colección.

1. INTRODUCTION

The National Museum of Australia (NMA), which first opened to the public in 2001, is a social history museum tasked with representing the continent's long human occupation. At present this is achieved through a series of 'permanent' exhibitions on the themes of Land, People and Nation that are refurbished every ten years, and through temporary exhibitions, usually of less than one year's duration, which examine particular social and historical topics. The museum has a large and varied textile and natural fibre collection covering traditional and modern indigenous Australian and Torres Strait Island items, and non-indigenous textiles from the early colonial period of the late 18th century until the present day. These include colorants predating the first synthetic dyes of the mid-19th century, and a range of synthetic and natural dyes employed in hand and factory fabric dyeing and printing since that period.

Published fading rate data for these textiles, and a vast range of other colored objects in the collection, is sketchy at best; nevertheless light-exposure decisions need to be made on the basis of conservators' experience and the best evidence available. In 2000 the Conservation Department adopted a slightly modified form of the exhibition lighting guidelines (Tait et al 2000) developed at the Victoria and Albert Museum (V&A) in the late 1990s (Derbyshire & Ashley-Smith 1999, Ashley-Smith et al. 2002), which built on earlier work by Colby (1992). A similar approach was subsequently taken by the International Commission on Illumination in their technical report on the control of damage to museum objects by optical radiation (CIE 2004). In the NMA's implementation of the V&A guidelines objects of (estimated or assumed) lightfastness ranging from the most unstable down to ISO Blue Wool 4 (BW4) equivalent were labelled "sensitive", and with their exposure based on an average stability of BW2, limited to two years display at 50 lux. More stable material classified "durable" (BW5-7) and "permanent" (BW8) could withstand proportionally greater or indefinite cumulative exposures. Higher light levels could be traded off against shorter display times providing cumulative exposures were tracked over time.

Like the Netherlands National Museum of Ethnology, however, the Museum found that in practice "[the] amount of work that such an extensive replacement programme would entail … [was] … a major problem" (Reuss et al. 2005, 693). At an estimated average cost of $1000 per light-driven changeover, including curatorial time locating and interpreting suitable replacements, registration activities, conservation, de-installation, re-installation, relighting and so on, application of the guideline was costing the NMA hundreds of thousands of dollars a year without a clear commensurate benefit. A way was needed to reduce costs and, perhaps even more importantly over the long term, address concerns that the BW2 average exposure for the 'sensitive' range over-exposed (by definition) the most fugitive materials. Another aim was to introduce more flexibility in lighting levels, including an option to exceed the 50 lux limit that in practice applied to most colored materials, and which for reasons outlined by Michalski (1997) are often too low for adequate viewing. These include low contrast and fine detail, viewing distance, darker objects and the inevitable decline in visual acuity that accompanies age related macular degeneration.

2. REVIEW OF LIGHTING GUIDELINES

When the Museum's past practices and experiences as well as a range of other museums' lighting policies were reviewed, two factors emerged as contributing most to the high cost of protecting the collection from excessive light damage. Each problem related to a different aspect of a general inability or unwillingness to impose exposure restrictions selectively rather than across the board.

The first and most obvious reason was gross uncertainty about the specific or even general lightfastness of the majority of the collection, which saw nearly all colored textiles classified as "sensitive" as a matter of precaution. With relatively few exceptions relevant light fastness data in the literature is limited to generalisations based on accelerated studies of newly prepared surrogate samples of mostly European historical interest. In practice it is rarely possible or economically feasible for conservators to routinely identify dyes and pigments. Even if this were not the case a colorant's identity does not determine crucial aspects of its light-fastness. Just as important are the extent to which fading has already occurred, dye preparation and application, substrate and other constituents, mordant type and concentration, depth of shade, pollutants and contaminants, washing, and the botanical origin and growing conditions of natural dyes.

