Chapter 13

Management of mycological problems at the National Library of Scotland – A multidisciplinary holistic approach to environmental conservation - A case study

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1 Summary

The purpose of today's paper is to give a brief outline of the problem relating to fungal growth in parts of the main building in George IV Bridge. At the time of the problem (1997/98) the building was undergoing a major renovation part of which was replacing the air conditioning plant and its delivery system. Also at the time of the problems difficulty was encountered in delivering conditioned air due to temporary combination of new plant and an old air delivery system.

2 Keywords

The National Library of Scotland, Collection Care, Environmental Monitoring, Moulds, Environmental Conditions

3 Introduction

3.1 Brief History of the National Library of Scotland

The National Library of Scotlandi is the successor to the historic library of the Faculty of Advocates, which opened off Edinburgh's Royal Mile in 1689.

Today, the Library is Scotland's foremost general research Library and the world's leading repository for the printed and manuscript record of Scotland's history and culture. It is the legal deposit library for Scotland, entitled to claim a copy of all UK and Irish publications. Almost 5000 items a week reach the Library in this way.

Three centuries after its foundation, the Library now holds 7 million printed books, 120,000 volumes of manuscripts, 1.6 million maps, and over 20,000 newspaper and magazine titles. This material can be consulted in the four reading rooms of its two main Edinburgh Buildings, at George IV Bridge and Causewayside.

The Libraries historic collections, built up over 300 years, are of both national and international importance. Among its 120,000 volumes of manuscripts is the last letter written by Mary Queen of Scots, and the only known copy of Blind Harry's fifteenth-century epic, The Wallace. Just as significant are the millions of papers documenting every aspect of the Scots at home and abroad.

Rare book collections cover the development of printing from its beginnings. The first printed book, the Gutenberg Bible of 1455, is there, as are the only known copies of the earliest works printed in Scotland. Special emphasis is given to books by or about the Scots, wherever published, and in whatever language they may be written. Complementing these written records is the Library's great collection of historic maps. It includes the first detailed maps of Scotland from the 1580s, and traces the urban and rural changes that made Scotland what it is today.

3.2 Buildings

The Library's headquarters building on George IV Bridge was opened in 1956 by Her Majesty the Queen. In October 1999 it was formally relaunched by Scotland's First Minister (Donald Dewar) following a five-year £12.7m refurbishment programme aimed at protecting the national collections from the hazards of fire. It houses the General Reading Room, North Reading Room (mss & rare books), and South Reading Room (microform and electronic publications).

The Library's Causewayside Buildingii, completed in 1995 at a total cost of over £40 million, is the location for the other Reading Room: The Map Library.

An administrative building in Edinburgh's Lawnmarket and a Preservation Services Unit at Sighthill, on the western outskirts of the capital, complete the Library's estate.

3.3 The Collections

There are eight principle floors in the National Library of Scotland's George IV Bridge building which house material from the printed and manuscript collections, both in open stacks, closed (i.e. locked) stacks, and purpose-built strong rooms (also referred to as Special Collection Rooms). The majority of shelving dates from the time of opening of the building in the mid-1950s, and is of the fixed, enamelled metal type.

The lower stack floors of the National Library of Scotland's George IV Bridge building (level 2, 3 & 4: Level 2 being the lowest floor) contain a wide variety of materials. As the Library has been a copyright Library since 1710, however, all of this material must be regarded as "heritage" material. Within this concept, however, there is encompassed materials ranging from very early printed books (1501 onwards) with very 'high' heritage value (and a high commercial value), to

modern paperback materials acquired through the terms of legal deposit legislation.

In the main, however, levels 2 & 4 contain older printed material, most of it pre-1900, and a large proportion pre-1800.

Level 2 contains approximately 60,000 volumes. A very high proportion of this material is in leather bindings, calf for the most part, although a significant quantity is in 19th century publisher's cloth, material with a very high starch content.

Level 3 has a mixture of very modern and 'heritage' material, although only the area containing 'heritage ' material was checked (a large caged area), as the remainder of the floor experiences frequent movements of stock. The material in the caged area has remained relatively static for at least ten years.

3.4 Level 2

Since 1982 there has been a problem with occasional fungal growth being suffered on level 2 (bottom floor) of the building. The origins of the problem are believed to go back to pre 1982 and there is good reason to believe it was much more severe then but no detailed information is available. On a number of occasions growth has been found on the metal shelves, books to some extent, part of the walls, but often several years have gone by without any evidence of growth taking place. Growth has not been vigorous but serious enough to cause concern. As far as collection items are concerned, mould was rarely seen on spines, much more often on the areas of the volumes less exposed to air movement. Conservation Staff has applied treatment to affected collection items but mould has, at times, reappeared with the most recent serious find being September/October 1997.

