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The Ideal Museum vs. The Real Museum: How do Museums in Western New York Implement Preventive Conservation?

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This thesis examines the need for preventive conservation in museums. Preventive conservation is an effort aimed at reducing damage and deterioration to collections by improving the environment. Out of the 4.8 billion objects in the museum collections in the United States, many of the objects are in need of some attention. They are at high risk of being lost forever, leaving future generations without such collection to learn from and enjoy. This thesis studies five institutions in the Western New York area. It examines how their preventive conservation practices hold up to standards put forth by museum experts. There are four stages in the research model and they are as follows: (1) identifying threats to collections, (2) substantiating the risk, (3) identifying cost-efficient means of measuring the risk, and (4) developing methods to reduce or eliminate risk. Once a museum has implemented these four stages, the next step is rather simple: monitor and control the principal agents of destruction. By knowing which of these areas are in the most need of the greatest assistance, conservators can make recommendations to help institutions take better care of their collections.

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The Ideal Museum vs. The Real Museum: How do Museums in Western New York Implement Preventive Conservation?

A Thesis in
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By

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Introduction

Of the 4.8 billion collection items in the U.S., more than 820 million are in need or urgent need; however, about 1.8 billion are in unknown condition. - Heritage Health Index

Museums and Their Collections

What is a museum? There is no one correct definition of a museum or at least not one on which everyone seems to agree. For the purpose of this paper a museum is defined as an institution "charged with the long-term duty of preserving and presenting the patrimony of the nation, culture or community."[1] Museums moved from private cabinets of curiosities (early museums) held by individuals to public collections that represent particular disciplines (present-day museums). Many of the first museums in the U.S. started with collections of scientific and natural history specimens. This was a direct outgrowth of the cabinets of curiosities and natural history specimens in Europe. [2] Marjorie Schwarzer has noted that "midway through the 19th century, collections in American museums were embarrassingly inferior to the priceless originals found in European museums."[3]

Museums preserve a wide variety of objects either natural or human made, that have been created throughout time.[4] Objects that have been made by "great artists" are more likely to survive because they are being protected by patrons. However, many objects (such as pottery, textiles, glassworks, etc.) do not survive because they were

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[1] Knell, Simon J. "Introduction: the Context of Collections Care." *Care of Collections*. London: Routledge, 2006. 2. Print.
[2] Buck, Rebecca A., and Jean Allman Gilmore. *Collection Conundrums: Solving Collection Management Mysteries*. Washington, DC: American Association of Museums, 2007. 5.Print.
[3] Schwarzer, Marjorie. *Riches, Rivals, & Radicals; 100 Years of Museums in America*. Washington DC: American Association of Museums, 2006. 70. Print.
[4] Ibid. 102.

never meant to survive. These objects were made to be used and in turn abused.[5] All that the museum personnel can do is put forth the effort to slow down the deterioration.[6] The assembly, preservation, and display of collections are fundamental to the idea of the museum.[7] The objects then justify the museum. The objects are "there for research, reference, prestige and entertainment."[8] They also create cohesiveness in a community. They can define a region and tell stories of the region, and are therefore identifiers of place.

Preventive Conservation

One aspect of a museum's mission is preservation of the collections. The museum's collection staff is charged with the preservation and long-term survival of the objects within the collection. While preserving collections is obviously essential, for many museums conservation is sadly not the primary concern. Experts generally perform conservation in this field who have a significant amount of training in how to restore, prevent damage and preserve. "Conservation is the primary care an object receives which protects it from damage or loss. It includes providing proper environmental conditions, treatments to ensure the preservation of the object, security, and handling." [9]

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[5] Bradley, Susan M. "Do Objects Have a Finite Lifetime?" *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 52. Print.
[6] Ibid. 54.
[7] Macdonald, Sharon. "*Collection Practices" In A Companion to Museum Studies*. Malden, MA: Blackwell Pub., 2006. 81. Print.
[8] Burcaw, George Ellis. *Introduction to Museum Work*. Walnut Creek, CA: AltaMira,1975, 1997ed. 56. Print.
[9] Fruth, Martha. "OHS - Local History - A Primer on Museum Collection Management." Ohio History Online Portal. Web. 10 Nov. 2010. <http://www.ohiohistory.org/resource/oahsm/notebook/julaug1985.html>.

Museums face significant challenges when it comes to preservation. There is a lack of education or funding to provide proper storage conditions, or both. The main focus of this paper is how museums in Western New York use preventive conservation and what they can do to reduce the risks museum collections face. What is preventive conservation? Preventive conservation is very different from conservation. “Preventive conservation emphasizes nonintervention action to prevent damage to and minimize deterioration of a museum object.”[10] Any museum professional can do this with minimal training in proper procedures. Preventive conservation can require a substantial outlay of funds, and it is unrealistic to think that all objects in the collection can receive equal attention. The collections manager must decide what objects can be restored, ideally guided by the institution’s collections policy. However, preventive conservation does not always require expensive or complicated care strategies. In many institutions, much can be done by applying common sense.[11]

Simon J.Knell states that “In principle, preventative conservation is a matter of monitoring and controlling the primary agents of destruction which are not limited to the following: light, inappropriate temperature, relative humidity, atmospheric pollutants, handling and transport, pests, poor storage and disasters.”[12] Many of these agents coincide with each other. Given the technical problems associated with remedial conservation, and the increasing awareness of factors responsible for objects’

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[10] "National Park Service - Museum Management Program." U.S. National Park Service - Experience Your America. Web. 10 Nov. 2010. PDF Filehttp://www.nps.gov/museum/publications/conserveogram/01-01.pdf

[11] Levin, Jeffrey. "Newsletter 7.1 Winter 1992 (Conservation at the Getty)." The Getty. Web. 03 Dec. 2010. http://www.getty.edu/conservation/publications/newsletters/7_1/preventive.html

[12] Knell, Simon J. "Introduction: the Context of Collections Care." *Care of Collections*. London: Routledge, 2006. 6. Print.

deterioration, many conservators are devoting more time to search out solutions on how to preserve deteriorating objects within the collection.

The following chapters will examine some of the major concerns of collection managers in caring for their collections. Controlling the environment in which an object resides can significantly affect its condition. However, it cannot reverse existing damage. It is incumbent on a museum to provide the environment that will best preserve the collections entrusted to its care. The optimum environment varies according to the materials with which an object is made. An example of this would be objects made from wood would need to be stored in areas with higher humidity to prevent cracking than objects made from metal, which could rust under higher humidity conditions. Environmental considerations include temperature, humidity, lighting, pest infestation, and chemical pollution.

Great attention needs to be paid to those items in storage, especially those that have not been placed on display for long period of time, as these objects can be quickly forgotten. It is easy to spot deterioration on objects that are exhibited and have greater visibility. However, the objects that are in storage are the ones at greatest risk. The greatest damage that can be done is the damage that goes undetected. Regular inspection is crucial. However, any action that is taken, no matter how minimal, can have a potentially positive outcome.

Chapter 1: Literature Review

One fundamental responsibility of a museum is the prevention of deterioration of art and artifacts through control of the environment in storage and exhibition. Different types of collections need different forms of care. Many objects are also composed of more than one material, each of which may respond differently to a variety of environmental factors. An example of this would be a rifle. The staff will have the task of delicately balancing the humidity needs of the wood, so it does not dry and crack, and the humidity needs of the metal so it does not rust. Museum collections staff first must understand the needs of each specific artifact before they can come up with a plan to preserve them. Preventive conservation is not an exact science. As time goes on, the museum collections staff will learn more about how different materials react over time. With this knowledge, a new set of standards is implanted.

A set of standards for the care of collections are put forth by the American Alliance of Museums (formerly American Association of Museums) in connection with their accreditation program. Why are standards so important? The standards are a way by which museums can measure their own performance. Clearly agreed upon standards describe what good and bad conducts are. The American Alliance of Museums recognizes the great diversity of the museum field and the importance of the ethical codes, standards, and best practices developed and issued by various organizations.[13] All good museums should strive to live up to these standards to the best of their abilities.

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[13] The American Association of Museums. *National Standards & Best Practices for U.S. Museums*. Washington DC: American Association of Museums, 2008. 4. Print.

In *Collection Conundrums: Solving Collection Management Mysteries*, Rebecca A. Buck, and Jean Allman Gilmore discuss how decades of research has influenced the many standards that have been implemented throughout the United States. Museums would formulate their individual systems if any, for documenting and tracking objects. Some museums even had several different systems in place at the same time. Some of these systems would be as basic as having a list of the objects held within the collection. Other systems were more complex, including criteria such as when it was made, where it was made, who donated it or where it was purchased, the physical conditions and other background information.

Methods for documenting and tracking objects became more uniform with the occurrence of computer database programs in the 1990s. One of the outcomes from computer programs, besides tracking and documenting, was that museum staff could take a more active role in the collection by being able to document more thoroughly the objects' physical condition and characteristics. The different compute programs that are available for museum use have fields that allow the staff to expand on the information they provide; an example would be the ability to document the maker's information, the time frame it was made, what it was used for, damages, etc. This then leads to increased opportunities to recognize potential issues and take action to preserve the object.[14]

In "Do Objects Have a Finite Lifetime" Susan M. Bradley writes that the greatest challenge for museum staff with regards to the care of collections is the conservation of

[14] Buck, Rebecca A., and Jean Allman Gilmore. *Collection Conundrums: Solving Collection Management Mysteries*. (Washington, DC: American Association of Museums, 2007): 81-82.

the objects when they arrive at the museum. This is a difficult task. The simple fact is that many objects are not made to survive. They begin to deteriorate as soon as they are made. Objects such as pottery, glassware, and clothing are examples of objects that are made to be used day to day and were not meant to last decades, centuries or longer. All a museum staff can do is slow down the deterioration and breakage in hopes of stabilizing the objects.[15] Preserving collections is a major part of a museum's mission; however, this is not always the case.[16] Essentially a museum's concern is for the objects because they justify the museum's existence. Without objects, the museum would cease to exist. The objects do not simply exist in a museum; they are there for research, reference, prestige, and entertainment.[17] It is the responsibility of the collections staff to ensure these objects are preserved for generations to come.

There are several ways in which the natural lifespan of an object can be extended, such as proper storage and environmental controls. Out of all the possible actions a museum can take, preventive conservation may be the most feasible. Compared to individual conservation treatment of individual objects, preventive conservation of entire collection is least expensive. The effort of preventive conservation is aimed at "non-interventive action to prevent damage to and minimize deterioration of a museum object."[18]

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[15] Bradley, Susan M. "Do Objects Have a Finite Lifetime?" *Care of Collections*. Ed. Simon J. Knell. (London: Routledge, 2006): 58.
[16] Levin, Jeffrey. "Newsletter 7.1 Winter 1992 (Conservation at the Getty)." *The Getty*. Web. 03 Dec. 2010. http://www.getty.edu/conservation/publications/newsletters/7_1/preventive.html
[17] Burcaw, George Ellis. *Introduction to Museum Work*. Walnut Creek, CA: AltaMira, 1997. 56. Print.
[18] Knell, Simon J. "Introduction: the Context of Collections Care." *Care of Collections*. London: Routledge, 2006. Print.' National Park Service - Museum Management Program." *U.S. National Park Service - Experience Your America*. Web. 10 Nov. 2010. PDF

Katharine Untch's essay "Managing Conservation without a Conservator on Staff" states a museum would ideally have a conservator on staff to handle the needs of the collection. This is not possible for most museums as the lack of funding prevents them from hiring one. It is not just the conservator that is costly; it is providing a suitable work area with proper equipment to perform conservation treatments. Museums without a conservator on staff and a suitable conservation lab can do the following: consult with an outside conservator, conduct assessments, prioritize tasks, write a collection management plan, find funding, and conduct improvement in phases.[19] There are things the collections staff can do to preserve objects even with minimal training and funding.

In "Introduction: the Context of Collections Care" in *Care of Collections*, Knell describes "the agents of destruction" that are: light, inappropriate relative humidity, atmospheric pollutants, handling and transport, pests, poor storage and disasters."[20] Knell provides a practical guide to the main aspect of collection care, as well as other sources that can be beneficial to institutions. The Getty Conservation Institute outlines a four staged scientific research model: "(1) identifying threats to collections, (2) substantiating the risk, (3) identifying cost-efficient means of measure the risk, and (4) developing methods to reduce or eliminate the risk."[21] Once a museum has implemented these four stages the next step is rather clear-cut: monitor and control the main agents of destruction. By knowing which of these areas are in the most need of

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[19] Katharine Untch's essay, "Managing Conservation without a Conservator on Staff" (*Collections A Journal for Museums and Archives* 2.3 ,February 2006) along with Konstanze Bachmann's *Conservation Concerns: A Guide for Collectors and Curators* (New York: Cooper-Hewitt National Museum of Design, Smithsonian Institution, 1992) are great assets to any institution that is in need of conservation help but does not have to resources to outsource.

[20] Knell, Simon J. "Introduction: the Context of Collections Care." *Care of Collections*. London: Routledge, 2006. 6. Print.

[21] Getty Conservation Institute. "Preventive Conservation." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. Print. 84.

assistance, conservators can make recommendations to help institutions take better care of their collections.[22]

Objects are formed from several different kinds of materials that respond differently to temperature and Relative Humidity (RH). David Erhardt and Marion Mecklenburg state that there are currently no universal, official museum standards for temperature and RH; it is up to each institution to implement its own. Therefore, staff must review the literature and implement the proper plan for their individual collection.[23] Professional painting conservators, Nico Boeijink and Rob Boekel state on their website[24] that the factors around or surrounding the objects should not be allowed to influence an object or the collection in a negative way. Proper climate control is an essential way to ensure the overall health of the collection. Experts such as Rebecca Buck, Jean Allman Gilmore, Chris Caple, John D. Hillberry, Susan K. Weinberg and Fergus Read,[25] suggest having relative humidity at 50% +/- 5% and temperature 70°F +/- 2°. This is a guideline for storing all types of objects together. Objects are formed from materials that respond to temperature and RH differently. Improper temperature and RH can lead to the acceleration of chemical and biological decay and encourage other conditions, insect infestations and molds. Climate control is the easiest and least expensive out of all the preventive conservation procedures. Many museums are

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[22] Ibid.
[23] Erhardt, David and Marion Mecklenburg, “Relative Humidity Re-Examined” Ed. Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 340. Print.
[24] Boeijink Nico and Rob Boekel "Preventive Conservation." *Painting Restoration and Conservation*. Web. Jan. 2012. <http://www.schilderijenrestaurator.eu/preventive-conservation.htm>.
[25] Buck, Rebecca A., and Jean Allman. Gilmore. *MRM5: Museum Registration Methods: 5th Edition*. Washington, DC: AAM, 2010. Print, Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. Print, Hilberry, John D., and Susan K. Weinberg. "Museum Collections Storage." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. Print, "Preventative Conservation by Fergus Read." *Meaco*. Web. 11 Mar. 2012. <http://www.meaco.com/preventa.htm>.

equipped with thermostats to control temperature. Controlling RH can be as easy as having a dehumidifier or humidifier depending on their need.[26]

In her essay "Intergrated Pest Mangement," Nancy L. Breische[27] goes into great detail explaining that pest control is one of the most difficult of the preventive conservation procedures. A museum collection is one of the most attractive things to pests. Museums house many different types of materials that pests use to thrive, such as wood, textiles, and paper. Not only does a museum need to be aware of what they are housing, but also what types of pests they may encounter with certain materials. There are four overlapping types of pests that a museum will encounter at some point: stored product and fabric feeders, wood destroying insects, general feeders, and nuisances and health hazards. [28]

Pest control does not limit itself to the inside environment, but the outside environment as well. As seasons change, so do the types of pests. Proper measures need to be taken to prevent collections' infestation. It is easier and less expensive to prevent infestation than to get rid of pests later on. While this is the most expensive of the prevention conservation measures, there are many things that can be done that are

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[26] Brooke Craddock, Ann. "Control of Temperature and Humidity in Small Collections. *"Conservation Concerns*. (Washington DC: Smithsonian Institution, 1992); Buck, Rebecca A., and Jean Allman Gilmore. *Collection Conundrums: Solving Collection Management Mysteries*. (Washington, DC: American Association of Museums, 2007); Hilberry, John D., and Susan K. Weinberg. "Museum Collections Storage." *Care of Collections*. Ed. Simon J. Knell (London: Routledge, 2006); *History Trust of South Australia*. (Web. 2010. PDF Filehttp://www.history.sa.gov.au/chu/downloads/CMP_help_sheets/Museum%20Environment%20final%20150609.pdf); "Preventative Conservation by Fergus Read." *Meaco*. (Web. 11 Mar. 2012. <http://www.meaco.com/preventa.htm>.)

[27] Breische, Nancy L. "Integrated Pest Management." Ed. Rebecca A. Buck and Jean Allman Gilmore. *The New Museum Registration Methods*. Washington, DC: American Association of Museums, 2001. Print.

[28] Visit "Museumpests.net." *Museumpests.net*. http://www.museumpests.net/ for an overview of types of pest, and pest control.

cost effective. Prevention can be anything from strategically placing sticky traps, to not allowing food in any place other than a lunch or break room, to proper housekeeping. Knowing the collection's vulnerability to pests is the first and most important of the preventive measures.[29] If there is ever the need to hire a professional, such as an exterminator, a museum must know what types of chemicals are being used. These chemicals can find their way inside the museum.

Both indoor and outdoor pollutants can be hazardous not only to the health of the patrons, but also to the health of the collection. Pollutants can be controlled by good housekeeping and a quality Heating, Ventilation, Air Conditioner (HVAC) system. Erhardt Danforth's website states that museums need an HVAC system that uses constant air volume, limitation of outside air, design based on the humidity, and use of prefilters and high-efficiency filters.[30]

The best way to prevent outdoor pollutants from coming in is to ensure that the building is free from leaks or drafts as well as filtering any air brought in from the outside.[31] History Trust of South Australia, Texas Historical Commission, and Museums Australia all provide basic guidelines on the topics of pollution. Indoor pollutants are maybe slightly more difficult to control: as some materials deteriorate, they may release

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[29] "Nature & Science Biology Resources Integrated Pest Management Manual." *Explore Biology*. (National Park Service, n.d. Web. 2011. <http://www.nature.nps.gov/biology/ipm/manual/museum.cfm>.) This manual does a breakdown of the types of pest along with photographs and detail descriptions.