Ideally, exposures would be based on monitoring the color change of individual objects under museum lighting conditions, however while this is sometimes feasible (Ford 1992), it is extremely time consuming and difficult or impossible in many cases for technical reasons. Accepting that accelerated techniques are necessary, Whitmore's (1999) microfade tester appeared to be the most practical way of bridging the information gap because it offered routine, rapid, and non-destructive access to object specific fading rate data.

The second factor – which none of the published guidelines addressed despite being based on hypothetical display lifetimes of several hundred years – is the underlying assumption (for the purpose of calculating exposure limits) that all objects are equally likely to be displayed, and therefore equally at risk of fading over time. In reality only a small proportion of the potentially light-sensitive objects in the Museum's collection are in such constant demand. From this it follows that equally restricting access to all objects irrespective of their likely display frequency is a costly overreaction, and if there were a way to estimate an object's "future display history" the less likely-to-be displayed part of the collection (the majority) might be left on exhibition longer without exceeding the cumulative color change targets in the existing guidelines. This idea had the merit of potentially reducing the cost of light driven replacements even without better fading rate data, although it would do nothing to identify and safeguard the most fugitive colorants.

Garry Thomson (1986, 33), who is most often cited as the authority for limiting the display of nearly all potentially fugitive materials to short periods at very low light levels, had actually addressed both of these issues when he recommended 50 lux 'for all very valuable material[s] ...that are especially sensitive to light'. He succinctly summarises the case for selectively restricting display, however the qualifier "for all very valuable material' – referring to objects for which there is most exhibition demand and for which the loss of value is potentially greatest – appears to have been largely ignored as conservators rushed to conform to unofficial international "standards" and researchers focused their attention on fading rates.

3. USING SIGNIFICANCE ASSESSMENTS TO REDUCE LIGHT-DRIVEN OBJECT REPLACEMENTS

Identifying and ranking significance in a consistent and meaningful way for museums has been systematically addressed by the Collection Council of Australia (CCA), whose significance assessment methodology (Russell & Winkworth 2009) is based on the 1979 ICOMOS Australia 'Burra Charter" (ICOMOS 1999) which has been used for over 30 years to prioritise and guide conservation decisions for cultural sites. Notwithstanding that some conservators were trained to believe it is unethical to base conservation decisions on value judgements (the so-called Rembrandt Rule), there is nothing new or particularly controversial about doing so, in fact it is impractical not to. The Burra Charter has evolved into an approach to heritage management called "Values Based Management (VBM)" (UNESCO 2010) and there is a growing literature on the subject for museums, particularly in relation to risk management (Michalski 2004, Waller 2003) where significance is used to measure potential loss. It is endorsed by AIC's sister organisation in Australia, the AICCM, whose code of ethics states (AICCM 2002, 4):

> [i]t is recognized that the significance of cultural material may have a bearing on conservation decisions. Accordingly ... the AICCM Member shall ensure that cultural material in her/his care receives levels of conservation appropriate to its significance and available resources.

The CCA publication breaks significance down into four overarching socio-cultural categories: historic, aesthetic, research and social or spiritual. Objects or collections are ranked in relation to one another within these categories according to comparative criteria: provenance, representativeness, rarity, condition and, importantly for a social history museum like the NMA, interpretative potential.

A statistical analysis of past exhibitions revealed that it was necessary only to sort objects into two categories, 'high use' and 'the rest', to significantly reduce light-driven changeovers by allowing those in the second category to remain on display longer. An exposure guideline was developed (table1) in which objects not considered likely to be in continuous demand for exhibition would be 'downgraded' to the next most stable category where their total color change over time remains much the same or less than their equivalent sensitivity 'high use' counterparts. An object, for example, that would be limited to 2 years display on the basis of its assessed blue wool rating (4 replacements/permanent exhibition assuming it is replaced with similar objects), could be displayed for 5 years (1 replacement) if it were not in the "high use" group – a saving of 75% in replacement costs. In developing this guideline the V&A's color change limit of 1 Just Noticeable Fade (JNF)/50 years was retained, while recognising that, for various reasons, counting JNF's may not be realistic (Ford & Smith 2009). The specific display intervals were kept in place because they were already embedded in forward work schedules incorporating 2 and 5 year changeovers.