The whole of level 2 was surveyed, volume by volume, for evidence of mould growth in November 1997. This revealed that although the mould was not vigorous, it was very widespread throughout the floor with some 3,860 volumes affected on some 294 presses. Mould was also found on the enamelled mild steel shelving. No pattern of affected presses could be determined, as the spread of the affected presses was even throughout the floor, although this may have been largely due to recent stock moves which had taken place during the Summer of 1997. Taking these moves into consideration, it is clear that there has been a greater concentration of affected volumes in the area bounded by the Void and Cowgate wallsiii. At the beginning of April 1998 further growth was identified on 16 volumes that had in the earlier check been clear. The growth was all on the fore-edge of volumes.

3.4.1 Levels 3 & 4

Checks made on level 4 in September 1997 had revealed roughly 2000 volumes affected. All were treated immediatelyiv. At the end of 1997 when the fungal growth outbreak was identified on level 2, further checks on levels 3 & 4 (the two higher floors) revealed further growth. 8 volumes on level 3 and some 575 volumes on level 4. Affected items were treated at the same time as those on level 2, (February 1998) and the situation has since been monitored. Like level 2,

the temperature and relative humidity are well within safe parameters. However, no further growth has been found on either of these two floors.

3.5 The Building

The building has been air conditioned with temperature and humidity control since it opened in 1956. In past years some building related problems have been identified and corrected. One wall of the affected floors divides the building from large arches constructed to support George IV Bridge roadv. These arches form huge voids, which are always damp. On level 2 a door in the outside wall through to this void was first replaced with a sealed unit and then bricked up completely to close off that access point. Initially the problem was concentrated in the immediate proximity of the door. Also, close by was an underfloor cavity routing a broken water-carrying drainage pipe from the void area. This fault was corrected in 1991. Some small penetrations of the outside wall bordering the void area under George IV Bridge were identified and sealed in 1997/8. Other unaffected storage floors are also divided from this under-road void. We now have no apparent building faults, which might be producing a damp environment and can say that as far as we can determine, we do not have a damp building.

Monitoring of the temperature and relative humidity has been maintained on a daily basis since 1984 by the library's conservation staff working within its Preservation Division. Novasina thermohygrometers calibrated regularly with saturated salts are used for spot readings and to calibrate the thermohygrographs placed on level 2 since January 1998. We are aware of the difficulty in accurately taking relative humidity readings but have taken great care, and are confident, that the readings taken are reasonably accurate. Past monitoring has indicated that relative humidity has increased on lower floors. Level 2 was the highest usually bordering on 60% with a temperature of 18° C. For the last 18 months conditions with regard to temperature and relative humidity on level 2 have been good and comparable with the rest of the building with readings typically being 18° C and a relative humidity between 45% & 50% (BS5454:2000 - Relative humidity should be kept as constant as possible and in any case within the range 45% to 60% + or – 5%). Despite this, fungal growth reappeared at the end of 1997 and again, slightly in May 1998.

In April 1998 a Hanwell monitoring systemvi was placed in the area on level 2 to supplement the recording thermohygrographs. This system is hard-wired to a main control room where the temperature and relative humidity readings are logged. There are 4 – 5 units installed on each floor of the main building.

It should be pointed out that the building in 1998 was undergoing a major refurbishment, which involved the replacement of all the air conditioning plant with delivery of air being made by a different method than beforevii. The new air conditioning plant was replaced during February to October 1997, during which time one of the AHU's was operational. The new plant initially relied on the old ducting to deliver treated air and for various reasons meant that the velocity was significantly reduced resulting in a reduction in air movement and the number of exchanges. Recognising this as a potential problem, efforts were made to increase the velocity of the delivered air on level 2 with some success. The

designed delivery system would not be available until mid to late 1999[viii]. The system is now fully operational.

Relevant papers from the Master Plan associated with the refurbishment were supplied to Dr Singh for information. Such papers included:

3.6 Client Brief

- Optional appraisal
- Building fabric
- Scheme design describing detail of the new Building Management System
- Original drawing of level 2
- Drawing showing proposed situation on level 2
- Drawing showing typical cork/wall construction for outer walls.