[30] *Air Filters & Air Purifiers*. "Museum & Library HVAC Air Cleaning Guide HVAC Indoor Air Quality Control For Archived Collections." Web. 22 May 2013. https://www.danforthfilters.com/secure/store/Air-Filters-Museum-4.asp

[31] *History Trust of South Australia*. (Web 2010. PDF Filehttp://www.history.sa.gov.au/chu/downloads/CMP_help_sheets/Museum%20Environment%20final%20150609.pdf); Texas Historical Commission. *Basic Guidelines For The Preservation of Historical Artifacts*. (Web 2012. Doc. www.thc.state.tx.us). Museums Australia (Vic). "AIR POLLUTION." (2003. Web. http://www.mavic.asn.au/assets/Info_Sheet_5_Air_Pollution.pdf).
All three websites provide basic guidelines on this topic along with many other topics discussed in this paper.

gasses into the surrounding area.[32]The Philadelphia Museum of Art suggests that temperature and humidity controls, as well as the Museum's HVAC system, play a tremendous role in the reduction of dust, particulate, and gaseous pollutants.[33] Linda Bullock, Sophie Julien, and Sarah Staniforth wrote in "Chemical Agents of Deterioration" that aggressive chemicals in the form of gasses, liquids or solids, can react with the material and cause changes in the composition, nature, or appearance of objects.[34] "Where artifacts are affected it may only be their surface that is altered, often resulting in visible change."[35] An example of this would be discoloration of a painting. "With porous materials, chemicals can penetrate and cause alteration deeper within the structure, which often leads to physical weakening."[36] Key pollutants are sulfur dioxide, nitrogen dioxide, ozone, reduced sulfur gasses, carbonyls, and fine particles. "Certain sensitive materials, e.g. photographs, silver objects, paper, leather, and dyes, demonstrate effects of immediate consequences."[37]

Jan Freedman writes extensively about radioactivity. This is another condition that many do not think of when it comes to pollutants. Many natural history and science museums have materials in their collections that are radioactive. Radioactive minerals have historically been stored within the main mineral collection. The author notes that many of these items, up until recently, have been stored in zip-lock bags and drawers

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[32] Baer, Norbert S., and Paul N. Banks. "Indoor Air Pollution: Effects on Cultural and Historical Material." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. Print.
[33] "Philadelphia Museum of Art - Research: Conservation." *Philadelphia Museum of Art - Research: Conservation*. Web. 06 Mar. 2012. <http://www.philamuseum.org/conservation/10.html?page=4>.
[34] Staniforth, Sarah, Sophie Julien and Linda Bullock "Chemical Agents of Deterioration" Ed. Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 225. Print.
[35] Ibid. 225
[36] Ibid. 225
[37] Baer, Norbert S., and Paul N. Banks. "Indoor Air Pollution: Effects on Cultural and Historical Material." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 137. Print.

labeled with warning labels. These did not stop the radioactivity from seeping into the environment around it. Freedman suggests using “radioactive bays” within the main storage; these bays have extraction to ventilate gasses, such as radon, to the outside. Some museums are moving their collections, mostly uranium, and thorium, to special lead-lined ventilated steel cabinets that are painted yellow and are labeled with radioactive signs. This is, however, more expensive, and many museums cannot afford to do this. Clear plastic boxes lined with plastazote can be used to replace zip-lock bags in those museums with minimal funding.[38] If a museum does not feel they can adequately store these objects, it may be in the best interest to donate them to an institution that can.

Light must be controlled in some form in order to reduce the damage to the surface of all objects.[39] While Sarah Staniforth’s essay "Light and Environmental Measurement and Control in National Trust Houses,”[40] focuses on historic sites, it can be applied to all institutions displaying objects. She explains how lighting an essential part of a museum can also cause great damage. A museum has to find the balance between lighting that is suitable for the objects and what is comfortable for the patrons. The museum environment is sometimes lit by a combination of natural light and artificial light. While some museums like to use natural lighting in order to keep energy costs down they can find it difficult to control the heat and UV levels if barriers are not used. Artificial lighting is much easier to control and adjust. Using artificial lighting does not

[38] Freedman, Jan "Storage of the Radioactive Mineral Collections at Plymouth City Museum and Art Gallery UK." *Collections: A Journal for Museums and Archives* 7.2 (Spring 2011): 210-212.
[39] Thomson, Garry “The Museum Environment- Light” Ed. Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 309. Print.
[40] Staniforth, Sarah. "Light and Environmental Measurement and Control in National Trust Houses." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. Print.

guarantee that damage will not be done. Each object in the collection also has a different need for lighting, just like specific needs for correct temperature and RH. Textiles and watercolors or more sensitive paper objects need to be exposed to less light. However, objects made out of metal and ceramics are less sensitive. The Rugby Football Union's website has examples of damage done by light such as fading, which is hard if impossible, to reverse.[41] Lighting needs to be considered when designing exhibits and when storing objects. Knowing how much light an object can withstand can save many objects from enduring unnecessary damage.

Museum Registration experts Buck and Gilmore mention in their writing that only two to five percent of a collection is on display at one time. This leaves 95% to 98% of the collection in storage. A collection's survival relies heavily on the conditions in which it is stored because all objects in a collection will spend significant time in storage. [42] The Getty Institution has several articles and essays on their website dedicated to the storage and handling of collections.[43] Konstanze Bachmann writes about how storage and handling are the greatest culprits in damages to an object. Some of this damage is caused by how these objects are stored or for how long they are stored. For example, textiles can cause the fibers to weaken where they are folded. Proper storage, however, is very expensive, and many museums make do with what they have. The ideal storage space, for any institution, would be one with that manages climate as well as monitors for fire and theft. The basic types of large storage units are cabinets, flat-drawer files, and bins, all fitted with acid-free boxes, shelves and the use vertical sliding racks for

[41] "Examples of Damage Caused by Bad Storage and Display." *RFU*. N.p., n.d. Web. 17 Jan. 2013. http://www.rfu.com/twickenhamstadium/worldrugbymuseum/thecollection/caringforrareitems/examples
[42] Buck, Rebecca A., and Jean Allman Gilmore. *MRM5: Museum Registration Methods: 5th Edition*. Washington, DC: AAM. 2010. Print. 293
[43] Getty Conservation Institute http://www.getty.edu/conservation/

storing paintings, mirrors, and other framed objects. Each object is unique and requires different conditions to survive.[44]

Unacceptable storage practices have a direct effect on the useful life of objects. Another leading cause of damage to an object is the way in which it is handled. Poor handling can lead to oils from the hands causing damage, dropping, or misplacing the object (not putting the object back in the proper spot). Proper handling is something all museum workers need to know and understand. The Northeast Document Conservation Center (NDCC) and the United Nations Educational, Scientific and Cultural Organization (UNESCO)[45] both provide guidelines for proper handling such as how to lift objects of different materials, how to transport them and how to store the objects. An integral part of preventive conservation is the proper care of the objects in storage as well as the correct management of the storage area. UNESCO states that good management of the storage area is the first defense against deterioration.

Dr. Jonathan Ashley-Smith writes about how museum professionals must balance the "good and evil" of preventive conservation. Not all conservation attempts are in the best interest of the object nor are all damages incurred detrimental. The study of risk is concerned with not only the probability, but also the impact. "A desirable outcome for treatment of an object is to maintain or increase its value." [46] Damage

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[44] Bachmann, Konstanze. *Conservation Concerns: A Guide for Collectors and Curators*. New York: Cooper-Hewitt National Museum of Design, Smithsonian Institution, 1992. Print.
[45] "Northeast Document Conservation Center. *"Northeast Document Conservation Center Storage Methods and Handling Practices*. Web. http://www.nedcc.org/resources/leaflets/4Storage_and_Handling/01StorageMethods.php, UNESCO. "Handling Collections in Storage." Web. <http://unesdoc.unesco.org/images/0018/001879/187931e.pdf>.
[46] Ashley-Smith, Jonathan. "Value." *Risk Assessment for Object Conservation*. Oxford: Butterworth-Heinemann, 1999. 287. Print.

comes in all forms. The *National Post News* [47] in Canada published an article in August 2012 describing unauthorized alterations made by a Spanish woman patron, who had no proper training, to a prized Spanish fresco painting. She took it upon herself to "fix" the deteriorating painting. However, without the proper training, the woman made unprofessional alterations so now the painting now looks "more like a child's finger-painting" (illustrated on page 56).

Other kinds of damage can be caused by disasters such as fire, flooding, leaky pipes or roofs that put objects in danger.[48] Many objects are deteriorating before they make their way into a museum. With this said, a collection manager is trying to beat the clock to get the items into a stable environment before time runs out, and the object cannot be saved.

In 2005, the National Institute for Conservation sent out the first comprehensive survey to assess the condition and preservation needs of U.S. collections, *A Public Trust at Risk: The Heritage Health Index Report on the State of America's Collections*. The survey found there are over 4.8 billion objects in the public trust held by more than 30,000 institutions in the United States. The full results can be found at www.heritagehealthindex.org. The National Institute for Conservation believes that providing a safe environment and proper care for collections is a fundamental responsibility of those charged with its care.

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[47] "*National Post News Good Deed by Rogue Restoration Pensioner Ruins 19th century Spanish fresco Comments*." N.p., n.d. Web. 19 Jan. 2013. http://news.nationalpost.com/2012/08/22/good-deed-by-rogue-restoration-pensioner-ruins-19th-century-spanish-fresco/

[48] Texas Historical Commission. "Basic Guidelines For The Preservation of Historical Artifacts". Web Feb. 2012. Doc. www.thc.state.tx.us

The type of institutions that answered the survey were small local historical societies, libraries, larger national institutions, historic homes, etc. The survey found that over 50% of the institutions that participated had their collections damaged by light and/or moisture with only 26% having no environmental controls. Environmental controls are the most urgently needed for preservation across the country. Without proper environmental controls, the collections are at great risk of damage and deteriorating beyond use.

The survey also found that 80% of the institutions do not have paid staff dedicated to collection care, and 71% need additional training for care effects of their collections. Improper training or staffing is not the only thing that effects the collection. 39% of the institutions have reported significant backlogs in cataloging, and many do not have a current assessment[49] of their collection. Due to inadequate staffing, 70% of the institutions honestly do not know what condition their collection is in.

These unassessed and virtually forgotten objects are at a great risk of being lost forever, leaving future generations without such objects to study to gain a better understanding of their past. Most museums in the United States rely on some public funding. When the economy takes a downturn, so does public funding. This leaves museums and other institutions scrambling to find extra funding just to cover their day to day costs, and object preservation may not be an immediate priority. Some items in a

[49] Assessment: Examine the entire collection, Note the types of objects by discipline and material, quantities of each object type, relative sizes, and required volumes for safe and accessible storage, Note object types by discipline and material makeup and their ranges of sensitivity to agents of deterioration such as temperature and relative humidity, light, and air pollution. "Chapter 7: Museum Collection Storage." *U.S. National Park Service - Experience Your America*. Web. PDF http://www.nps.gov/museum/publications/MHI/CHAP7.pdf

museum's collection can go unseen for decades before the money is available for conservation. A local example of this is an exhibit at The Buffalo History Museum that featured John Mix Stanley's "*The Trial of Red Jacket".* The painting was in storage since the 1960s before the money became available for the display and conservation of associated artifacts that inform the understanding the painting's theme. The painting will soon go on tour and will be viewed widely across the United States. Many of the experts believe that the public trust is at risk. We as citizens are at risk of losing large parts of our past. Much more attention needs to be paid to the institutions that house the public trust. The public has a desire to see the objects in collections. Collaborating and sharing collections for exhibit among museums will bring many rare and important artifacts in need of conservation to the attention of the public. Two of Western New York's institutions, The Buffalo History Museum and the Burchfield Penney Art Center, collaborated to select art that is significant to the region's history. "The two institutions share focused regional missions." The Buffalo History Museum strives "to tell the stories of Western New York, from the ordinary to the extraordinary." The Burchfield Penney Art Center is "dedicated to the art and vision of Charles E. Burchfield and distinguished artists of Buffalo-Niagara and Western New York State." The exhibition's theme was to show that "art provides a documentary look at individuals, events and the environment as it looked more than a century ago."[50]

[50] Burchfield Penney Art Center. Time Share. Web 9 May 2015 https://www.burchfieldpenney.org/exhibitions/exhibition:10-23-2010-05-29-2011-time-share-an-historic-collaboration/

Collecting, including assembly, preservation, and display of collections is fundamental to the idea of the museum.[51] Museums need to gain an understanding of the stability of an ever-increasing list of materials entering the collections such as “new alloys, plastics and synthetic textiles”, and “more exotic and degradable substances.”[52] The structure and condition determines the support needed to prevent damage over time. [53]Things to consider when dealing with a museum environment are the following: dust and other pollutants, levels of light, both natural and artificial, temperature and humidity, corrosion, and pests.[54] As Getty experts conclude, “The first level of awareness is simply understanding what preservation conservation means; the second is accepting it as a legitimate collections care strategy.”[55] Lastly and the most important stage is for the institution consciously to adopt preventive conservation as an integral part of its mission and practice.[56] Providing the proper environment and treatment for an object can ensure the preservation of the object.[57]

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[51] Macdonald, Sharon. *A Companion to Museum Studies*. Malden, MA: Blackwell Pub., 2006. 81. Print.
[52] Knell, Simon J. "Introduction: the Context of Collections Care." Care of Collections. London: Routledge, 2006. 5. Print.
[53] Preventive Conservation." Welcome to The Field Museum. Web. 12 Feb. 2012. <http://fieldmuseum.org/explore/department/conserving-collections/preventive>.
[54]History Trust of South Australia. Web. 12 Nov. 2010. PDF Filehttp://www.history.sa.gov.au/chu/downloads/CMP_help_sheets/Museum%20Environment%20final%20150609.pdf
[55] Getty Conservation Institute. "Preventive Conservation*." Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 87. Print.
[56] Ibid. 87.
[57] Fruth, Martha. "OHS - Local History - A Primer on Museum Collection Management." Ohio History Online Portal. Web. 10 Nov. 2010. <http://www.ohiohistory.org/resource/oahsm/notebook/julaug1985.html>.

Chapter 2: The Survey

Part of the research for this thesis was based on a survey[58] that was sent out to twelve Western New York institutions. This survey asked the institutions to examine how they care for their collections. They were asked to rate their preventive conservation measures, what they believed needed improvement and what did not. They were also asked to describe the type of damage their collections may have suffered. The survey also takes a look at each institution's staffing and funding to see if there is any correlation between these factors and the conditions of the collections. The survey was modeled after the Historic Preservation's survey sent out for "A Public Trust at Risk: The Heritage Health Index Report" (HHIR) in 2004.

The HHIR report was published in December 2005 and concluded that immediate action is needed to prevent the loss of 190 million artifacts in the United States that are in need of conservation treatment. This was the first comprehensive survey to assess the condition and preservation needs of U.S. collections.[59] The survey done for this thesis asked the institutions to take into consideration specifications that have been suggested by many experts, mainly those of the American Association/Alliance of Museums. These suggestions can be found in *MRM5: Museum Registration Methods: 5th Edition* and throughout this paper. The basis of this survey was to gauge how the institutions in Western New York viewed the care of their collections. The purpose of the survey was to see how the local institutions would rate their current preventive conservation practices. The institution may or may not have participated in the HHIR, and this survey could be used to their benefit as a way to look

[58] The survey and results in their entirety are represented in Appendix 1 and 2.70-94.
[59] "Introduction and Acknowledgements." Introduction. *A Public Trust at Risk: The Heritage Health Index Report on the State of America's Collections*. Washington, D.C.: Heritage Preservation, 2005. I. Print.

at their current situation and assess the areas that are in need of help.

A total of six surveys were received; one responding institution does not have a collection of its own but displayed collections from other museums. This survey was not included in the data used for the thesis, thus leaving five surveys from collecting institutions. A mixture of organizations from the Western New York area participated. Two of the organizations have state of the art buildings, access to funding, and a variety of other resources such as working with the local colleges and students to provide inexpensive conservation; while the others, however, seem to be struggling to survive with minimal resources, such as space, money, etc., at their disposal.

Institution 1

Institution 1 describes itself as a history museum and open air museum. It is governed by a non-profit, non-governmental organization or foundation. It received funding from the local municipality and earned income through membership, special events, classes, etc. Its staff consists of 9 full-time employees, 2 part-time employees, 300 volunteers, 2 interns, and 4 seasonal employees. It has a curator for preservation, and it has a contract for conservation (private conservator and local college conservation department) funded with money from a grant they receive about every two years.

Institution 1's mission statement states it is an educational institution, chartered by the State of New York. The mission is to instill, educate, and cultivate in a public audience an informed approached of the American past and it impact on current lifestyles, culture, and historical development. They achieve this through historical

research and interpretation, preservation and management of their collections and historic buildings.

In the survey, the institutions were asked to describe their collections along with the approximate number of each object. Institution 1 listed its collection as:

- 6,500 Archival material objects
- 12,000 photographs
- 10,000 textiles
- 30,000 other 3-dimensional items (19th-century household, business, agricultural items

When asked about its environment, Institution 1 stated that they use environmental controls to meet temperature, relative humidity, and light specifications in some, but not all, areas of the institution. They did believe that 80-99% of their collection was stored in areas that were adequate for the collection, with adequate pest management. However, they did not provide any proof of how the institution's integrated pest management plan is implemented.

The institutions were also asked to rate some environmental areas that may or may not need improvement within their institutions. Institution 1 believes that temperature control, artificial light levels, natural lights levels and inside pest management needs little to no improvement. However, they believe that Relative Humidity (RH), outside pest management, storage (both proper space and type) are in need of improvement. These ratings were based on the current condition of the institution during the time they took this survey.

To get a better understanding of how the previous topics affect the objects in the institution, several of the remaining questions on the survey focused on preservation and care of the collections. When this institution took the survey, they noted that their mission statement included something about preservation of the collection as well as having a long-range preservation plan. They are now in the process of updating their mission statement and preservation plans. Currently, only a portion of their collection has a conservation/preservation program.