The two tiered approach in table 1will be trialled when the administrative and organisational arrangements, such as how significance is documented, recorded and communicated, and how frequently significance assessments should be repeated to account for changing circumstances, have been finalised. In the meantime display durations are set as if all objects are in the high significance/high use category and exposure is determined purely on the basis of microfading results. The strong intention is to avoid applying the criteria mechanically or inflexibly because fading rates and light levels are only part of the decision making process; for example the handwriting on an important historic document was determined to be relatively lightfast (BW4-3) according to microfade testing, but only because it was already very faded. With this in mind the lighting recommendation was much more conservative than the fading rate data would normally indicate because the contrast between the yellowing ink and the parchment was already very low and would likely decline seriously with any additional change.

Eventually a combination of pre-selection using significance and more valid generalisations based on previous testing should cut the proportion of objects tested, with the caveat that it is not unusual for superficially similar materials to test very differently. For this reason all high significance objects will be fade-tested individually unless there are very good grounds for not doing so.

ISO (BW#)	< about BW2	about BW2 –3	about BW3 –4	> about BW4
	about 50 lux	50-100 lux*	50-150 lux*	100 -250 lux*
Exposure of high significance (high use) objects	individually decided	2 years/decade	5 years/decade	life of exhibition
Exposure of average significance (lower use) objects	Individually decided	5 years/decade	life of exhibition max 10 years	life of exhibition max 10 years

*as low as possible consistent with good display.

Table 1.Significance based lighting framework, where BW = ISO Blue Wool Fading Standard, based on a color change target of less than 1 Just Noticeable Fade/50 years.

4. MICROFADING

The V&A's exposure recommendations for colorants less stable than BW4 are based on an average fading rate of BW2. This 'underexposes' the more stable colorants according to the 1JNF/50 year criterion, imposing unnecessary and costly access restrictions, and risks over-exposing colorants whose lightfastness is less than BW2. These are the very dyes and pigments that will suffer significant damage over a relatively short period of display, even under museum conditions. The logical way to contain costs (if one is reasonably sure of relative fading rates) is to allow those at the lower end of the 'sensitive' range greater exposure than the more fugitive ones, where the increase is justified by the twofold decrease in stability for each numerical step up the ISO Blue Wool increments. This approach was adopted by the Netherlands National Museum of Ethnology, whose conservators subdivided the 'sensitive' range into 'sensitive 1' (BW1 or worse), 'sensitive 2' (BW2-3) and 'sensitive 3" (BW3-4), with an additional 'vulnerable' category containing 'sensitive 1' objects that are also pristine (Brokerhof et al. 2008). Incidentally, the last category is actually a significance judgment based on 'condition' and probably 'rarity' as well, since pristine-ness is not a common characteristic of historic materials of low lightfastness. We believed that in practice, however, sorting objects in the Museum's very diverse collection into such narrowly defined categories would often amount to little more than guesswork.