The Library maintains an Estates Division which is responsible for all accommodation matters. It has well qualified staff including the Estates Manager who is a Chartered Surveyor and electrical and mechanical engineering staff.

3.7 Protective Cocoons

As contractors carry out work on each floor the collections have, for the most part, to stay in place. The chosen method of providing protection during these periods is to cocoon each bayix of shelves with protective material sealing off that local area from the rest of the environment on the floor. Whole floors of collections are cocooned in this way. The method has worked well in the past contracting stages with no problems but with the present fungal outbreak the Library is anxious to apply a cure and preventive treatment before level 2 collections are cocooned. The cocooning of level 2 was scheduled for July 1998.

3.8 Remit

Dr Singh's remit was to:

- To identify/confirm the type of fungal growth involved
- To identify the source(s) and cause(s) of the problem
- To establish a course of actions which will;

Identify safe conditions under which the collections may be stored to ensure there is no recurrence of the fungal growth.

Establish a course of action to achieve in the long term, the continuous safe conditions referred to in (a) above.

Provide protection during the interim period before the new air-conditioning system is fully operational, including measures while the temporary protection is in place.

I will now hand you over to Dr Singh who will describe the action taken to achieve the remit handed to him by the National Library of Scotland.

3.9 Action Taken by Preservation Division Staff

It is important to monitor the situation on a regular basis and a Conservator does this using a hand held Novasina thermohygrometerx. At present daily temperature and relative humidity readings are taken at 17 points in the main building and one reading from outside. This action will continue until I am happy with the calibration of the centralised vaisala units located at strategic points throughout the building. When the daily readings are taken, the conservator also performs spot checks looking for any signs of mould on the collections.

3.9.1 Book-cleaning

The common enemy of Libraries is dust on the collections. I look upon dust as being a food source for mould should the conditions allow. At the National Library of Scotland we have a book-cleaning programme running to assist with the preservation effort. Four members of staff each working seventeen hours per week are employed on this programmexi. Books are dusted with a soft bristled brush into a hepa-filtered vacuum cleaner. Operatives wear personal protective equipment in the form of dust masks and dust coats when performing this operation. Approximately 15,000 volumes per month are vacuum cleaned.

Twice per year air sampling is carried out at six locations including one location at each of Level 2 general stack area (South wall, Middle section and North section),

Level 2 strong room (South wall, West wall and Northwest area),

Level 3 (Southwest, Middle area and Northwest),

Level 4 (Southwest corner, Middle west and Northwest corner),

Level 5 (Southwest, Middle section and Northwest) ; and

One location in front of the National Library west elevation.

Three replicates are taken at each sampling zone giving a total of eighteen samples taken. Air sampling is performed using a Biotest Hycon RCS Plus Air Samplerxii, ready made yeast and mould nutrient agar stripsxiii supplied by Environmental Building Solutions and our own Novasina thermohygrometer.

The RCS Plus sampler is set to sample 100 litres of air. Nutrient strips are marked with sampling date & sampling location and placed into the RCS Plus Air Sampler where 100 litres of air is absorbed.

The nutrient strips are then sent to Environmental Building Solutions for analysis. It generally takes around three weeks for the mould to grow on the nutrient stripsxiv.

From the analysis of each sample the colony forming unit count per cubic metre can be established. This information is returned to me in tabular form showing the population density of mycofloraxv (CFUm-3) for each sample. The CFU count is compared with the guidelines set by the World Health Organisation (WHO) report on Indoor Air Quality.

Results from sampling taken in September 1999 and December 1999 at the National Library of Scotland show concentrations of fungi at all floors are considered low when judged on the scale proposed by WHO.

4 Conclusions

Important lessons learned from the recent mould experience include the following:

Temperature and humidity to BS5454:2000 recommendations

Movement of air – air within a repository should not be stagnant. There should be sufficient air movement to avoid areas of stagnant air and to prevent a build-up of pockets of high relative humidity.

Cleanliness – a regular book-cleaning programme is in place to ensure that books and shelves are kept clean and free from dust.

Environmental monitoring – all stack floors are monitored regularly by conservation staff and cross-referenced to the centralised system.

Inspection of books – Conservation staff regularly inspect, at random, the volumes on all the floors for mould growth.

Bookfetchers spend a great deal of time on all floors have been trained on what to look for regarding mould growth.

Buildings staff and Preservation Division staff are proactive in maintaining the proper environmental conditions in the Library.