The final part of the survey asked about having a survey done about the general condition of the collection. Institution 1 indicated that one had been done. The next question asked them to go further and rate the causes of damage or loss of the objects in the collections that are currently in need for treatment. Fire and vandalism were rated the lowest for causing damage or loss. Handling as a cause of damage or loss is unknown to the institution. Fading caused by lighting, pests, and prior treatments and/or restoration was ranked as having caused some damage or loss. The things that caused the most significant damage or loss were water or moisture, such as stains and warping, improper storage, objects being bent, broken or adhered together, and lastly deterioration due to temperature, humidity and age. Due to the fact that part of the institution is considered to be an open air museum; it is more difficult for them to control things such as natural light, temperature, and humidity.

The curator of the institution did mention that improper storage and handling caused much of the damage before his/her time there, and that considerable effort has been put forth to correct these areas. Institution 1 has several areas that need to be improved. They are, however, making an effort to correct these issues. The most recent

correspondence from the institution stated that they were in the process of a major upheaval, which has occurred within the last two years, with a new staff and a rebranding.

Overall, Institution 1's collection is in good shape and no major changes are needed. The only area that may need improvement is storage. As their collection continues to increase, the space in which they have to store it will decrease. The institution needs to do an audit of its storage and find specific areas that are in need of improvement, whether this is the need for space or better storage containers. They can then determine if they need to relocate the storage area, upgrade the storage equipment, or expand their current storage space. Based on the size of the institution, they can apply for grants to help fund this improvement. Overall, the staff of the institution has a good handle on the care of the collection and its needs.

Institution 2

Institution 2 describes itself as a historical society, historic house/ site that was set up as a church in 1800s, and a history museum. They are governed by non-profit, non-governmental organization or foundation. They did not indicate the type of funding they receive. They are currently staffed with eight volunteers. They have worked with a local college in the past, but the majority of the objects are stored in a town building with no care at all. They listed their collection as having assorted artwork, 100+ books, period clothing, quilts and assorted bedding, kitchenware, late 1800 to early 1900 furnishings and miscellaneous items.

Institution 2 stated that with the limited staff, as well as their aging population, the collection has no real care; though their mission statement does include preservation of the collection. They stated that there are no environmental controls to meet temperature, RH, or light levels. They believe that 0% of their collection in stored in adequate areas or having adequate pest management. They are in desperate need of improvement in all areas. There has been a general survey of the collection for condition, but it is not up to date. It does not have a long-term plan or program for the conservation/preservation of the collection.

They reported no loss or damage caused by fire and vandalism. Handling, water or moisture, fading caused by the lighting, and pests have been the cause of some damage or loss. Improper storage, deterioration and prior treatments and/or restoration caused significant damage or loss. Based on the answers provided in the survey, Institution 2 is the most in need of improvement out of all the institutions that responded to the survey.

The recommendation for this institution is first and foremost to come up with an Integrated Pest Management (IPM) policy. By understanding its pest problems and the areas that are in need of help, it can start to implement a plan to help reduce their pest problem. It can do this by placing sticky traps inside the building where the collection is housed and by entryways, cleaning up the vegetation around the building. Samples of pests could be taken to an expert or college/ university to determine their type. This can help steer the institution in the right direction when it comes to developing and IPM plan. The next step will be to conduct a general condition survey of the collection. After this is done, the institution can get a better understanding of the issues at hand. Appling for

grants will help with the funding of such projects as well as working with the local colleges.

Institution 3

Institution 3 has described itself as an archive, art museum, and archive for and about a local artist, his contemporaries and Western New York artists. It is governed by a not-for-profit, non-governmental organization or foundation and a college, university or another academic entity. Funding for this institution comes from federal and other governmental, and corporate agencies, foundations and donations from individuals, and memberships. It has a staff consisting of 16 full-time, 10 part-time, 40 volunteers and 5 interns.

When it comes to the institution's collection, it works with an outside conservator as well as the local college's conservation department. Its collection consists of the following:

- 35,500 works on paper (including drawings, prints, photographs and wallpapers)
- 200 sculptures
- 500 arts and crafts objects
- 50 + miscellaneous objects

It does have a written long-range conservation/preservation plan for its collection though it is not up to date. There has been a general condition survey done on some of the collection. The building is the newest out of all of the institutions that responded. It was considered to have a state of the art building when it was built. Its temperature controls meet specifications in all areas. It also believes that RH and lighting meet

specifications in some, but not all, areas. Only 60-79% of the collection is considered to have adequate storage. Handling, water or moisture and deterioration caused the most significant damage to the institution's collection, mostly accrued prior to the new building.

The institution does have the benefit of being one of the newest buildings that leads them to having fewer areas in need of improvement. The areas that need some improvement (though not a great need) are outside pest management and both storage space and type. With ever-changing specifications that are in place, it is no surprise that even the newest institution has areas that are in need of improvement. Other than needing more space this institution is in great shape and needs the least amount of improvement.

Institution 4

Institution 4 is a historic house/site, national historic landmark, history museum and home related to the inauguration of a former president. It is governed by a non-profit, non-governmental organization or foundation. Funding comes from municipal sources, individual donors or private philanthropists, admissions, memberships, and fundraising. They have a staff of 40 volunteers, who also handle the conservation/preservation of the collection. Their collection consists of furniture, quilts, kitchenware, toys, musical instruments, flags, paintings, decorations, lithographs, posters, and miscellaneous objects. Their mission statement does account for preservation; and they have a written long-range preservation plan, though there has

not been a survey of the general condition of the collection. They also do not have a written emergency plan or a conservation/ preservation program in place.

Historic houses often face difficulties in making improvements needed to bring the environmental controls up to specifications. As a historic house, Institution 4 is limited to the changes that can be made to the house exterior. The local government has a preservation ordinance with the goal of protecting and preserving historic properties in the City of Buffalo that meets the requirements of New York State and the Federal government. They do not have specific environmental monitors throughout the home; however, they have heat and air conditioning installed. They are then able to use the thermostats to control the temperature. They control RH the best they can by having a dehumidifier in a basement space where some of their collections are stored. Like the other areas, they do control lighting the best they can by limiting the length of use and how they place lighting around the exhibits. They protect much of the furniture by draping covers over them during non-business hours. Institution 4 is like all the others who completed the survey; they wish to have more storage to meet the needs of their growing collections. They state that 80-99% of their collection currently has adequate storage areas.

When asked to rate the areas that are in need of improvement they said that RH has little to no need of improvement. Temperature control, artificial lighting and inside/outside pest management need some improvement; however, they said that 40-59% pf the collection has adequate management. This leaves both storage space and type needing the most improvement. Storage along with water or moisture, light, deterioration and prior conservation treatments were listed as areas that caused some

damage or loss to the collection. Handling, fire, pest, and vandalism have caused no damage or loss to the collection.

Institution 4 has the benefit of being a national historic landmark and receives funding from not only the local government, but also the federal government. They need to do a general audit of their problem areas, such as pest management, lighting, and temperature control. They need to look closely at what is bringing in pests and how they might be able to control this problem. This can be accomplished by using sticky traps, and controlling what comes in and out of the building (things like food, plants, etc.), and where the staff eats their lunch. The easiest way to fix the lighting problem is to change the type of lights used and limit their time usage. They can invest in lights that have UV filters or ones that are on a timer to limit the amount of light an object receives. Adjusting the temperature may be a little trickier to accomplish; the museum can invest in portable air conditioners or heaters if installing a new HVAC system is not possible. They can also use thermometers, thermostats, and hygroscopes (an instrument that gives an indication of the humidity of the air) to monitor the temperature and relative humidity. The staff then can begin to formulate a plan to control the temperature and humidity better. This can be done by turning on the air conditioners, heaters and dehumidifiers at certain times of the day.

Institution 5

Institution 5 is an archive, history museum, and a historical society, with more than one building that is governed by a non-profit, non-governmental organization or

foundation. It receives funding from federal, state and municipal sources. Its staff consists of the following:

- 14 full-time
- 10 part-time
- 5 volunteers
- 3 interns

Institution 5's mission statement includes preservation of the collection. It also has a written emergency/disaster plan for their collection. Object conservation is done by need to prepare objects for exhibits. For conservation needs, it can contract outside help as well as use the local college's conservation department.

Within the past few years, Institution 5 was able to make several upgrades to its environmental controls, so temperature, RH, and light levels all meet recommended specifications. Like the other institutions, it believes that it needs an adequate storage stating that only 60-79% of the collection to be in adequate storage. The area that is in the most need of improvement is pest control, mainly on the inside. It stated that 40-59% of the collection had adequate pest management. With the improvements that have been made in the past few years, fire, vandalism, and improper storage have caused no damage or loss. Water or moisture, pest, deterioration, and prior treatment have caused some damage or loss, leaving handling and light to cause the most significant damage or loss.

This institution's primary focus needs to be on implementing an Integrated Pest Management (IPM) plan. It has more than one building and needs to focus on the buildings individually. Once it knows what the problems are and where they are, it can

begin to implement an IPM. This institution, like the others, needs to know what can be changed in order to minimize the pest issue.

Institution 6

The last institution describes itself as a historic house/site and an art museum. It reported that it does not own a collection and, therefore, could not complete the survey in its entirety. It did, however, mention that it is governed by a corporate or for-profit organization. It received funding from the state and earned income through membership, special events, class, etc. The staff consists of two volunteers.

Summary

Each of the institutions was able to acknowledge the areas that need the most improvement. Some of the institutions are lucky to have up-to-date facilities while others are struggling with inadequate facilities. The following chapters will go into more depth about what is recommended and how these institutions can implement the recommendations.

The set of criteria mentioned in this paper are those put forth by the American Association of Museums (now American Alliance of Museums) through their accreditation program and recommendations made in the HHIR. Why are standards so important? The standards are a way we can be broadly accountable for our conduct. Clearly agreed upon standards describe what is "good" and "bad" conduct.[60] It assures a museum's stakeholders that the organization is striving to meet best practices,

[60] The American Association of Museums. *National Standards & Best Practices for U.S. Museums*. Washington DC: American Association of Museums, 2008. 4. Print.

whether or not a museum is accredited.

Chapter 3: Temperature and Humidity

The most important factor in the preservation of collections maintenance is maintaining proper environmental conditions. These elements should not be allowed to influence an object or a collection in a negative way.[61] Controlling the environment in which an object resides can significantly affect its condition.

Temperature and relative humidity (RH) differ from the other environmental factors. They are interdependent, and their effects on objects are more varied and complex. Issues with temperature and RH cannot be eliminated, but instead satisfactory values for each must be determined.[62] Proper climate control is one of the essential ways to manage museum object storage. “There is no such thing as an ideal temperature or humidity for storing all museum objects.”[63] It is highly desirable to have individual controls for each storeroom, assuming such storage is available so that the different temperature and humidity requirements for different media can be met.[64] RH was the ratio of the actual absolute humidity (amount of water found as a vapor in a given volume of air) of measured air to its potential absolute humidity if it were saturated.[65]

Experts, such as Buck, Allman Gilmore, Caple, Hillberry, Weinberg and Read,[66] recommend a general setting RH at 50% +/- 5% and temperature at 70°F +/- 2°F. This

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[61] "Preventive Conservation." *Painting Restoration and Conservation*. Web. Jan. 2012. <http://www.schilderijenrestaurator.eu/preventive-conservation.htm>.
[62] Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 339. Print.
[63] Hilberry, John D., and Susan K. Weinberg. "Museum Collections Storage." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 163. Print.
[64] Ibid. 163.
[65] Brooke Craddock, Ann. "Control of Temperature and Humidity in Small Collections. *“Conservation Concerns*. Washington DC: Smithsonian Institution, 1992. 15. Print.
[66] Buck, Rebecca A., and Jean Allman Gilmore. *MRM5: Museum Registration Methods: 5th Edition*. Washington, DC: AAM, 2010. Print, Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. Print, Hilberry, John D., and Susan K. Weinberg. "Museum Collections Storage." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. Print, "Preventative Conservation by Fergus Read." *Meaco*. Web. 11 Mar. 2012. <http://www.meaco.com/preventa.htm>.

is a general recommendation to accommodate the objects being stored or displayed.[67] Excessive heat and humidity can speed up chemical and biological decay. Warm and moist air is also attractive to insects and molds that thrive in such conditions.[68]

Temperature is measured with a *thermometer*; relative humidity with a *hygrometer*; a *thermal hygrometer* measures both.[69] All are considerably inexpensive ways to monitor the temperature and humidity. However, the staff needs to know what to do with the information that these instruments provide.

Monitoring temperature and humidity would be considered the easy part of climate control. The actual controlling of these conditions is slightly more complicated. At least two of the museums that responded to the survey acknowledged that they were either located in a newer up-to-date building or have recently updated their climate control systems. This places them in an excellent position for controlling the climate. The others are small local museums without the means of updating their system, and therefore they are in a daily battle for climate control. Many of these museums have to rely on dehumidifiers, humidifiers, air conditioners or fans. A good portion of their collection is in distress because of the lack of proper climate control.

Some objects are unstable due to their inherent qualities, such as materials used to make them. One, for an example, is glass 19th century, and earlier glass items that had a lower content of lead, which was used as a stabilizer. With a lower level of lead, glass suffers from what is called weeping and crizzling. Moisture is attacking the glass

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[67] Buck, Rebecca A., and Jean Allman. Gilmore. "5G Preventive Care." *MRM5: Museum Registration Methods*: 5th Edition. Washington, DC: AAM, 2010. 287. Print.
[68] History Trust of South Australia. Web. 12 Nov. 2010. PDF Filehttp://www.history.sa.gov.au/chu/downloads/CMP_help_sheets/Museum%20Environment%20final%20150609.pdf
[69] "Preventative Conservation by Fergus Read." *Meaco.* Web. 11 Mar. 2012. <http://www.meaco.com/preventa.htm>.

causes this. “Weeping” is “the formation of water droplets or a film of water on the glass surface.” Crizzling is “the presence of surface crazing or an increase in opacity accompanied by leaching out of water-soluble alkali.” Lead acts as a stabilizer and helps prevent these things from happening.[70] A very high (RH) is conducive to mold growth. Fluctuating RH can also cause materials like wood, ivory, and paper to cycle through expansions and contractions leading to cracks, broken paint, and warping.[71]

Looking at the surveys, one can deduce that many of the museums feel that temperature is not an issue for the collection, though one museum stated that currently its collection is being stored in a town building with no controls at all and needs to improve significantly. With RH, the results were more mixed: two museums think they need improvement, and the other three believe this is not an area that is in need of improvement. It is possible that their assumptions are correct seeing how temperature and RH are the easiest areas to control. There can always be room for improvement.

In a survey done by the Heritage Health Index, the institutions that employ environmental controls in all or some areas where collections are held, find that the temperature is more likely to be controlled than relative humidity. The use of environmental controls correlates to the size of the institution with large institutions more likely to control temperature, relative humidity, and light levels in all and some areas that hold collections. Smaller institutions are most likely not to use environmental controls in any areas; 27% of small institutions do not control temperature or relative humidity in

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[70] Bradley, Susan M. "Do Objects Have a Finite Lifetime?" *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 55. Print.

[71] "Preventive Conservation." *Welcome to The Field Museum*. Web. 12 Feb. 2012. <http://fieldmuseum.org/explore/department/conserving-collections/preventive>.

any areas.[72] The results of the survey done for this paper seem to agree with these results.

Objects are formed from materials that respond differently to temperature and RH. Therefore, the challenge for museums is to determine how to store collections with varied temperature and humidity needs in the same space. Currently, there are no universal official museum standards for temperature and RH; it is up to each institution to implement its own. Some general guidelines will be discussed later on. The staff must take time to review the literature and implement the proper plan for their unique collection.[73]

[72] "Chapter 5: Collections Environment." *A Public Trust at Risk: The Heritage Health Index Report on the State of America's Collections*. Washington, D.C.: Heritage Preservation, 2005. 51-52. Print.
[73] Erhardt, David and Marion Mecklenburg, "Relative Humidity Re-Examined" Ed. Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 340. Print.

Chapter 4: Pest Control

Pest control is one of the most difficult environmental issues to deal with. Museums are very attractive places for insect pests to inhabit. Museums house items of all kinds of materials, such as textiles, wood, etc., which can be very attractive to numerous types of beetles, moths, ants and borers that feed on these items. Getting rid of an insect infestation is much harder than preventing one.[74] As seasons change and the collection changes, this brings about an ongoing need to change tactics to keep pests under control.

Integrated Pest Management, (IPM) was first used in agriculture in the 1970s in response to the growing knowledge about the negative side-effects of pesticide overuses.[75] In the early 1980s, the first literature began to appear about non-agricultural IPM use. Prior to the 1980s, insect infestations of museum objects or collections addressed within a reactive matter, meaning that the object or collection was fumigated, sprayed or dusted with chemical agents that were toxic to insects and potentially human health. By the 1990s, a more proactive and cost effective approach, IPM, was being adopted.

Soon after that, IPM replaced the term “pest control” in museums. Some collections are more vulnerable than others. Such factors as the type of storage furniture used, whether they are closed cabinets, as opposed to open shelving, as well as the type of storage material, also has an impact in the management of unwanted

[74] History Trust of South Australia. Web. 12 Nov. 2010. PDF Filehttp://www.history.sa.gov.au/chu/downloads/CMP_help_sheets/Museum%20Environment%20final%20150609.pdf

[75] "Museumpests.net." *Museumpests.net*. N.p., n.d. Web. 25 Apr. 2012. <http://www.museumpests.net/>.

pests.[76] Things like wood storage shelves can be attractive to pests, who would move from the wood shelving itself to the objects being stored. A museum also has to be careful when using synthetic materials. Some materials are made of chemicals that can release gases into the air and cause damage to the objects.

Pests can be anything living, from pigeons to rats to insects. While not all pests affect the collection directly, they do affect the employees and/or visitors. The simplest way to deal with the situation is to lay out traps for rodents, and insects; also cover or block all entrance points for such pests. Many places will use wiring and spikes on the roof to prevent birds from nesting. These types of measures can be seen as unattractive to those who come to visit, and can take away from the historical aspects of the building. [77]

Routine building maintenance can serve the cause of preventive conservation. Ensuring that windows and roofs are in good repair, keeping both storage and exhibition spaces clean and free from dirt and dust and improving ventilation, and air circulation will benefit the collection. Preventive conservation relies on controlling the museum environment. Institutions need to foster a general appreciation of collections care.[78] Environmental controls should aim to maintain an environment that is not hospitable for pests.