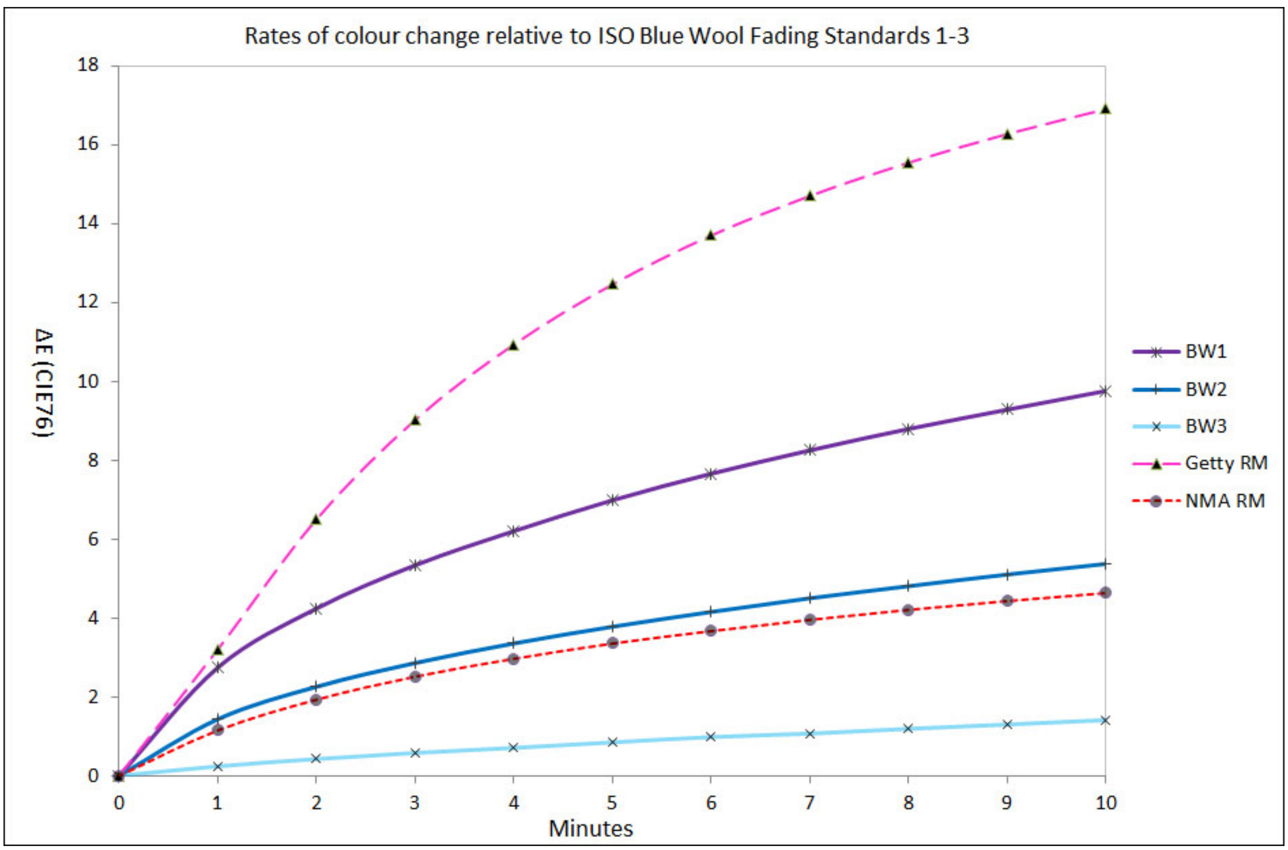

Figure 1. Fading rate curves, separate tubes of W&N Rose Malmaison purchased in the USA (Getty) and Australia (NMA).

In 2008 the Museum acquired a Newport Oriel® Micro Fade Tester and since then accelerated lightfastness measurements have been made on hundreds of objects representing well over 1000 colorants. Direct measurement approaches like Whitmore's (1999), and also Pretzel's (2000, 2008) studies of the Bullerswood and Ardabil Carpets, cut through the maze of unknowns (and unknowables) by rapidly and non-destructively quantifying – to the extent possible with accelerated ageing – the lightfastness of the item intended for display. It is completely unnecessary to know the identity of colorants and substrates or specific dyeing processes and subsequent history; although where this kind of information is available it provides a fascinating physical and chemical context for micro-fading results.

Conversely there is good reason to believe that with the benefit of accumulated data on relatively well characterised colorant and substrate systems, micro-fading will complement existing analytical methods on the basis of reflectance spectra and spectral and colorimetric change under test conditions. A glimpse of this potential is provided in figures 1 and 2, where two very similar paints are clearly distinguishable by their fading rates and colorimetric change. The spectral data (not shown) provides additional information.