Museums are at risk from four overlapping categories of pests: stored product and fabric feeders, wood destroying insects, general feeders, and nuisances and health

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[76] "Museumpests.net." *Museumpests.net*. N.p., n.d. Web. 25 Apr. 2012. <http://www.museumpests.net/>.
[77] Breische, Nancy L. "Integrated Pest Management." Ed. Rebecca A. Buck and Jean Allman Gilmore. *The New Museum Registration Methods.* Washington, DC: American Association of Museums, 2001. 261. Print.
[78] Getty Conservation Institute. "Preventive Conservation." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 86. Print.

hazards. Most insect damage to fabrics is caused by carpet beetles or clothes moths; these are the Fabric Pests. It is not the adult insects that do the damage. It is the larva or immature stage that feeds on the fabric, fur, feathers, or virtually anything made of animal fibers. Museums have objects made in part of seeds, nuts, grains, spices, dried fruits and vegetables, and other foods. A long list of pests, traditionally called "stored product pests" or "pantry pests," can infest items containing these foods. Materials made of wood are susceptible to attack by a number of wood- infesting pests, usually, powderpost beetles or dry wood termites. Both can severely damage valuable artifacts while remaining invisible to the untrained eye. Any household pests, such as cockroaches, rodents, silverfish, and ants, can invade and infest a museum as well as a house or other structure.[79] On page 93, Appendix 3 has examples and descriptions of some of the most common types of pests.

Treating other pests can get complicated. There are several things to consider when using IPM on insects. There are health and safety laws to follow. It is suggested that if one has to fumigate the museum or use any chemical, one should use the least-toxic method possible. This not only helps minimize the damage done to the collection, but it also keeps those who work or visit the museum from becoming ill from exposure to the chemicals. This is something that the museum should not take on alone. An expert is needed to ensure that the right chemicals are being used in the right amount at the right location. [80]

The museum staff needs to monitor pest issues; one way of doing this is to place

[79] "Nature & Science Biology Resources Integrated Pest Management Manual." *Explore Biology*. National Park Service, n.d. Web. 17 Nov. 2011. <http://www.nature.nps.gov/biology/ipm/manual/museum.cfm>.
[80]Breische, Nancy L. "Integrated Pest Management." *The New Museum Registration Methods* Ed. Rebecca A. Buck and Jean Allman Gilmore. Washington, DC: American Association of Museums, 2001. 257. Print.

sticky traps in several areas and log pest activity. The staff needs to minimize the pest-friendly environment by not eating at their desks, taking trash and recycling out regularly, vacuuming, and keep unnecessary items such as plants to a minimum. [81] Another way to keep pests out is to quarantine new items for at least two weeks. They can also use the freezing technique: place the item in a freezer for several days, take the item out of the freezer for a few days and then place back into the freezer, to kill any pests that may be in or on the item.[82]

Out of the five surveys received the results were mixed on the questions involving IPM. Institutions 1 and 3 believed they had adequate pest management in 80-99% of their collection, Institutions 4 and 5 found they had 40-59%, and Institution 2 believed they had 0%. Most of the museums believed that pest management for the building exterior was an area in need of improvement. There were similar results for pest control regarding adequacy. As for damage caused to the collection by pests; two museums rated the collection as having no damage or loss due to pests and the other three rated their collections as having some damage or loss.

There are a few areas of control that should be considered when implementing an IPM. The first is mechanical and physical control. Museums must decide how to change the physical structure such as vents, drains, screens, doors, plants, or windows. For example, to keep birds away, remove vines and bushes from exterior walls; to keep cockroaches away, remove leaves and grass clippings. Next is cultural control. This may be more difficult. Museums must develop policies and provide facilities to change people's work (or eating) habits in the galleries, offices, library, and storage rooms. For

[81] Ibid.259-63. Print.
[82] Ibid. 264.

example, do not leave food or wrappers in wastebaskets overnight; do not leave dirty dishes in the sink. Sanitation also goes along with this. The goal is to make living in the museum more difficult for the pest. For example, make sure all windows have screens and caulk all openings to stop pests from coming up around pipes.[83]

[83] History Trust of South Australia. Web. 12 Nov. 2010. PDF Filehttp://www.history.sa.gov.au/chu/downloads/CMP_help_sheets/Museum%20Environment%20final%20150609.pdf

Chapter 5: Lighting

Light is essential in order to see the objects in both the exhibit and storage areas, but light also damages these objects. Light is made up of three aspects: ultraviolet radiation or UV light, infrared light, and visible light. Excessive light and heat cause damage. Reducing bright UV light will limit fading and reducing infrared light will limit heat damage.[84] Museum environments are lit by a combination of natural light and artificial light. It can be too bright in areas directly under windows and also can become very bright and hot in sunny weather causing problems to items. Historical houses typically have different lighting issues than galleries and museums, which are often built without windows in display areas. In historical houses, light brightness and temperature can be controlled by using window coverings such as curtains and/or indoor or outdoor blinds, covering windows completely with an opaque panel, or limiting, UV light levels with transparent or translucent film.[85]

Artificial lighting can be controlled and adjusted more quickly than natural light. Types of artificial lighting to choose include: low UV or UV-filtered globes that are low voltage so they will not produce too much heat; fluorescent lighting (the most common ones used for general illumination, but not desired at all); UV-filtered fluorescents, and low UV track lighting can be used to highlight certain features.[86] Now LED (Light-emitting diode) is available. There are also filters that are transparent and colorless and do not affect the quality of light. The intensity of light is measured in “lux” or foot candles, taking the duration of the exposure into account, the total and the light dose

[84] History Trust of South Australia. Web. 12 Nov. 2010. PDF Filehttp://www.history.sa.gov.au/chu/downloads/CMP_help_sheets/Museum%20Environment%20final%20150609.pdf
[85] Ibid.
[86] Ibid.

are measured in “lux hours”. [87] The recommended maximum levels for light is up to 50 lux for more sensitive materials, textiles and works of art on paper, and 200 lux for oil-paintings.[88] The following table shows the recommended levels for different types of objects in the collection.

Table 5.1[89] Visible and UV light level recommendations

	Visible light	**UV light**
Sensitive collections Including textiles, watercolors, photographs and other papers	Maximum: 50 lux (5 foot candles)	Ideal:0 - 10 microwatts per lumen* Maximum:75 microwatts per lumen
Lesser sensitive collections Including paintings, wood, and leather	Maximum: 150 lux (15 foot candles)	Ideal:0 - 10 microwatts per lumen Maximum:75 microwatts per lumen
Least sensitive collections Including most metal, ceramics, stones, and glass	Maximum: 300 lux (30 foot candles)	Ideal:0 - 10 microwatts per lumen Maximum:75 microwatts per lumen

*****Lumen is a measure of the total amount of visible light emitted by a source.

Natural light varies depending on the time of day and the weather. Objects that are placed outdoors need to avoid the natural light. Objects such as sculptures, paintings, etc. can be having the following done to help protect them: place large objects in shaded areas or under a built shelter, keeping in mind the amount and direction of light as the day progresses.[90] Shutters and/or blinds need to be closed when the museum is not open to minimize the items’ exposure to the light.[91]

Incandescent lights do not give off ultraviolet radiation; however, they can emit a

[87] Staniforth, Sarah. "Light and Environmental Measurement and Control in National Trust Houses." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 118. Print.
[88] Ibid. 117.
[89] Texas Historical Commission. *Basic Guidelines For The Preservation of Historical Artifacts*. Web Feb. 2012. Doc.Pg.4 www.thc.state.tx.us
[90] History Trust of South Australia. Web. 12 Nov. 2010. PDF Filehttp://www.history.sa.gov.au/chu/downloads/CMP_help_sheets/Museum%20Environment%20final%20150609.pdf
[91] Staniforth, Sarah. "Light and Environmental Measurement and Control in National Trust Houses." v. *Care of Collections.* Ed. Simon J. Knell. London: Routledge, 2006. 119. Print.

significant amount of heat and should not be placed inside or near display cases. Various lamp modifications are available; along with using the lowest wattage possible, and make sure the surrounding areas are well ventilated.[92] The following chart provides the recommended light levels for artifacts on display. When exhibiting mixed collections, one needs to choose the recommended light level for the most sensitive artifacts on display.[93]

The HHIR found that 27% of small institutions do not control light levels, among other things.[94] Three out of the five museums (Institutions 1, 3, and 5) that participated in the present survey indicated that there is little or no need of improvement with natural and artificial lighting. Institutions 1 and 3 said that controlled light levels meet specifications in some, but not all areas. Institution 5 has controlled light levels that meet specifications in all areas.

Institution 2 reported that they were in need of significant improvement with both natural and artificial lighting, and Institution 4 showed that it was not in great need, but there is room for some improvement. Institution 2 is in the greatest need of improvement to controlled light levels for it does not meet specifications in any areas. Institution 4 stated that controlled light levels meet specifications in some, but not all areas. They control light level by draping particular furniture with covers (mainly cotton sheets) as a means of controlling the exposure to light.

Light can only damage what it reaches. To reduce surface deterioration to a

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[92] Texas Historical Commission. *Basic Guidelines For The Preservation of Historical Artifacts*. Web Feb. 2012. Doc.Pg.3 www.thc.state.tx.us

[93] Ibid.

[94] "Chapter 5: Collections Environment." *A Public Trust at Risk: The Heritage Health Index Report on the State of America's Collections*. Washington, D.C.: Heritage Preservation, 2005. 52. Print.

minimum the lighting must be controlled.[95] An institution needs to know all the media (or composite material) of collection objects in order to ensure the proper lighting. Light can create some serious irreversible damage to objects in the collection. The light causes less extensive damage to some materials like metals and ceramics.[96] Light is cumulative, and the objects will never regain color nor will fabrics regain their flexibility and strength.[97] The figure 5.1 shows how three jerseys suffered from light damage, with fading and discoloration where the light was directed. [98]

Figure 5.1

Source "Examples of Damage Caused by Bad Storage and Display." *RFU*

Many museums (especially those with little funding or support) typically use halogen or metal halide track lighting. There are four lighting alternatives for the lighting used in a museum. Light emitting diodes (LEDs) are considered to be the most promising source of light. These lights consume one-fifth the energy of a conventional light bulb. These lights are more expensive than incandescent lighting, but their low

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[95] Thomson, Garry " The Museum Environment- Light" Ed. Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 309. Print.
[96] "Preventative Conservation by Fergus Read." *Meaco*. Web. 11 Mar. 2012. <http://www.meaco.com/preventa.htm>.
[97] Buck, Rebecca A., and Jean Allman Gilmore. *MRM5: Museum Registration Methods: 5th Edition*. Washington, DC: AAM, 2010. 210. Print
[98] "Examples of Damage Caused by Bad Storage and Display." *RFU*. Web. 17 Jan. 2013. http://www.rfu.com/twickenhamstadium/worldrugbymuseum/thecollection/caringforrareitems/examples

energy cost make them more cost-effective in the long-term.[99]

Remote sources lighting or fiber optic lighting uses plastic or glass fibers to distribute the light. The benefit of using these lights is that the heat source is removed from the end of the fiber. This is a creative solution to the problem; however, there are a few issues. While the glass fibers dissipate UV light; the plastic fibers require UV filtering. The longer the fiber and severe bending of the fiber, the more light is lost. Energy cost savings may not offset the expense of the implementation.[100]

One of the newest technologies in lighting is Hybrid Solar Lighting (HSL). HSL uses solar power and fiber optics to channel sunlight. There are similar issues with lighting as with the fiber optics (where fiber length and a severe bending fiber causes more light to be lost). The last alternative is natural lighting. Museums can take advantage of natural light by diffusing direct sunlight and creating a system that tracks and controls sunlight while avoiding UV rays.[101] It comes down to the individual institutions to come up with creative and cost-effective ways to light their institutions. For example, as stated before, Institution 4 protects the furniture, by covering these objects with sheets to limit the amount of light exposure. Other ways to protect items is to move them away from the light source, limit the amount they are on display, or to use motion sensors or lights on a timer.

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[99] Buck, Rebecca A., and Jean Allman. Gilmore. *MRM5: Museum Registration Methods: 5th Edition*. Washington, DC: AAM, 2010. 383. Print.
[100] Ibid. 383-384
[101] Ibid. 384

Chapter 6: Indoor and Outdoor Pollutants

The survey did not touch on indoor and outdoor pollutants. However, the author believes that this subject is a vital part of preventive conservation which should be included in this paper.

There are two types of air pollutants: particulate and gaseous (ozone, peroxides, nitrogen oxide and sulfur dioxides).[102] The atmosphere that surrounds an object is composed of storage or display materials and the environment including the fine particles suspended in the gas.[103] Pollutants in the ambient air are undesirable in museum indoor environments due to the risk of material damage.

Pollutants can be controlled with a quality HVAC (heating, ventilation, and air conditioning) system. To ensure the best quality air and minimum pollutants, the systems should be routinely cleaned and regularly maintained. HVAC systems are used to help maintain good indoor air quality through adequate ventilation with filtration. The proper HVAC system for the needs of a museum includes the following elements: use of constant air volume, limitation of outside air, design based on the humidity, and use of prefilters and high efficiency filters.[104] Top of the line HVAC systems can be very expensive. There are, however, cost effective options for institutions:

- Seal the building using caulking, weather-stripping, etc. to make sure the building is weather tight as well as reducing pest access
- Stabilize the environment by reducing the size of the system to cover only the collections and exhibit areas

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[102] Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 221. Print.
[103] Ibid. 221
[104] *Air Filters & Air Purifiers*. "Museum & Library HVAC Air Cleaning Guide HVAC Indoor Air Quality Control For Archived Collections." Web. 22 May 2013. https://www.danforthfilters.com/secure/store/Air-Filters-Museum-4.asp

- Clean better
- Use only preservation quality materials, when possible.
- Reduce winter heating. Not only will maintain 68℉ be beneficial for the collections; it will also cost 75% less than maintaining 75℉.
- Use supplemental Air Purification where only a single room requires the additional protection, which can be obtained in the form of "add-on" air filters.
- Improve air filtration by replacing the standard filters with a combination fiberglass/potassium permanganate filter or perhaps pleated filters.[105]

Materials used for the construction of buildings, industrial manufacturing, and cars produce harmful emissions that pollute the air.[106] "The most effective solution is to prevent any pollutant from entering the museum building."[107] While it is difficult to ensure that a building is airtight, the building should be free of any leaks or drafts and the air that is brought into the building through the mechanical ventilation system (assuming there is one) needs to be filtered.

Keep all windows and doors closed to help ensure reduced pollution. General housekeeping will help reduce the air pollutants in the museum. Chemicals and gases given off by harsh commercial cleaners can transfer to artifacts, so using milder cleaners can significantly reduce damage to the collection caused by the chemical and gases in the harsher cleansers.

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[105] Danforth Filters. *Air Filters & Air Purifiers*. "Museum & Library HVAC Air Cleaning Guide HVAC Indoor Air Quality Control For Archived Collections." Web. 22 May 2013. https://www.danforthfilters.com/secure/store/Air-Filters-Museum-4.asp

[106] Museums Australia (Vic). "AIR POLLUTION." 2003. Web. 06 Mar. 2012. <http://www.mavic.asn.au/assets/Info_Sheet_5_Air_Pollution.pdf>.

[107] Ibid.

Indoor pollutants in museums originate primarily from off-gassing of structural or decorative materials, organic materials (such as wooden shelving, heating, plants, or activities of visitors and staff,) and outdoor pollutants. There is significant evidence that indoor air pollution can cause an enormous amount of damage to the items in the museum. There are certain objects and materials that show effects immediately, such as photographs, silver, paper, leather, and dyes.[108] Table 6.1 (on page 50) compiled by Norbert Baer and Paul N. Banks outlines the type of impact, principal air pollutants, other environmental factors, and methods of measurement for different materials.[109]

The chemical agents of deterioration are aggressive chemicals in the form of gases, liquids or solids, which can react with material and cause changes in the composition, nature, or appearance of the objects, such as fabric, paintings, organic material, etc.[110] Principal pollutants are sulfur dioxide, nitrogen dioxide, ozone, reduced sulfur gases, carbonyls, and fine particles. The pollutants may have natural or man-made sources; carbonyls are a particular indoor-generated problem.[111] Temperature and humidity controls, as well as the Museum's HVAC system, play a tremendous role in the reduction of dust, particulate, and gaseous pollutants.[112] Table 6.1 illustrates how indoor pollution can damage different materials.

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[108] Baer, Norbert S., and Paul N. Banks. "Indoor Air Pollution: Effects on Cultural and Historical Material." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 144. Print.
[109] Ibid. 136.
[110] Staniforth, Sarah, Sophie Julien and Linda Bullock "Chemical Agents of Deterioration" Ed. Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 225. Print.
[111] Baer, Norbert S., and Paul N. Banks. "Indoor Air Pollution: Effects on Cultural and Historical Material." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 137. Print.
[112] "Philadelphia Museum of Art - Research: Conservation." Philadelphia Museum of Art - Research: Conservation. Web. 06 Mar. 2012. <http://www.philamuseum.org/conservation/10.html?page=4>.

Table 6.1 Indoor air pollution damage to materials[113]

Material	Impact	Principal air pollutants	Other environmental factors	Methods of measurement
Metals	Corrosion, tarnishing	Sulphur oxides, hydrogen sulphide	Moisture, air, salt, particulate matter, ozone	Weight loss after removal of corrosion products
Paintings Moreover, organic coatings	Discoloration Soiling	Sulphur oxides, hydrogen sulphide, alkaline aerosol	Moisture, sunlight, ozone, particulate matter	Surface reflectivity loss, chemical analysis
Paper	Embrittlement Discoloration	Sulphur oxides	Moisture, physical wear, acidic materials introduced in the manufacture	Decrease folding endurance, pH change
Photographic materials	Micro blemishes 'subheading.'	Sulphur oxides, hydrogen sulphide	Particulate matter, moisture	Visual and microscopic examination
Textiles	Reduced tensile strength, soiling	Sulphur and nitrogen oxides	Particulate matter, moisture, light,	Reduced tensile strength, chemical analysis
Textile dyes	Fading, color change	Ozone, nitrogen oxides	Light, high-temperature	Reflectance and color value measurements
Leather	Weakening powdered surface	Sulphur oxides	Physical wear, residual acids	Loss in tensile strength, chemical analysis, shrinkage
Rubber	Cracking	Ozone	Sunlight, physical wear	Loss in elasticity and strength

Another type of pollutant is radioactivity. Science museums may have materials in their collections that are radioactive. In the late 19th century, objects were painted with a mixture containing radium to make them glow in the dark. Some of the items that have this treatment are clocks, watches, compasses, light switches, etc. There are many minerals in Science and Natural History museums that are considered radioactive.

[113] Baer, Norbert S., and Paul N. Banks. "Indoor Air Pollution: Effects on Cultural and Historical Material." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 137. Print.

Radioactive minerals have historically been stored within the primary mineral collection. Many of these items, up until recently, have been stored in zip-lock bags, and drawers labeled with warning labels. This did not and has not stopped the radioactivity from seeping into the environment around it. Some museums are now beginning to separate the radioactive collection from the main mineral collections. They are doing this by using "radioactive bays" within the main storage. These bays have extraction to ventilate gases such as radon to the outside. Museums like the Carnegie Museum of Natural History, Plymouth City Museum and Art Gallery, and many more around the world are moving their collections, mostly uranium and thorium, to special lead-lined ventilated steel cabinets that are painted yellow and are labeled with radioactive signs. This is, however, more expensive, and many museums cannot afford to do this. Clear plastic boxes lined with plastazote, closed cell chemically cross-linked polyethylene foam, can be used to replace zip-lock bags in those museums with minimal funding.[114]

Contaminants destroy all objects through disintegration, discoloration, and corrosion, with chemically reactive and porous materials being particularly vulnerable. Pollutants can reach the objects through airborne delivery, contact with a contaminated object, or even be intrinsic to the object itself.[115] The primary response to any potential loss is to minimize or eliminate contact. This can be done by providing physical barriers such as special lead-lined ventilated steel cabinets or air-filtration systems.[116]

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[114] Freedman, Jan "Storage of the Radioactive Mineral Collections at Plymouth City Museum and Art Gallery UK." *Collections: A Journal for Museums and Archives* 7.2 (Spring 2011): 210-212.
[115] Buck, Rebecca A., and Jean Allman. Gilmore. *MRM5: Museum Registration Methods: 5th Edition.* Washington, DC: AAM, 2010. 290. Print.
[116] Ibid.291.

Avoidance is a solution that can be adopted by most of the institutions, if they stop introducing any new internal sources of gaseous pollutants. They should avoid any equipment that can generate harmful gases, such as printers that dispense particles that are solid or liquid substances that can deteriorate the items in the collection. These should not be near any object that is vulnerable. To exclude pollutants, especially external pollutants, windows and doors should be kept shut and, if possible, sealed.

Assess the risk of the collection to pollutants and establish guidelines for control strategies that give flexible and pragmatic solutions. A proactive, defensive approach includes having the knowledge of the reaction between objects and gases, then monitoring and /or eliminating damaging gases. For historical houses and museums, like those that participated in the survey, dust is a perennial problem. There is ongoing research by environmental bio-geochemists around the world to find the nature of what constitutes dust; however, this can vary from museum to museum. Awareness of the damage that can be caused by just removing the dust, noting how and where the dust is deposited, and recognizing what steps can be taken to reduce the dust are more proactive methods and cost-effective solutions.[117]

[117] Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 222-223. Print.

Chapter 7: Damage

Despite its advantages, preventive conservation, even where it is understood, is more accepted in theory than practice. Attending to the immediate conservation needs of an important or frequently exhibited piece can seem far more significant and urgent.[118] The scientific research model for preventive conservation involves four stages: (1) identifying threats to collections, (2) substantiating the risk, (3) identifying cost-efficient means of measure the risk, and (4) developing methods to reduce or eliminate the risk. [119] Whether intentional or not, there are various effects of treatment that can change the physical state of an object. Examples are in the following table created by the Getty Conservation Institute.[120]

Table 7.1	**Intentional**	**Unintentional**
Material is permanently added	protective coating, consolidate, lining, restored part.	residual enzymes in paper and paint films, biocide residues in paper and textiles
Material is permanently removed	old repairs, insect damaged wood, discolored varnish	sizing washed from paper, original metal polished away.
Material is permanently rearranged	bent metal reshaped; paper, textile “relaxed.”	heating thermal luminescence, x-ray shaping and creases lost by relaxation
The physical state of the object is temporarily altered	heating or freezing to kill insects, humidification treatments	permanent change from accelerated ageing due to extreme environment

Museum professionals must balance the good and evil of preventive

[118] Getty Conservation Institute. "Preventive Conservation." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 84. Print.
[119] Ibid. 84.
[120] Ashley-Smith, Jonathan. "Value." *Risk Assessment for Object Conservation*. Oxford: Butterworth-Heinemann, 1999. 287. Print.

conservation. Not all conservation attempts are useful for the item nor are all “damages” wrong. The study of risk is concerned with not only the probability, but also the impact. [121] A desirable outcome for treatment of an object is to maintain or increase its value.[122] Figure 7.1 is a recent example of a poor attempt at conservation by a non-professional. A Spanish woman, who had no proper training, made unauthorized alterations to a fresco of Jesus by Elías García Martínez, a 19th-century painter.[123] While this “alteration” may be reversible, it will take several hours and money to correct the damage. There are, however, some reports that say it may not be reversible.

Figure 7.1

Source: National Post News Good Deed by Rogue Restoration Pensioner Ruins 19th-century Spanish fresco

No one knows when a pipe will leak or burst, so museum staff need to consider this when planning the museum collection storage and exhibits. Pipes for heating and

[121] Ibid. 82.
[122] Ibid. 287.
"*National Post News Good Deed by Rogue Restoration Pensioner Ruins 19th century Spanish fresco Comments*.” Web. 19 Jan. 2013. http://news.nationalpost.com/2012/08/22/good-deed-by-rogue-restoration-pensioner-ruins-19th-century-spanish-fresco/

cooling and plumbing should not be contained in the same area as a collection. If this is not possible, then all steps need to be taken to minimize the exposure to the collection.[124] Disasters such as fire or flooding can also put objects in danger, as can leaky pipes or roofs.[125]

Most objects are not made to last forever. Objects are deteriorating in various stages even before they make their way into a museum. There are various stages of deterioration. One of the collection manager's responsibilities is to try to "beat the clock" to get the items into a stable environment. If deterioration is compromising the object's structural integrity, one might have to take a different approach to ensure the object's survival.[126] This includes making a replica or duplicate item and storing the original item in a "totally stable" environment; of course, this means the original may never be shown publicly and only would be available privately for special scholarly research. Susan M. Bradley wrote about damaged bronzes in the Department of Western Asiatic Antiquities at the British Museum. She wrote that bronze disease had been observed to cause a complete breakdown of an object to powder, making the object lose its form. These are the types of objects that need to be stabilized and stored away from the public.[127]

In the survey, museum staff were asked to identify the causes of damage to their museum collections. The following Graph 7.2(on page 56) shows their responses. Institution 1 believes that handling is one of the greatest causes of damage to their collections. Institution 2 named three areas that cause damage to their collections:

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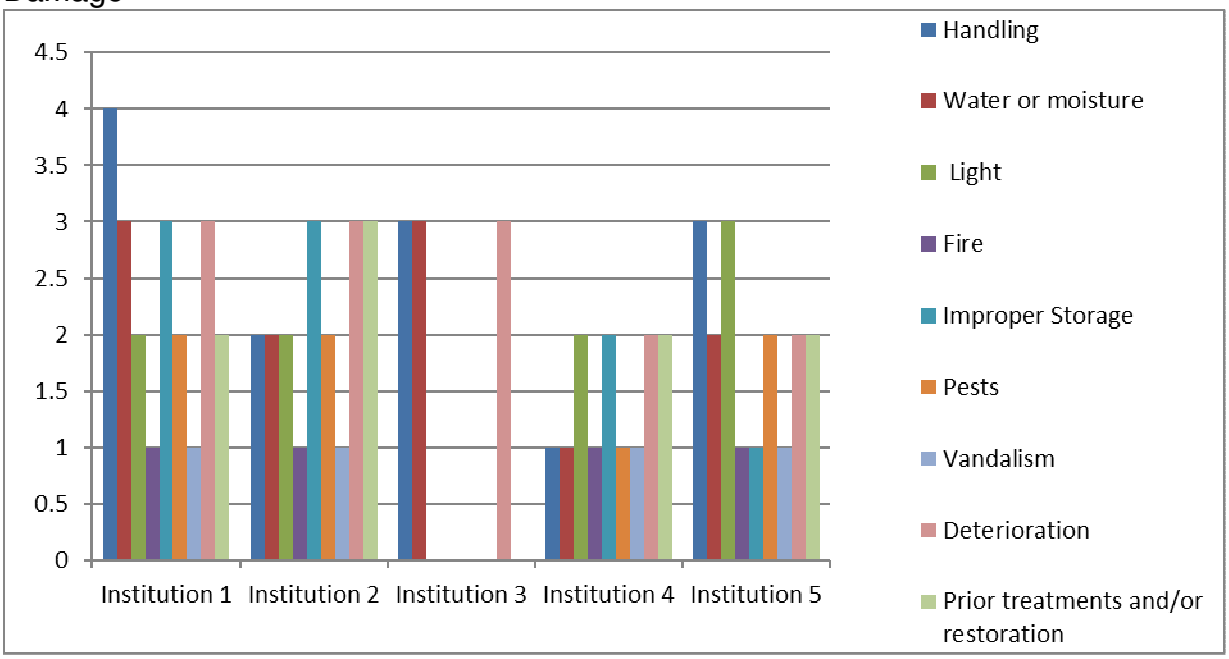
[124] Hilberry, John D., and Susan K. Weinberg. "Museum Collections Storage." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 161. Print.
[125] Texas Historical Commission. *Basic Guidelines For The Preservation of Historical Artifacts*. Web Feb. 2012. Doc. www.thc.state.tx.us
[126] Bradley, Susan M. "Do Objects Have a Finite Lifetime?" *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 57. Print.
[127] Ibid. 57.

improper storage, deterioration, and light. Institution 3 reported that handling, water and/or moisture and deterioration all played an equal role in their collections. Institution 4 reported that light, improper storage, deterioration and prior treatments and/ or restorations as being the primary cause of the damage. Finally, Institution 5 rated handling and light to be the main causes of their damage. Among all the institutions all rate vandalism and fire that has caused the least amount of damage. The rest of the areas vary among the institutions. The HHI found that the most urgent area of preservation is environmental control. The HHIR found the 26% of collecting institutions have no environmental controls; 59% had their collections damaged by light, and 53% had their collections damaged by moisture.[128]

Graph 7.2 Causes of Damage



1 No damage or loss, 2 Some damage or loss, 3 Significant damage or loss, 4 Don't Know.

[128] "Heritage Health Index Full Report." *A Public Trust at Rick: The Heritage Health Index Report on the State of America's Collections*. Heritage Preservation; the National Institute for Conservation, Mar. 2006. Web. 19 Sept. 2011. http://www.heritagepreservation.org/HHI/HHIsummary.pdf

The HHIR found that millions of objects are in urgent need of attention of some sort. In their survey the HHIR found that 12.6 million black and white photographs, 2.5 million scrapbooks, albums, and pamphlets, 2.4 million botanical specimens, 500,000 works of art on paper, 475,000 textiles, and 95,000 pieces of historic furniture are in need of treatment by a skilled professional.[129]

In order to diagnose and eliminate the causes of deterioration, the preservation environment needs to be assessed as well as collection condition audits conducted. It is recommended that all objects that are coming into a collection be photographed in order to record the original condition visually and assist in tracking any changes that occur throughout its care. A museum's job is not to stop the inevitable deterioration, but to slow it down as much as possible, and stabilize its objects.[130]

[129] "Heritage Health Index Full Report." *A Public Trust at Rick: The Heritage Health Index Report on the State of America's Collections*. Heritage Preservation; the National Institute for Conservation, Mar. 2006. Web. 19 Sept. 2011. http://www.heritagepreservation.org/HHI/HHIsummary.pdf
[130] Bradley, Susan M. "Do Object Have a Finite Lifetime?" *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 54. Print.

Chapter 8: Storage and Handling

Damage to objects occurs in all museums. Most objects in museums are inherently vulnerable. Any object accepted into the museum's collection will likely reside in storage for a significant amount of time and during this time in the museum, may be moved for exhibiting. Proper storage of collections is a costly responsibility, and many institutions lack the funding to provide the best possible storage, leaving them to compromise and place their collections at risk. It is estimated that only a small percentage of a museum's collection is on display at any one time. This leaves the majority in storage.[131] All the previous chapters in this report play a part in planning and implementing proper storage.

Most collections can be safely stored in closed cabinets or open shelving with dust and light covers. Sliding racks for framed artworks and weapons are available. There are some simple and cost effective ways to store items. Flat textiles should be rolled or stored flat in drawers. Clothing and costumes can be stored on padded hangers or, preferably, in acid free boxes; depending on the fragility and integrity of the textile. Paper and photos can be stored in acid-free folders, (using unbuffered papers for photographs). The more difficult objects to store are three-dimensional objects, which require more creativity of the staff and the use of their money and labor. There may not be space large enough to store the larger objects. Small to medium-sized

[131] Buck, Rebecca A., and Jean Allman. Gilmore. *MRM5: Museum Registration Methods: 5th Edition*. Washington, DC: AAM. 293. 2010. Print.

objects are placed in boxes that are specially created for them and then stored on shelves.[132]

Each of the respondents to the survey reported inadequate storage. In the HHIR, only 11% of institutions reported adequate storage facilities for all their collections. Museums and historical societies are least likely to have 100% of their collections stored appropriately.[133] When asked by the HHIR, institutions reported the following areas in need of improvement: additional on-site storage, additional offsite storage, renovated storage space, and new or improved storage furniture or accessories.[134] As Stated in the HHIR:

> Improper storage or enclosures, which could cause collections to be crushed, bent, creased, adhered together, broken, or otherwise damaged, ranks as one of the greatest threats to collections documented by the Heritage Health Index. Damage from handling can also be related to improper storage because cramped conditions make item retrieval by staff or researchers risky. Significant damage due to handling has occurred in 3% of institutions, and some damage from handling has happened at 51% of institutions.[135]

The purpose of storage is to retain objects as a source of information, education, and display. Determining the specialized storage equipment needed to contain a collection adequately is fundamental to planning a collection storage space. The ideal storage space for any institution would be one with climate controls and monitors for relative humidity, temperature, fire, and theft.[136] In addition to a proper environment, storage units such as cabinets or shelves are also crucial to the storage area. Museum

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[132] Ibid. 294.
[133] "Chapter 6: Collection Storage." A Public Trust at Risk: *The Heritage Health Index Report on the State of America's Collections*. Washington, D.C.: Heritage Preservation, 2005. 57. Print.
[134] Ibid. 59.
[135] "Chapter 6: Collection Storage." *A Public Trust at Risk: The Heritage Health Index Report on the State of America's Collections.* Washington, D.C.: Heritage Preservation, 2005. 59. Print.
[136] Bachmann, Konstanze. *Conservation Concerns: A Guide for Collectors and Curators*. New York: Cooper-Hewitt National Museum of Design, Smithsonian Institution, 1992. 5. Print.

specific storage units are preferred; however, they can be costly.[137] One example of this would be lateral systems, which are ideal for institutions with little storage space.[138]

The following pictures are examples of improper storage and damage cause to the objects. Figure 8.1 is that of caps squashed and piled on top of each other in plastic bags and a cardboard box. This caused them to lose their shape and cause stress to the fabric fibers. Figure 8.2 shows the damage that can be caused by the improper storage of fragile fabric items. [139] The objects should have been placed on a form in order to keep their shape. If this could not be done, then the objects should be stored in individual boxes.

Figure 8.1 **Figure 8.2**

Source: “Examples of Damage Caused by Bad Storage and Display." *RFU*

The theoretical ideal for storing any object is in a “black box”, also known as archival solander box, which represents secure storage, insulation against temperature

[137] Texas Historical Commission. *Basic Guidelines For The Preservation of Historical Artifacts*. Web Feb. 2012. Doc. www.thc.state.tx.us
[138] " Spacesaver." *Museum Storage Solutions, Museum Storage, Art Storage*. Web. 15 May 2013. http://museum.spacesaver.com/Museum-Storage-Solutions/Museum-Collections-Storage.htm
[139] "Examples of Damage Caused by Bad Storage and Display." *RFU*. N.p., n.d. Web. 17 Jan. 2013. http://www.rfu.com/twickenhamstadium/worldrugbymuseum/thecollection/caringforrareitems/examples

and RH fluctuation, a barrier against gases, light, pests and human handling? Any actual object storage environment can be compared to the black box standard.[140] The basic types of large storage units are cabinets, flat-drawer files, bins, and shelves. It is best to use enameled metal and stay away from wood. Off-gasses, such as formaldehyde, from wood could cause damage to objects. Use vertical sliding racks for storing paintings, mirrors and other framed objects.[141]

As stated on the Field Museum of National History website:

> For long-term preservation, it is critical that object housing provides physical support to the object and that the housing materials are archival (chemically stable materials that will not cause harm to the object). Conservation staff study manufacturer's data and conduct artificial aging and chemical tests of materials to select materials for storage housing and display mounts that are archival. The object structure and condition determines the support needed to prevent distortion and breakage over time.[142]

Unacceptable storage practices have a direct effect on the useful life of the objects. Poor handling also takes its toll. Any handling increases the risk of causing damage, but rough handling can and will quickly lead to serious and irreparable harm. Proper handling of objects will lead to future savings by minimizing the need for repair or replacement.[143]

UNESCO's General Guidelines for handling are as follows:

- Plan the move

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[140] Caple, Chris. "Conservation Skills: preventive conservation- storage" *Preventive Conservation in Museums*. London: Routledge, 2011. 81. Print.
[141] Bachmann, Konstanze. *Conservation Concerns: A Guide for Collectors and Curators*. New York: Cooper-Hewitt National Museum of Design, Smithsonian Institution, 1992. 7. Print.
[142] "Preventive Conservation." *Welcome to The Field Museum*. Web. 12 Feb. 2012. <http://fieldmuseum.org/explore/department/conserving-collections/preventive>.
[143] Northeast Document Conservation Center. *"Northeast Document Conservation Center Storage Methods and Handling Practices*. Web. 06 Mar. 2012. <http://www.nedcc.org/resources/leaflets/4Storage_and_Handling/01StorageMethods.php>.