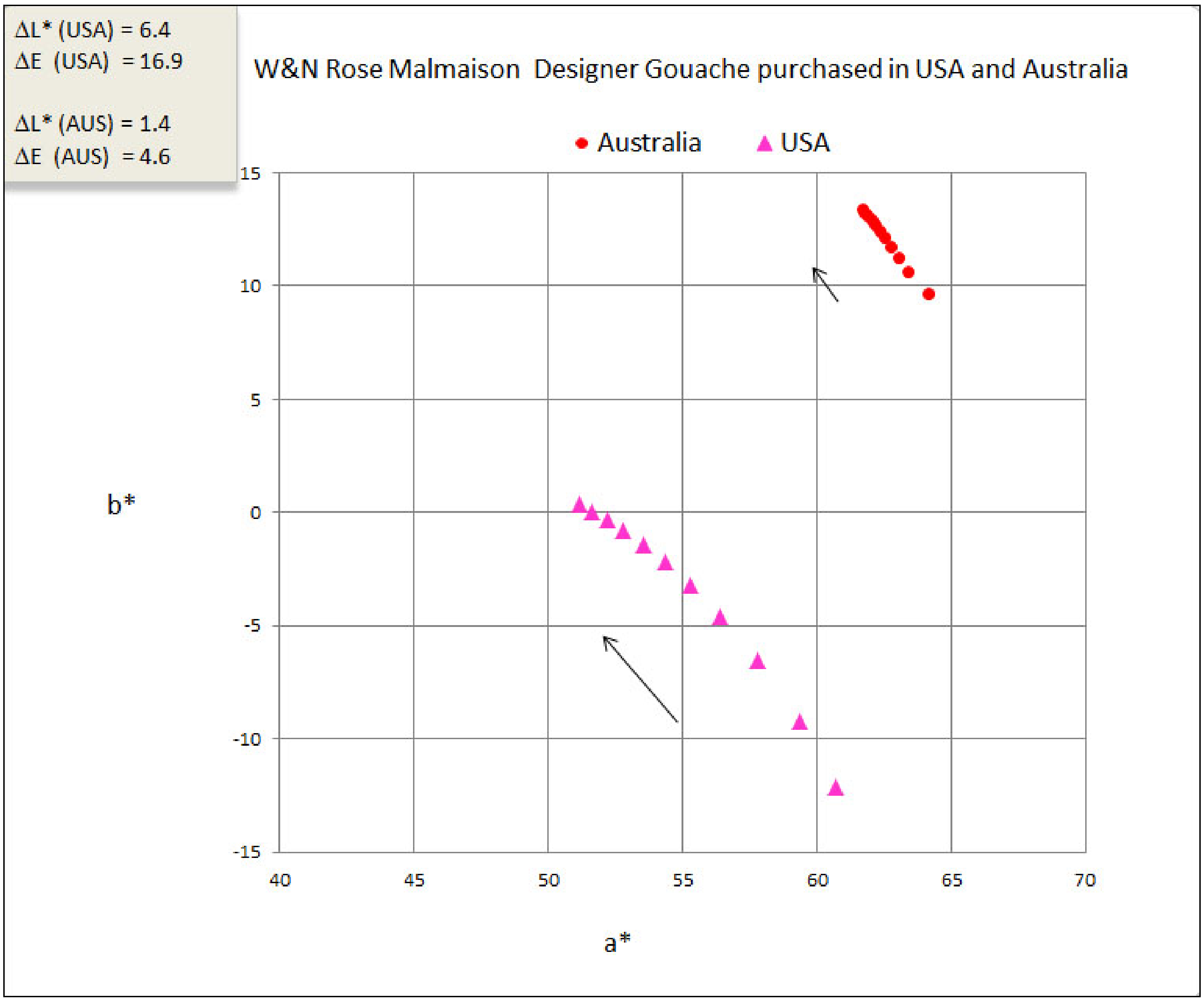

Figure 2. CIEDE76 a* b* plot, W&N Rose Malmaison USA and NMA. Clearly shows the two paints are different.