- Handle objects as little as possible.
- Wear gloves to touch objects, when it is appropriate
- Carry only one object at a time.
- Support the object with both hands and never pick it up by its handle alone.
- Avoid obstacles; clear any obstacles in the path before moving the object
- Use more than one person when moving larger objects
- Avoid overloading trolleys or stacking objects on top of each other on trays or containers.
- Never force an object or part of an object into position.[144]

All these will ensure the best chance for the object to make it to its destination safely.

The most obvious threat to any object is the risk of damage from handling, moving, seismic activity and anything that results in the impact of the surface with the object. Careful handling is the single most important skill that any museum worker can develop to help minimize the damage to objects. As in the other areas of preventative conservation, there are no simple do's or don'ts. Each situation needs to be assessed, and then the appropriate precautions need to be implemented.[145]

[144] UNESCO. "Handling Collections in Storage." Web. 12 Feb. 2012. <http://unesdoc.unesco.org/images/0018/001879/187931e.pdf>.
[145] Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 53. Print.

Conclusion

Simon J. Knell stated “Conservators also need to gain an understanding of the stability of an ever-increasing list of materials entering the collections.” Some of these include “new alloys, plastics and synthetic textiles,” and “ever more exotic and degradable substances.”[146] Things to consider when dealing with a museum storage environment include dust and other pollutants, levels of light (both natural and artificial), temperature and humidity, corrosion, and pests.

The History Trust of South Australia states, “Museums need to maintain appropriate and stable environments to protect and preserve their collection. Conditions in both exhibition and storage areas needed to be modified and monitored wherever possible to ensure the safety and preservation of collection items.” [147] Knell states: “The first level of awareness is simply understanding what preservation conservation means; the second is accepting it as a legitimate collections care strategy.”[148] This is done by knowing the current status of the institution’s collection and knowing what needs to be done and how to do it. Lastly and “the most important stage is when preventive conservation becomes an integral part of an institution’s consciousness.”[149] This can be accomplished by training the staff and volunteers. Organizations like the Conservation Assessment Program run by the AAM provides webinars, classes and other resources available.

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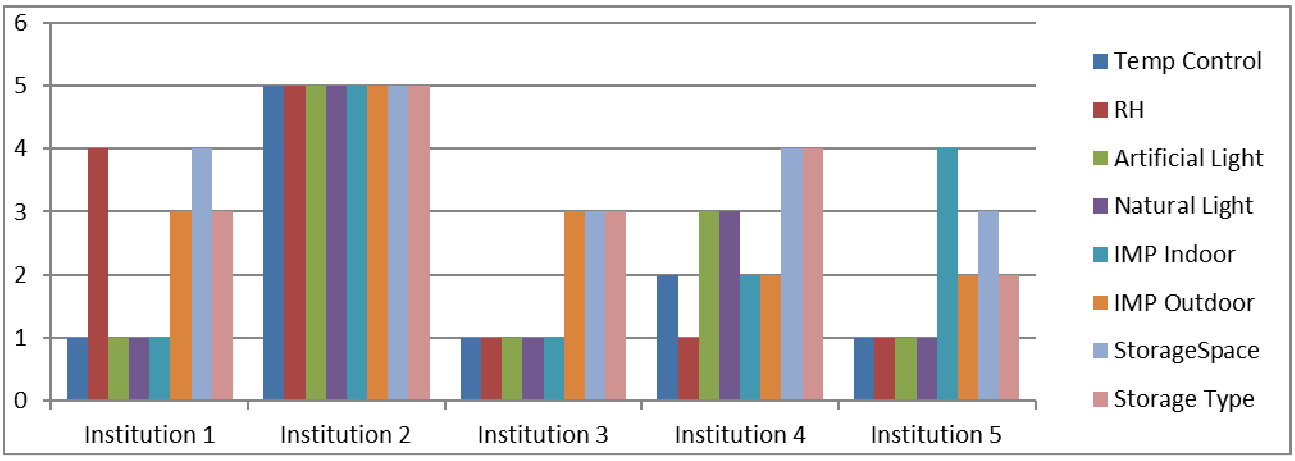
[146] Knell, Simon J. "Introduction: the Context of Collections Care." *Care of Collections*. London: Routledge, 2006. 5. Print.
[147]History Trust of South Australia. Web. 12 Nov. 2010. PDF Filehttp://www.history.sa.gov.au/chu/downloads/CMP_help_sheets/Museum%20Environment%20final%20150609.pdf
[148] Getty Conservation Institute. "Preventive Conservation." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. 87. Print.
[149] Ibid. 87.

The rate of deterioration in a group of objects can be slow and not fully appreciated except over long periods. Because the deterioration rate is difficult to quantify, the results of preventive conservation are not easily measured, nor are the results visually dramatic since preventive conservation does not involve improving the appearance of objects.

For the Getty, Jeffrey Levin wrote: “For preventive conservation to be effective to a particular collection, technical knowledge has to be matched with an administrative commitment to integrating preventive conservation into an institution's operation.”[150]

Graph 9.1 shows what each institution in the survey rated each area based on its current condition and its need of improvement, with 1 meaning little to no need of improvement and 5 the greatest need for improvement.

Graph 9.1 Current conditions of Collections and their need of improvement



Institution 1 believes that RH and storage space as areas in the greatest need of improvement, rating both a 4. They rated IMP outdoor and storage as a 3 and

[150] Levin, By Jeffrey. "Newsletter 7.1 Winter 1992 (Conservation at the Getty)." The Getty. Web. 03 Dec. 2010. http://www.getty.edu/conservation/publications/newsletters/7_1/preventive.html

temperature control, artificial light, natural light, IMP indoor as needing little to no improvement. Institution 2 rated all the areas as needing significant improvement. Institution 3 rated IMP outdoor, storage space and storage type as all needing the greatest improvement. In contrast, temperature control, RH, artificial light, natural light and IMP indoor all require the least amount of improvement. Institution 4 rated storage space and type as the areas with the greatest need of improvement with RH as needing the least. Artificial and natural lighting were the next areas that need improvement. Institution 5 rated IMP indoor as needing the greatest improvement, followed by storage space. They measured temperature control, RH, natural and artificial lighting as needing the least change.

Although the treatment of an object may sometimes be necessary, it alone is not sufficient enough to preserve collections. In his chapter on "Care of Collections," G. Ellis Burcaw stated "All materials [within a collection] deteriorate;" and since the museum is devoted to permanent preservation of its collections, it must maintain the best possible conditions for the longest possible life of each object."[151] Preventive conservation efforts aim to reduce damage and deterioration to collections by improving their environment. These measures include controlling temperature, relative humidity, and pollutants; housing; integrated pest management; cleaning and housekeeping; handling procedures.[152]

All museums face increasing expectations and demands relating to managing their collections; however, it is predicted that they will be less equipped with the

[151] Burcaw, George Ellis. *Introduction to Museum Work*. Walnut Creek, CA: AltaMira, 1997. 103. Print.
[152] "Preventive Conservation." *Welcome to The Field Museum*. Web. 12 Feb. 2012. <http://fieldmuseum.org/explore/department/conserving-collections/preventive>.

resources needed to take care of the objects they hold. Many experts suggest that funding will be static with costs expected to grow.

Promoting preventive conservation—the management of the environmental conditions under which collections are housed and used—should be a primary objective of every museum. It takes highly trained professionals with unique needs for storage and supplies to care for a collection. However, very small museums often are run by volunteers. The entire museum staff, from the administrator to the curator to the guide, needs to have at minimum the most basic knowledge of preventive conservation. The public also needs to be educated in what it takes to care for a collection so they can better understand the need for more funding. The public can be very strong advocates for supporting museums with small budgets. There are also many publications available to help institutions learn about preventive conservation.[153] As well, several museums have a website with links dedicated to sharing information on preventive conservation. Museum staff can take online courses or seminars that are offered by AAM and state and local organizations.

The HHIR states that lack of financial support is the root of all the issues that were also identified having an adverse impact on collections. No one institution is perfect, and all need improvement in some area or another. Many institutions, locally and nationally, do not allocate money in their budgets for preservation of collections.

[153] See Appendix 4 for a list of resources

This should be a top priority for all institutions. By being persistent and consistent, an institution can keep small problems from becoming bigger more expensive ones. [154]

Museum functions are changing in most museums. The roles of museum professionals are changing as well. Curators often now plan conservation management and collection care. Collection managers can take necessary care of the collection and engage in primary preventive conservation.

In his article "Critical Concepts Concerning Non-Living Collections," Stephen L. Williams's best describes museums and their collections as follows:

> "An art museum without a collection is only a gallery. A children's or science museum without a collection is only a discovery center. A historical society without a collection is only an affinity group. A historical site without a collection is only a local attraction. A zoological or botanical garden without a collection is only a nature center. A museum without a collection is not a museum." [155]

While many museums have expanded their visions to serve the public better and increase educational programming, collections need to stay at the center of attention of any museum's mission.

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[154] "Heritage Health Index Full Report." *A Public Trust at Risk: The Heritage Health Index Report on the State of America's Collections*. Heritage Preservation; The National Institute for Conservation, Mar. 2006. Web. 19 Sept. 2011. <http://www.heritagepreservation.org/hhi/full.html>.

[155] Williams, Stephen L. "Critical Concepts Concerning Non-Living Collections" *Collections A Journal for Museums and Archives* 1.1 (August 2004).

Appendix 1: The Survey[156]

1. Institute's name: _____

Address: _____

City, State and Zip: _____

Name of parent institution, if applicable: _____

2. Name of person (s) completing survey: _____

Email: _____ Phone #:_____

3. For purposes of comparing you with other institutes in the study, which of the following most closely describes your function and/or services *(**select all that apply**) (circle your primary function/service)*

❑ a. Archives

❑ b. Historical Society

❑ c. Historic house/site

❑ d. History Museum

❑ e. Art Museum (including the art gallery, art center, or art organization)

❑ f. Children's/Youth Museum

❑ g. Natural history museum

❑ h. Science/Technology Museum

❑ i. Museum with one narrowly defined discipline, please specify: _____

❑ j. Other, please specify one function _____

❑ k. Library

❑ l. Archeological Repository or research collection

❑ m. Aquarium, Zoo, Arboretum, Botanical Garden, Nature Center or Planetarium

[156] Adapted from "Heritage Health Index Full Report." A Public Trust at Rick: The Heritage Health Index Report on the State of America's Collections. Heritage Preservation; The National Institute for Conservation, Mar. 2006. Web. 19 Sept. 2011. <http://www.heritagepreservation.org/hhi/full.html>.

4. Which of the following most closely describes your institution's governance? (*select one*)

❑ a. College, university or another academic entity

❑ b. Non-profit, non-governmental organization or foundation

❑ c. Corporate or for-profit organization

❑ d. Federal

❑ e. State

❑ f. Local (county or municipal)

❑ g. Tribal

5. Staffing, please list below the number of employees you currently have in the following:

____ Full-time ____Part-time____Volunteer____Intern

6. Briefly describe your current staffing for conservation/preservation? (i.e. paid conservator, volunteer, contracted– such as using an outside conservator or Buffalo State College's Art Conservation Dept., etc.)

_____
_____
_____

7. Type of funding (please check all that apply)

❑a. Federal
❑b. State
❑c. Municipal
❑d. Corporation or company
❑e. Foundation
❑f. Individual donor or private philanthropist
❑g. Other, please specify_____

8. Please briefly describe the types of items in your collections (i.e. artwork watercolors, pastels; decorative art-jewelry, timepieces; textiles, etc.) Please, provide an approximate number of items in the collection.

_____
_____
_____

9. **Environment:** Each item in the collection needs a particular type of environment. For the following questions, the specifications are not the ones that your institute has implemented. However, they are the ideal conditions are for the items.

A. Do you use environmental controls to meet temperature specifications for the preservation of your

collection? (*select one*)

❑ a. Yes, in all areas

❑ b. In some, but not all areas

❑ c. No, in no areas

❑ d. Don't know

❑ e. Not applicable

B. Do you use environmental controls to meet relative humidity specifications for the preservation of your collection? (*select one*)

❑ a. Yes, in all areas

❑ b. In some, but not all areas

❑ c. No, in no areas

❑ d. Don't know

❑ e. Not applicable

C. Do you control light levels to meet the specifications for the preservation of your collection? (*select one*)

❑ a. Yes, in all areas

❑ b. In some, but not all areas

❑ c. No, in no areas

❑ d. Don't know

❑ e. Not applicable

❑ g. 100%

❑ h. Don't know

D. What estimated percentage of your collection is stored in areas you consider to be adequate? This can mean having enough room for large items; proper shelving, etc. (*select one*)

❑ a. 0 %

❑ b. 1-19%

❑ c. 20-39%

❑ d. 40-59%

❑ e. 60-79%

❑ f. 80-99%

E. What estimated percentage of your collection do you consider having adequate pest management? (*select one*)

❑ a. 0 %

❑ b. 1-19%

❑ c. 20-39%

❑ d. 40-59%

❑ e. 60-79%

❑ f. 80-99%

10. For the following question, please rate the items 1-5 (1 being little to no need and 5 being in great need) based on need of improvement. Please, base this off of your current situation. Do not base this rating off of potential changes in the future i.e. getting new shelving, HVAC system, etc.

____a. Temperature control

____b. Relative Humidity

____c. Artificial light levels

____d. Natural light levels

____e. Pest management, inside

____f. Pest management, outside

____g. Storage, proper space

____h. Storage, proper type

11. **Preservation activities**

A. Does the mission of your institution include preservation of your collection? (*select one*)

❑ a. Yes

❑ b. No

❑ c. Don't know

B. Does your institution have a written, long-range preservation plan for the care of the collection (a document that includes a multi-year plan of action for the overall preservation needs of the collection)? (*Select one*)

❑ a. Yes

❑ b. Yes, but it is not up-to-date

❑ c. No, but one is being developed

❑ d. No, but preservation is addressed in overall long-range plan

❑ e. No

❑ f. Don't know

C. Has a survey of the general condition of your collection been done? (*select one*)

❑ a. Yes

❑ b. Yes, but only of a portion of the collection

❑ c. Yes, but it is not up-to-date

❑ d. Yes, but only of a portion of the collection and it is not up-to-date

❑ e. No

❑ f. Don't know

D. Does your institution have a written emergency/disaster plan that includes the collection? (*select one*)

❑ a. Yes

❑ b. Yes, but it is not up-to-date

❑ c. No, but one is being developed

❑ d. No

❑ e. Don't know

E. Does your institution have a conservation/preservation program? (*select one*)

❑ a. Yes

❑ b. Yes, but only of a portion of the collection

❑ c. Yes, but it is not up-to-date

❑ d. No

❑ e. Don't know

12. For all of your collections that are currently in need of treatment identify all of the causes of damage or loss i.e. if handling is a major cause of damage to you items then you would rate it a 3. Use: 1.No damage or loss 2.Some damage or loss 3.Significant damage or loss 4.Do not Know.

___a. Handling (by the researcher, staff, shipping)

___b. Water or moisture (stains, warping)

___c. Light (fading)

___d. Fire

___e. Improper storage (bent, broken, adhered together)

___f. Pests (moths, beetles, etc.)

___g. Vandalism

___h. Deterioration (due to temperature, humidity, age)

___i. Prior treatments and/or restoration

Appendix 2: Survey Results

Institution: 1

Location: Western New York

Type of Institute: History museum/ Open air museum

Institute's governance: Non-profit, non-governmental organization or foundation

Staffing: 9 Full-time 2 Part-time 300 Volunteer 2 Intern 4 Seasonal

Current conservation/preservation staffing: Curator- preservation, contract conservation (private and Buffalo State Art Conservation Dept.) with a grant for every two years

Type of Funding: Municipal, events, membership, school tours, admission

Objects in collections: Archival material, photographs, textiles, other 3-dimensional items (19th-century household, business, agricultural items

Environmental control to meet temperature specifications: In some, but not all areas

Environmental control to meet relative humidity specifications: In some, but not all areas

Controlled light levels to meet specifications: In some, but not all areas

Collection stored adequately: 80-99%

Adequate pest management: 80-99%

The following question items were rated 1-5 (1 being little to no need and 5 being in high need) based on need of improvement. For current conditions

1 a. Temperature control

4 b. Relative Humidity

1 c. Artificial light levels

1 d. Natural light levels

1 e. Pest management, inside

3 f. Pest management, outside

4 g. Storage, proper space

3 h. Storage, the proper type

Mission statement includes preservation for collections: Yes

Written long-range preservation plan: Yes, but not up to date

Survey of the general condition of a collection: Yes

Written emergency/disaster plan for collection: Yes

Conservation/Preservation program: Yes, but only for a portion of the collection

For all of the collections that are currently in need of treatment identify all of the causes of damage or loss. (1. No damage or loss 2.Some damage or loss 3.Significant damage or loss 4.Don‘t Know.)

4 a. Handling (by the researcher, staff, shipping)

3 b. Water or moisture (stains, warping)

2 c. Light (fading)

1 d. Fire

3 e. Improper storage (bent, broken, adhered together)

2 f. Pests (moths, beetles, etc.)

1 g. Vandalism

3 h. Deterioration (due to temperature, humidity, age)

2 i. Prior treatments and/or restoration

Institution: 2

Location: Western New York

Type of Institute: Historical Society, Historic house/site, History museum, set up as 1800 Church

Institute's governance: Non-profit, non-governmental organization or foundation

Staffing: 0 Full-time 0 Part-time 8 Volunteer 0 Intern 0 Seasonal

Current conservation/preservation staffing: Worked with Buffalo State in the past, currently have no care for the majority of a collection

Type of funding: Did not answer

Objects in collections: Artwork, books, textiles, furnishings, utensils, tools

Environmental control to meet temperature specifications: No, in no areas

Environmental control to meet relative humidity specifications: No, in no areas

Controlled light levels to meet specifications: No, in no areas

Collection stored adequately: 0%

Adequate pest management: 0%

The following question items were rated 1-5 (1 being little to no need and 5 being in high need) based on need of improvement. For current conditions

5 a. Temperature control

5 b. Relative Humidity

5 c. Artificial light levels

5 d. Natural light levels

5 e. Pest management, inside

5 f. Pest management, outside

5 g. Storage, proper space

5 h. Storage, the proper type

Mission statement includes preservation for collections: Yes

Written long-range preservation plan: No

Survey of the general condition of a collection: Yes, but it is not up-to-date

Written emergency/disaster plan for collection: No

Conservation/preservation program: No

For all of the collections that are currently in need of treatment identify all of the causes of damage or loss. (1. No damage or loss 2.Some damage or loss 3.Significant damage or loss 4.Don‘t Know.)

2 a. Handling (by the researcher, staff, shipping)

2 b. Water or moisture (stains, warping)

2 c. Light (fading)

1 d. Fire

3 e. Improper storage (bent, broken, adhered together)

2 f. Pests (moths, beetles, etc.)

1 g. Vandalism

3 h. Deterioration (due to temperature, humidity, age)

3 i. Prior treatments and/or restoration

Institution: 3

Location: Western New York

Type of Institute: Archives, Art Museum, Western New York artists and contemporaries

Institute's governance: College, university, or other academic entity, non-profit, non-governmental organization or foundation

Staffing: 16 Full-time 10 Part-time 40 Volunteer 5 Intern 0 Seasonal

Current conservation/preservation staffing: Outside contractor with occasional work sent to Buffalo State Art Conservation Dept.

Type of Funding: Federal, Corporation or company, Foundation, Individual donor or private philanthropist

Objects in collections: Work on paper, prints, paintings, photographs, wallpaper, sculpture, arts and crafts

Environmental control to meet temperature specifications: Yes, in all areas

Environmental control to meet relative humidity specifications: In some, but not in all

Controlled light levels to meet specifications: In some, but not in all

Collection stored adequately: 60-79%

Adequate pest management: 80-99%

The following question items were rated 1-5 (1 being little to no need and 5 being in high need) based on need of improvement. For current conditions

1 a. Temperature control

1 b. Relative Humidity

1 c. Artificial light levels

1 d. Natural light levels

1 e. Pest management, inside

3 f. Pest management, outside

3 g. Storage, proper space

3 h. Storage, the proper type

Mission statement includes preservation for collections: Yes

Written long-range preservation plan: Yes, but it is not up-to-date

Survey of the general condition of a collection: Yes, but only of a portion of the collection

Written emergency/disaster plan for collection: Did not answer

Conservation/Preservation program: Yes, but only of a portion of the collection

For all of the collections that are currently in need of treatment identify all of the causes of damage or loss. (1. No damage or loss 2.Some damage or loss 3.Significant damage or loss 4.Do not Know.)

Stated that handling, water or moisture and deterioration as reasons for the need of treatment.

a. Handling (by the researcher, staff, shipping)

b. Water or moisture (stains, warping)

c. Light (fading)

d. Fire

e. Improper storage (bent, broken, adhered together)

f. Pests (moths, beetles, etc.)

g. Vandalism

h. Deterioration (due to temperature, humidity, age)

i. Prior treatments and/or restoration

Institution: 4

Location: Western New York

Type of Institute: Historical house/site (National Historical Landmark), History Museum, House of important historical figure, educational

Institute's governance: Non-profit, non-governmental organization or foundation

Staffing: 0 Full-time 0 Part-time 40 Volunteer 0 Intern 0 Seasonal

Current conservation/preservation staffing: volunteer

Type of Funding: Municipal, Individual donor or private philanthropist, Admissions, Membership, Fundraising

Objects in collections: Furnishings, textiles, toys, kitchenware, musical instruments, painting, lithographs

Environmental control to meet temperature specifications: No, in no areas (not specific environmental monitors, but heat and AC installed)

Environmental control to meet relative humidity specifications: In some, but not all areas (dehumidifier in basement space)

Controlled light levels to meet specifications: In some, but not in all areas (certain furniture draped with covers)

Collection stored adequately: 80-99% (could use more storage space)

Adequate pest management: 40-59%

The following question items were rated 1-5 (1 being little to no need and 5 being in great need) based on need of improvement. For current conditions

2 a. Temperature control

1 b. Relative Humidity

3 c. Artificial light levels

3 d. Natural light levels

2 e. Pest management, inside

2 f. Pest management, outside

4 g. Storage, proper space

4 h. Storage, the proper type

Mission statement includes preservation of collections: Yes

Written long-range preservation plan: Yes

Survey of the general condition of a collection: No

Written emergency/disaster plan for collection: No

Conservation/preservation program: No

For all of the collections that are currently in need of treatment identify all of the causes of damage or loss. (1. No damage or loss 2.Some damage or loss 3.Significant damage or loss 4.Don‘t Know.)

1 a. Handling (by the researcher, staff, shipping)

1 b. Water or moisture (stains, warping)

2 c. Light (fading)

1 d. Fire

2 e. Improper storage (bent, broken, adhered together)

1 f. Pests (moths, beetles, etc.)

1 g. Vandalism

2 h. Deterioration (due to temperature, humidity, age)

2 i. Prior treatments and/or restoration

Institution: 5

Location: Western New York

Type of Institute: Archives, Historical Society (primary function), History, Museum

Institute's governance: Non-profit, non-governmental organization or foundation

Staffing: 14 Full-time 10 Part-time 5 Volunteer 3 Intern 0 Seasonal

Current conservation/preservation staffing: Contracted and Buffalo State Art Conservation Dept.

Type of Funding: Federal, State, Municipal

Objects in collections: Artwork, decorative arts, textiles, weapons, etc.

Environmental control to meet temperature specifications: Yes, in all areas

Environmental control to meet relative humidity specifications: Yes, in all areas

Controlled light levels to meet specifications: Yes, in all areas

Collection stored adequately: 60-79%

Adequate pest management: 40-59%

The following question items were rated 1-5 (1 being little to no need and 5 being in high need) based on need of improvement. For current conditions

1 a. Temperature control

1 b. Relative Humidity

1 c. Artificial light levels

1 d. Natural light levels

4 e. Pest management, inside

2 f. Pest management, outside

3 g. Storage, proper space

2 h. Storage, the proper type

Mission statement includes preservation of collections: Yes

Written long-range preservation plan: Don't Know

Survey of the general condition of a collection: Yes

Written emergency/disaster plan for collection: Yes

Conservation/Preservation program: Don’t Know

For all of the collections that are currently in need of treatment identify all of the causes of damage or loss. (1. No damage or loss 2.Some damage or loss 3.Significant damage or loss 4.Don‘t Know.)

3 a. Handling (by the researcher, staff, shipping)

2 b. Water or moisture (stains, warping)

3 c. Light (fading)

1 d. Fire

1 e. Improper storage (bent, broken, adhered together)

2 f. Pests (moths, beetles, etc.)

1 g. Vandalism

2 h. Deterioration (due to temperature, humidity, age)

2 i. Prior treatments and/or restoration

Institution: 6

Location: Western New York

Type of Institute: History House/site

Institute's governance: Corporate, For-profit organization

Staffing: 0 Full-time 2 Part-time 0 Volunteer 0 Intern 0 Seasonal

Current conservation/preservation staffing: No collection

Type of funding: State, Membership, events, classes

Objects in collections: No collection

Environmental control to meet temperature specifications: N/A

Environmental control to meet relative humidity specifications: N/A

Controlled light levels to meet specifications: N/A

Collection stored adequately: N/A

Adequate pest management: N/A

The following question items were rated 1-5 (1 being little to no need and 5 being in high need) based on need of improvement. For current conditions

N/A a. Temperature control

N/A b. Relative Humidity

N/A c. Artificial light levels

N/A d. Natural light levels

N/A e. Pest management, inside

N/A f. Pest management, outside

N/A g. Storage, proper space

N/A h. Storage, the proper type

Mission statement includes preservation for collections: N/A

Written long-range preservation plan: N/A

Survey of the general condition of a collection: N/A

Written emergency/disaster plan for collection: N/A

Conservation/preservation program: N/A

For all of the collections that are currently in need of treatment identify all of the causes of damage or loss. (1. No damage or loss 2.Some damage or loss 3.Significant damage or loss 4.Don‘t Know.)

N/A a. Handling (by the researcher, staff, shipping)

N/A b. Water or moisture (stains, warping)

N/A c. Light (fading)

N/A d. Fire

N/A e. Improper storage (bent, broken, adhered together)

N/A f. Pests (moths, beetles, etc.)

N/A g. Vandalism

N/A h. Deterioration (due to temperature, humidity, age)

N/A i. Prior treatments and/or restoration

Summary of Survey Data

Type of Institutions

Institution 1: History Museum/ Open air museum

Institution 2: Historical Society, Historic house/site, History museum, set up at 1800 Church

Institution 3: Archives, Art Museum, Western New York artists and contemporaries

Institution 4: Historical house/site (National Historical Landmark), History Museum, House of prominent historical figure, educational

Institution 5: Archives, Historical Society (primary function), History, Museum

Institution 6: Historical house/site, Art Museum

Type of Governance

Institution 1: Non-profit, non-governmental organization or foundation

Institution 2: Non-profit, non-governmental organization or foundation

Institution 3: College, university, or other academic entity, non-profit, non-governmental organization or foundation

Institution 4: Non-profit, non-governmental organization or foundation

Institution 5: Non-profit, non-governmental organization or foundation

Institution 6: Corporate, for-profit organization

Type of Staffing

Institution 1: 9 Full-time 2 Part-time 300 Volunteer 2 Intern 4 Seasonal

Institution 2: 0 Full-time 0 Part-time 8 Volunteer 0 Intern 0 Seasonal

Institution 3: 16 Full-time 10 Part-time 40 Volunteer 5 Intern 0 Seasonal

Institution 4: 0 Full-time 0 Part-time 40 Volunteer 0 Intern 0 Seasonal

Institution 5: 14 Full-time 10 Part-time 5 Volunteer 3 Intern 0 Seasonal

Institution 6: 0 Full-time 0 Part-time 2 Volunteer 0 Intern 0 Seasonal

Type of Funding

Institution 1: Municipal, events, membership, school tours, admission

Institution 2: Did not answer

Institution 3: Federal, Corporation or company, Foundation, Individual donor or private philanthropist

Institution 4: Municipal, Individual donor or private philanthropist, Admissions, Membership, Fundraising

Institution 5: Federal, State, Municipal

Institution 6: State, Membership, events, classes

Objects in Collections

Institution 1: Archival material, photographs, textiles, other 3-dimensional items (19th-century household, business, agricultural items

Institution 2: Artwork, books, textiles, furnishings, utensils, tools

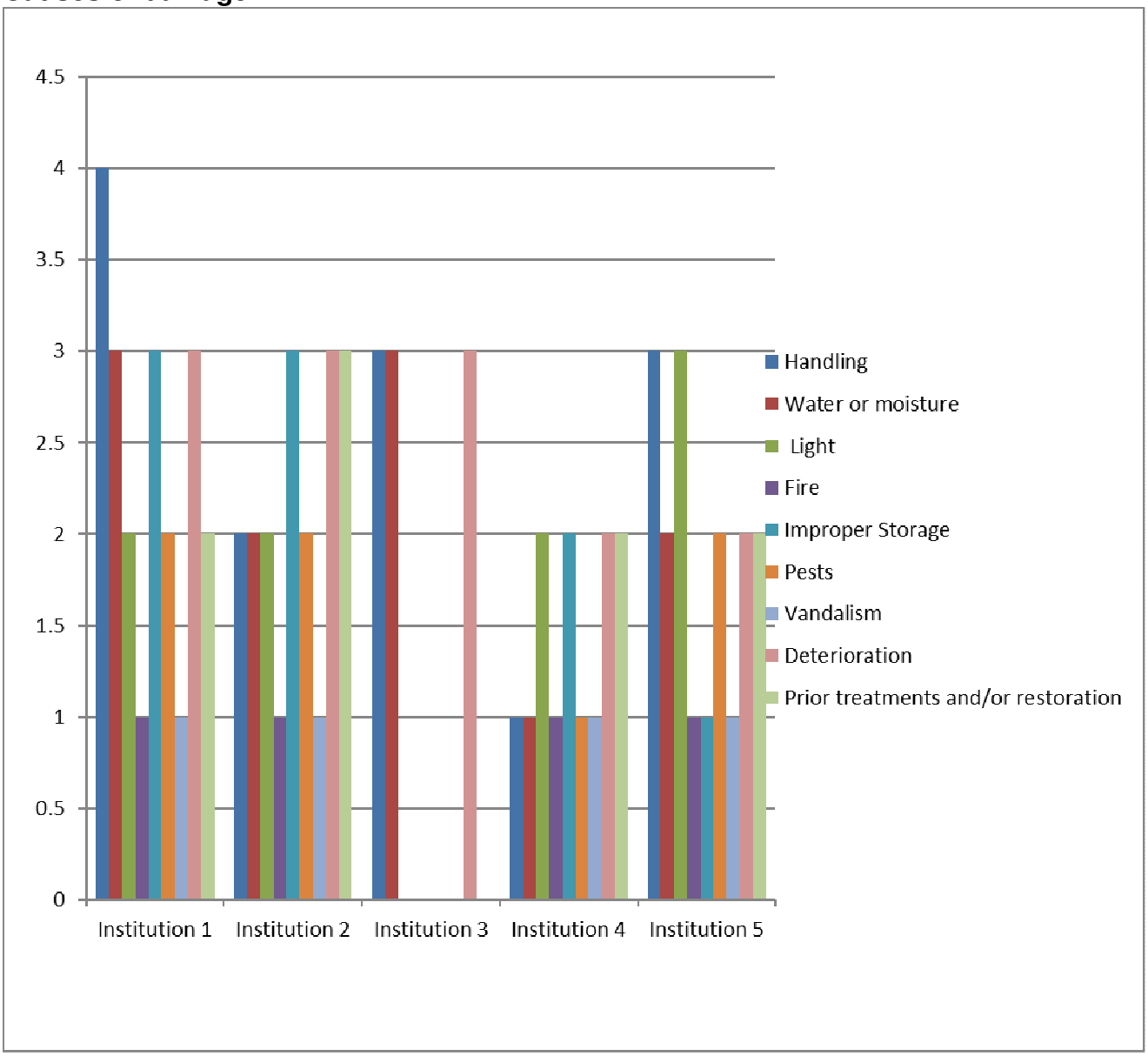
Institution 3: Work on paper, prints, paintings, photographs, wallpaper, sculpture, arts and crafts

Institution 4: Furnishings, textiles, toys, kitchenware, musical instruments, painting, lithographs

Institution 5: Artwork, decorative arts, textiles, weapons, etc.

Institution 6: None

Graph 7.2
Causes of damage



1. No damage or loss 2.Some damage or loss 3.Significant damage or loss 4.Do not Know.

In the survey, the museum staff was asked to identify the causes of damage to their museum collections.

Institution 1 believes that handling is one of the greatest causes of damage to their collections. Water and/or moisture, improper storage and deterioration were all considered to be the next likely cause of damage. The areas that caused the least amount of damage were fire, and vandalism.

Institution 2 named three areas that cause damage to their collections; Improper storage, deterioration, and light. The areas that caused the least amount of damage were fire, and vandalism, as the other areas landing in the middle.

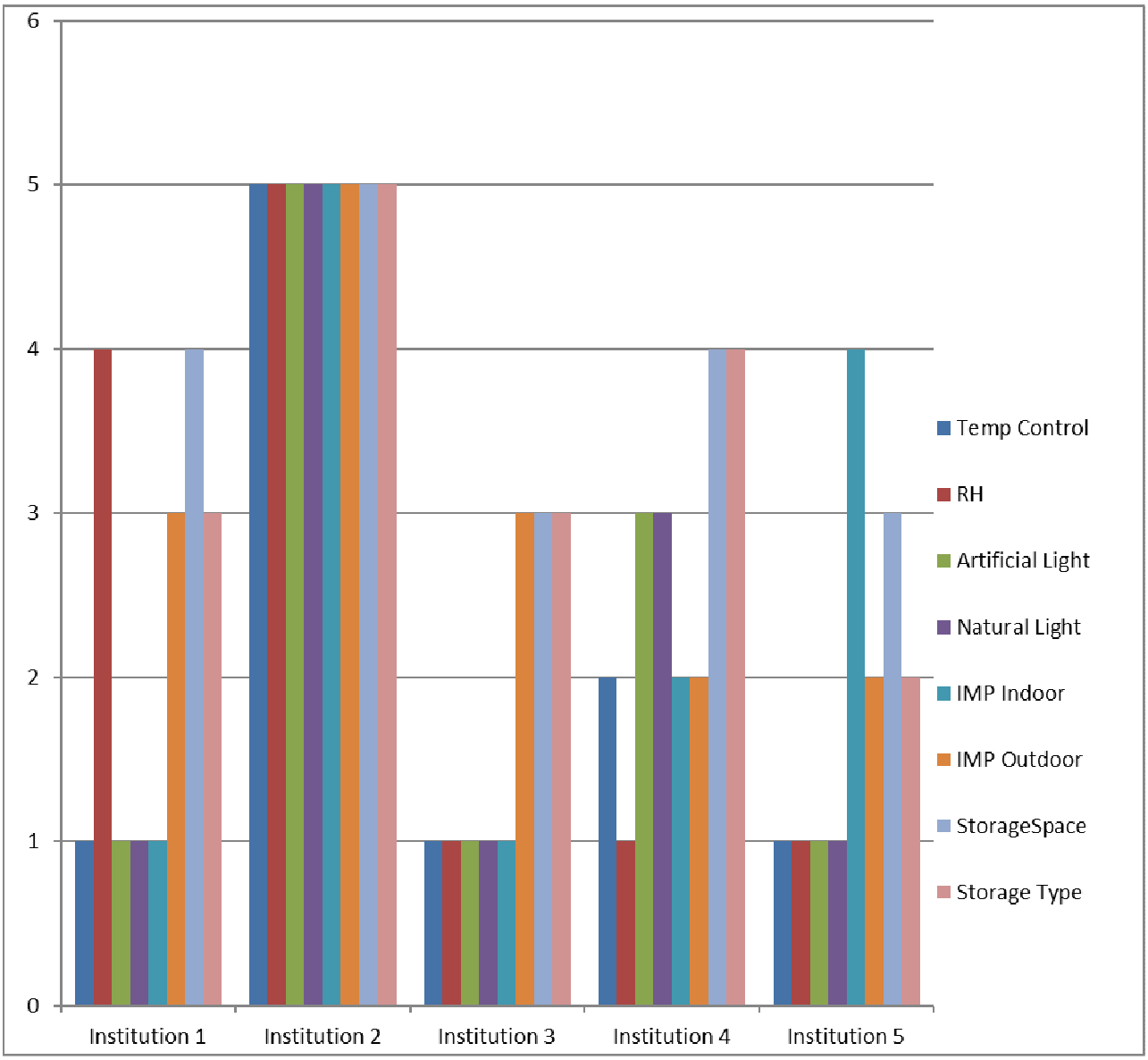
Institution 3 rated they believed that handling, water and/or moisture and deterioration all played an equal role in their collections. This institution did not rate the other areas.