One of the difficulties with using the existing tables is that the assumed stability depends on qualifiers such as “most” (furs), “cheap” (synthetic colorants) “good quality” (acrylics, paper) or “carbon” (inks), however even leaving aside prior exposure and other factors that profoundly affect fading rates, how is the exhibition conservator to tell? In fact, one of the most consistent lessons from microfade testing is that lightfastness is often unpredictable. Winsor and Newton’s ‘Rose Malmaison’ designers’ gouache is a good example. Two different tubes of this rhodamine based paint, which has a manufacturer's light fastness "c" rating (poor), were microfade tested by the GCI and the NMA. Its lightfastness had also been determined by microfading and published by Whitmore (1999); the labeling of the two tubes (one bought in the USA and the other Australia) were identical; both were painted out on filter paper; and neither had received prior exposure to light. Furthermore according to Winsor and Newton there had been no changes in formulation. This is the best possible scenario for using V&A or CIE type heuristic guidelines, however the paint from each of the tubes reproducibly faded at very different rates and occupied different positions on the a* b* plane of the CIE76 L*a*b* color space (figs. 1 & 2). Exposures based on the NMA's tube at BW2 would seriously overexpose paint from the GCI's tube, which was much less stable than BW1.

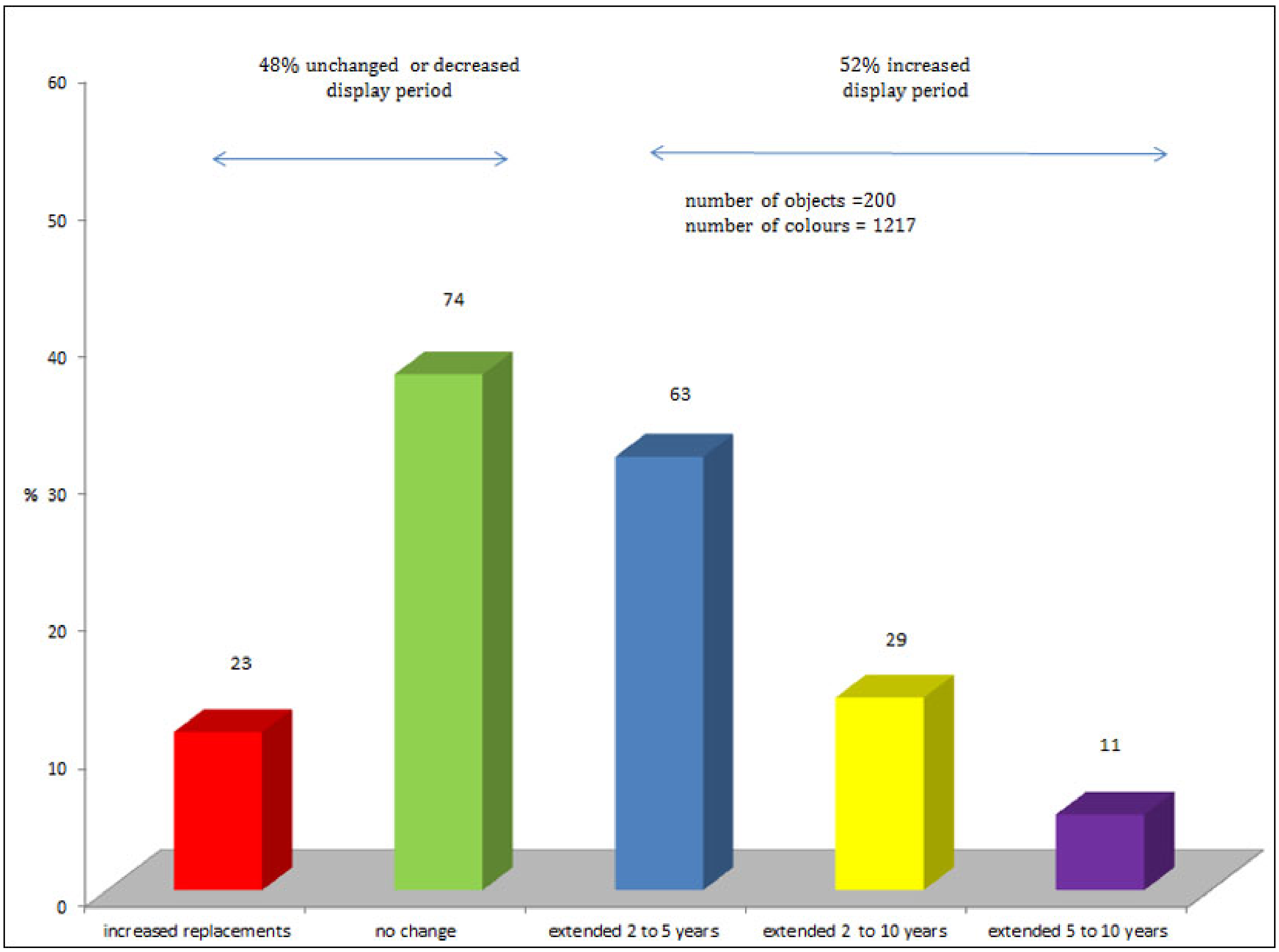

Figure 3. Changes to recommended exhibition duration based on microfade testing of 200 objects selected for exhibitions during 2009-10.

Shortly after the acquisition of the O-MFT routine microfade testing began on most colored objects destined for 'permanent' exhibition, ranking their lightfastness against the ISO Blue Wool fading standards 1-4. In most cases, the exhibitions in question were already in place; however changes to light-driven replacement rates for 200 objects in figure 3 show that if microfade testing had been carried out from the outset, 70-80% of replacements would have been avoided over the exhibitions' (10 year) display cycle. At $1000/replacement, this would represent a saving in the order of $700,000 to $800,000 per year to the museum. As it is for the 200 objects tested, more than 800 changeovers have been saved over the remaining lives of the exhibitions, largely by extending the display of objects in the two year category out to five. According to these figures the benefit of microfading is at least an order of magnitude greater than the cost of testing.