Institution 4 rated light, improper storage, deterioration and prior treatments and/ or restorations as being the primary cause of the loss. While this institution also rated fire, and vandalism as causing the least amount of damage, they also rated water and/or moisture, handling and pest as causing little to no damage.

Institution 5 rated handling and light to be the main causes of their damage. They, like the others, rated vandalism and fire along with improper storage that has caused the least amount of damage. The other areas landed in the middle.

Graph 9.1

Areas in need of improvement



This graph shows the common areas that are need of improvement. Each institution rated each area as the following: 1 little to no need of improvement and 5 in the greatest need of improvement.

Institution 1 believes that RH and storage space as areas in the greatest need of improvement rating both a 4. They rated IMP outdoor and storage as a 3

and temperature control, artificial light, natural light, IMP indoor as needing little to no need of improvement.

Institution 2 rated all the areas as needing significant improvement.

Institution 3 rated IMP outdoor, storage space and storage type as all needing the greatest of improvement. Temperature control, RH, artificial light, natural light and IMP indoor all need the least amount of improvement.

Institution 4 rated storage space and type as the areas with the greatest need of improvement with RH as needing the least. Lighting was the next areas that need improvement.

Institution 5 rated IMP indoor as needing the greatest need of improvement, followed by storage space. They measured temperature control, RH, natural and artificial lighting as needing the least.

Appendix 3 Types of Pest

Source: National Park Service[157]

Fabric Pests

Most insect damage to fabrics is caused by carpet beetles or clothes moths. The adult's stage is seen most often seen since adults fly, and some are attracted to lights and windows, but it is not the adult insects that do the damage. They feed outside on pollen or not at all. It is the larva or immature stage that feeds on the fabric, fur, feathers, or virtually anything made of animal fibers.

Carpet Beetles

The immature carpet beetles feed on dried animal products such as wool, silk, felt, hair, fur, feathers, dead animals, and stuffed trophy heads. Carpet beetle larvae are repelled by light and are, usually, found burrowed deeply into infested material or in little-used drawers, cases, and storage bins. In heavy infestations, you may find large numbers of these light-colored shed skins. The adults are often seen crawling up walls and congregating on window ledges. There are many species of carpet beetles. In addition, many common beetles resemble carpet beetles.

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[157] "Nature & Science Biology Resources Integrated Pest Management Manual." *Explore Biology*. National Park Service, n.d. Web. 17 Nov. 2011. <http://www.nature.nps.gov/biology/ipm/manual/museum.cfm>.

Black carpet beetle

This is the most abundant and destructive of the carpet beetles. The adult is a solid dark brown or dull black color, and more elongate than carpet beetles described below. The larva is long and carrot-shaped and is covered with golden brown hairs and has a characteristic "tail" of long hairs at the rear end.

Varied carpet beetle

This beetle is primarily a scavenger. It is common in the nests of birds, on dead animals, and in insect collections, but can damage woolens, carpets, wall hangings, hides, horns, and bone artifacts. Small populations often go unnoticed behind furniture or along baseboards feeding on accumulated lint, hair, food crumbs, dead insects, and another organic debris. The adult is oval to round, with splotches of white, yellow, and black on its back. The larva is tear-drop shaped and covered with rows of light brown hairs.

Common carpet beetle

The common carpet beetle attacks carpets, woolens, and animal products such as feathers, furs, leather, silks mounted museum specimens and pressed plants. The adult has a band of orange scales down the middle of its back. The larva is reddish-brown and covered with brown or black hairs. A mature larva is active and moves rapidly.

Furniture carpet beetle

This beetle attacks furniture (mainly old horsehair-stuffed furniture) and items made from wool, fur, feathers, silk, horns and tortoise shell. The adult is rounded and blackish with variable mottling of yellow and white scales on the back and yellow scales on the legs. The larva is difficult to tell from the common carpet beetle.

Clothes Moths

Cloth moths are small, silvery-beige moths. They have narrow wings fringed with long hairs. Small grain and flour-infesting moths are often confused with clothes moths. However, clothes moths have different flying habits. They avoid light and are rarely seen flying. They prefer dark corners, closets, and storage areas, and usually remain out-of-sight.

Wood Pests

Materials made of wood are susceptible to attack by a number of wood-infesting pests. The culprits in museums are, usually, powderpost beetles or dry wood termites. Both can severely damage valuable artifacts while remaining invisible to the untrained eye.

Powderpost Beetles

Powder beetles spend months or years inside the wood in the larval stage. Their presence is only apparent when they emerge from the wood as adults, leaving pin hole openings, often behind and piles of powdery frass below. Items in museums that can be infested by powder post beetles include wooden artifacts, frames, furniture, tool handles, gunstocks, books, toys, bamboo, flooring, and structural timbers.

Drywood Termites

Drywood termites establish colonies in dry, sound wood with low levels of moisture, and they do not require contact with the soil. They are primarily found in the coastal southern states, California, and Hawaii, but they are easily transported to northern states in lumber, furniture, and wooden artifacts. Drywood termites attack wooden items of all kinds. The termites feed across the grain of the wood, excavating chambers that are connected by small tunnels.

Stored Product Pests

Many museums include items made in part of seeds, nuts, grains, spices, dried fruits and vegetables, and other foods. A long list of pests, traditionally called "stored product pests" or "pantry pests," can infest items containing these foods.

Cigarette beetle

This beetle is named for the fact that it is a pest of stored tobacco but is also a serious pest of flax, spices, crude drugs, seeds, and, most importantly for museums, books, and dried plants. It has also been found infesting rodent bait.

Drugstore beetle

The Drugstore beetle feeds on a wide variety of foods and spices (particularly paprika or red pepper). It is also a serious pest of books and manuscripts, has been reported "feeding on a mummy," and has been known to chew through tin foil and lead sheeting.

Moisture Pests

Moisture is not only a threat to museum specimens on its own; it may attract a number of moisture-loving pests that can do additional damage. The most important of such pests are the molds and insects in the order Psocoptera that feed on those molds.

Molds

Molds are fungi that can cause damage or disintegration of organic matter. Plants without roots, stems, leaves, or chlorophyll, molds occur nearly everywhere. When moisture and other environmental conditions are right, molds

can appear and cause significant damage to wood, textiles, books, fabrics, insect specimens, and many other items in the collection. Their growth can be rapid under the right conditions.

Psocids

Psocids are commonly called booklice; they are not related to parasites such as head lice or body lice. Booklice got that name because they often infest damp, moldy books. They feed on the mold growing on paper and in the starchy glue in the binding. Psocids do not themselves cause damage. They become pests simply by their presence. However, their presence also indicates a moisture problem and the likely presence of damaging molds.

General Pests

Any household pest may become a pest in a museum. Cockroaches, rodents, silverfish, ants, and other common pests can invade and infest a museum as well as a house or other structure.

Appendix 4 Additional Recommended Resources

American Alliance of Museums http://www.aam-us.org/

American Association for State and Local History http://www.aaslh.org/

CCI Notes, published by the Canadian Conservation Institute, deal with topics of interest to those who care for cultural objects. Intended for a broad audience, the Notes offer practical advice about issues and questions related to the care, handling and storage of cultural objects. They are available for a small fee. www.cci-icc.gc.ca/publications/ccinotes/index_e.aspx

Campbell Center for Historic Preservation Studies: www.campbellcenter.org
Caring for Your Treasures is a series of booklets published by the American Institute for Conservation of Historic & Artistic Works. Free access online. http://www.conservationus.org/index.cfm?fuseaction=Page.viewPage&pageId=472

Conservation Online (CoOL), a project of the Preservation Department of Stanford University Libraries, is a full text library of conservation information, covering a wide spectrum of topics of interest to those involved with the conservation of library, archives and museum materials. http://palimpsest.stanford.edu/

The Getty http://www.getty.edu/

Heritage Preservation, the National Institute for Conservation, provides a variety of resources on collections care programs, publications and awards on its website. www.heritagepreservation.org/PROGRAMS/COLLECT.HTM

Institute of Museum and Library Services http://www.imls.gov/resources/

The Library of Congress http://memory.loc.gov/ammem/about/techIn.html

The Museum Resource Network http://themuseumresourcenetwork.org/

National Association for Museum Exhibition http://name-aam.org/resources/further-resources

National Endowment for the Humanities: www.neh.gov/grants/

The National Park Service's http://www.cr.nps.gov/

The National Park Service's Conserve O Gram series are short, focused leaflets about caring for museum objects, published in loose-leaf format. They are available free online. www.cr.nps.gov/museum/publications/conserveogram/conserv.html

The National Park Service's Museum Handbook is a reference guide on how to manage, preserve, document, access and use museum collections. Part I focuses on standards and procedures of preventive care for museum collections and also includes appendices on techniques for the preservation of specific types of materials found in museum collections.
www.cr.nps.gov/museum/publications/handbook.html

The Northeast Document Conservation provides leaflets for caring for paper and photograph collections. Free access online.
www.nedcc.org/leaflets/leaf.htm

The Northern States Conservation Center offers technical leaflets and other helpful resources.
www.collectioncare.org

Save America's Treasures: www.cr.nps.gov/hps/treasures/

Small Museum Association http://www.smallmuseum.org/

Smithsonian http://museumstudies.si.edu/resources.html

Tech Talk is a column published periodically in the Minnesota History Interpreter that offers technical assistance in preserving and conserving historic objects, buildings and sites. Available for free online.
www.mnhs.org/about/publications/techtalk.html

Bibliography

The American Association of Museums. *National Standards & Best Practices for U.S. Museums*. Washington DC: American Association of Museums, 2008. Print.

Ashley-Smith, Jonathan. "Value." *Risk Assessment for Object Conservation*. Oxford: Butterworth-Heinemann, 1999. Print.

Baer, Norbert S. and Paul N. Banks. "Indoor Air Pollution: Effects on Cultural and Historical Material." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. Print.

Bradley, Susan M. "Do Objects Have a Finite Lifetime?" *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. Print.

Bachmann, Konstanze. *Conservation Concerns: A Guide for Collectors and Curators*. New York: Cooper-Hewitt National Museum of Design, Smithsonian Institution, 1992. Print.

Boeijink Nico and Rob Boekel. "Preventive Conservation." *Painting Restoration and Conservation*. Web. Jan. 2012. <http://www.schilderijenrestaurator.eu/preventive-conservation.htm>.

Breische, Nancy L. "Integrated Pest Management." Ed. Rebecca A. Buck and Jean Allman Gilmore. *The New Museum Registration Methods*. Washington, DC: American Association of Museums, 2001. Print.

Brooke Craddock, Ann. "Control of Temperature and Humidity in Small Collections. *"Conservation Concerns*. Washington DC: Smithsonian Institution, 1992. 15. Print.

Buck, Rebecca A. and Jean Allman Gilmore. *Collection Conundrums: Solving Collection Management Mysteries*. Washington, DC: American Association of Museums, 2007. Print.

Buck, Rebecca A. and Jean Allman Gilmore. *MRM5: Museum Registration Methods: 5th Edition*. Washington, DC: AAM, 2010. Print.

Burcaw, George Ellis. *Introduction to Museum Work*. Walnut Creek, CA: AltaMira, 1975, 1997 ed. Print.

The Burchfield-Penney. Time Share. Web 9 May 2015 https://www.burchfieldpenney.org/exhibitions/exhibition:10-23-2010-05-29-2011-time-share-an-historic-collaboration/

Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. Print.

Danforth Filters. *Air Filters & Air Purifiers*. "Museum & Library HVAC Air Cleaning Guide HVAC Indoor Air Quality Control For Archived Collections." Web. 22 May 2013. https://www.danforthfilters.com/secure/store/Air-Filters-Museum-4.asp

Erhardt, David and Marion Mecklenburg, “Relative Humidity Re-Examined” Ed. Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 340. Print.

The Field Museum, "Preventive Conservation." *Welcome to The Field Museum*. Web. 12 Feb. 2012. <http://fieldmuseum.org/explore/department/conserving-collections/preventive>.

Freedman, Jan "Storage of the Radioactive Mineral Collections at Plymouth City Museum and Art Gallery UK." *Collections A Journal for Museums and Archives* 7.2 (Spring 2011): 210-212.

Fruth, Martha. "OHS - Local History - A Primer on Museum Collection Management." *Ohio History Online Portal*. Web. 10 Nov. 2010. <http://www.ohiohistory.org/resource/oahsm/notebook/julaug1985.html>.

Getty Conservation Institute http://www.getty.edu/conservation/

Getty Conservation Institute. "Preventive Conservation." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. Print.

Heritage Preservation. "Heritage Health Index Full Report." *A Public Trust at Rick: The Heritage Health Index Report on the State of America's Collections*. Heritage Preservation; The National Institute for Conservation, Mar. 2006. Web. <http://www.heritagepreservation.org/hhi/full.html>.

Hilberry, John D. and Susan K. Weinberg. "Museum Collections Storage." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. Print.

History Trust of South Australia. Web. 12 Nov. 2010. PDF Filehttp://www.history.sa.gov.au/chu/downloads/CMP_help_sheets/Museum%20Environment%20final%20150609.pdf

Knell, Simon J. "Introduction: the Context of Collections Care." *Care of Collections*. London: Routledge, 2006. Print.

Levin, Jeffrey. "Newsletter 7.1 Winter 1992 (Conservation at the Getty)." *The Getty*. Web. 03 Dec. 2010. http://www.getty.edu/conservation/publications/newsletters/7_1/preventive.html

Macdonald, Sharon. *A Companion to Museum Studies*. Malden, MA: Blackwell Pub., 2006. Print.

Museums Australia (Vic). "Air Pollution." 2003. Web. 06 Mar. 2012. <http://www.mavic.asn.au/assets/Info_Sheet_5_Air_Pollution.pdf>.

"Museumpests.net." *Museumpests.net*. Web. 25 Apr. 2012. <http://www.museumpests.net/>.

National Park Service. "Chapter 7: Museum Collection Storage." *U.S. National Park Service - Experience Your America*. Web. 10 Nov. 2012. PDF http://www.nps.gov/museum/publications/MHI/CHAP7.pdf

National Park Service. “Museum Management Program." *U.S. National Park Service - Experience Your America*. Web. 10 Nov. 2010. PDF http://www.nps.gov/museum/publications/conserveogram/01-01.pdf

National Park Service. "Nature & Science Biology Resources Integrated Pest Management Manual." *Explore Biology*. National Park Service, n.d. Web. 17 Nov. 2011. <http://www.nature.nps.gov/biology/ipm/manual/museum.cfm>.

National Post. "*National Post News Good Deed by Rogue Restoration Pensioner Ruins 19th-century Spanish fresco Comments*.". Web. 19 Jan. 2013. http://news.nationalpost.com/2012/08/22/good-deed-by-rogue-restoration-pensioner-ruins-19th-century-spanish-fresco/

Northeast Document Conservation Center. "Northeast Document Conservation Center Storage Methods and Handling Practices. *“Northeast Document Conservation Center Storage Methods and Handling Practices*. Web. 06 Mar. 2012.

Philadelphia Museum of Art. "Philadelphia Museum of Art - Research: Conservation." *Philadelphia Museum of Art - Research: Conservation*. Web. 06 Mar. 2012. <http://www.philamuseum.org/conservation/10.html?page=4>.

Read, Fergus. "Preventative Conservation by Fergus Read." *Meaco*. Web. 11 Mar. 2012. <http://www.meaco.com/preventa.htm>.

Rugby Football Union. "Examples of Damage Caused by Bad Storage and Display." *RFU*. Web. 17 Jan. 2013. http://www.rfu.com/twickenhamstadium/worldrugbymuseum/thecollection/caringforrareitems/examples

Schwarzer, Marjorie. *Riches, Rivals, & Radicals; 100 Years of Museums in America*. Washington DC: American Association of Museums, 2006. Print.

Staniforth, Sarah. "Light and Environmental Measurement and Control in National Trust Houses." *Care of Collections*. Ed. Simon J. Knell. London: Routledge, 2006. Print.

Staniforth, Sarah. Sophie Julien and Linda Bullock “Chemical Agents of Deterioration” Ed. Caple, Chris. *Preventive Conservation in Museums*. London: Routledge, 2011. 225. Print.

Texas Historical Commission. *Basic Guidelines For The Preservation of Historical Artifacts*. Web Feb. 2012. Doc. www.thc.state.tx.us

Thomson, Garry. “The Museum Environment--Light,” *Preventive Conservation in Museums*. Ed. Chris Caple. London: Routledge, 2011. 309. Print

UNESCO. "Handling Collections in Storage." Web. 12 Feb. 2012. <http://unesdoc.unesco.org/images/0018/001879/187931e.pdf>.

Untch, Katharine. “Managing Conservation without a Conservator on Staff” *Collections: A Journal for Museums and Archives* 2.3 (February 2006): 219-243.

Williams, Stephen L. “Critical Concepts Concerning Non-Living Collections” *Collections A Journal for Museums and Archives* 1.1 (August 2004).