As expected, a significant minority of objects (12%), some of them very important, would certainly have been over-exposed if they were displayed for 2 years at 50 lux according to the criteria underpinning the old heuristic guidelines. While many of them were predictable (daylight fluorescent colors for instance) others were not: for example black inks on good quality paper and even artists' acrylic paints which under the old NMA guidelines (Tait et al 2000) were all considered "durable" and eligible for permanent display at 150 lux.

5. CONCLUSION

Lighting decisions are often a source of tension in museums where conservators have been cast – or cast themselves – in the unfortunate role of "lighting police" (Michalski 1990, 586). It is uncomfortable to enforce rules based on inadequate data, especially when it has such a serious impact on access, other people's work, and operating costs. Collection care is increasingly defined as a process of "making well informed decisions to prioritize and allocate resources to optimize the value of our collections" (Brokerhoff 2006, 1) and in the context of light exposure, museums badly need the better data microfading affords. A significance filter will help to identify objects in high demand and therefore more exposed to light over time, and also more broadly to define the values which conservation aims to protect, whether they are physical integrity, historical and spiritual associations, information content or pristineness. In this sense the lighting project is a useful test case for the wider introduction of risk management principles based on minimizing loss of value(s) (Waller 2003). Even in relation to color alone there are factors other than light whose effects need to be weighed up against exposure related damage, for example thermal yellowing, or physical changes to feathers where color is partly or wholly structural in nature.

The Museum's old lighting guidelines resulted in well-intentioned, but unnecessary over-protection of about half of all objects in long-term displays, and over-exposure of a vulnerable minority that are not easy to predict. Their application seriously limited access to many objects and spread the available resources over the whole collection instead of concentrating on the objects at greatest risk. A greater than necessary number of sometimes fragile objects were subjected to physical interventions and handling, and unreasonably low exhibition light levels were generally adopted. While microfading is a relatively new technique, and there will always be uncertainty about the correlation between accelerated and museum fading in any particular case, there is little doubt that at worst it reliably flags very fugitive colorants. It is the best available scientific risk management tool to selectively limit light damage at this time, and it has given the NMA the confidence to display its collection to best advantage now, and to keep it for the benefit of visitors and scholars well into the future.

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