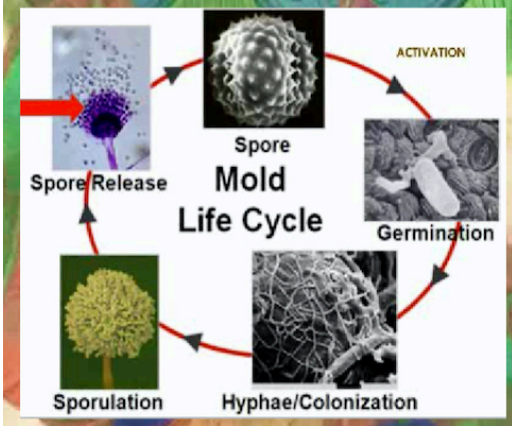
Treasure Caretaker Training
DIGITAL MONASTERY PROJECT



RISK ASSESSMENT: TEMPERATURE AND RELATIVE HUMIDITY

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PRESERVATION OF BUDDHIST TREASURES RESOURCE is the free online resource for monasteries and communities, with practical information on digital documentation, risk assessment and disaster recovery, safer storage, and preservation of thangka and other treasures. The resource comes from over 50 years of preservation work in monasteries.

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TEMPERATURE AND RELATIVE HUMIDITY

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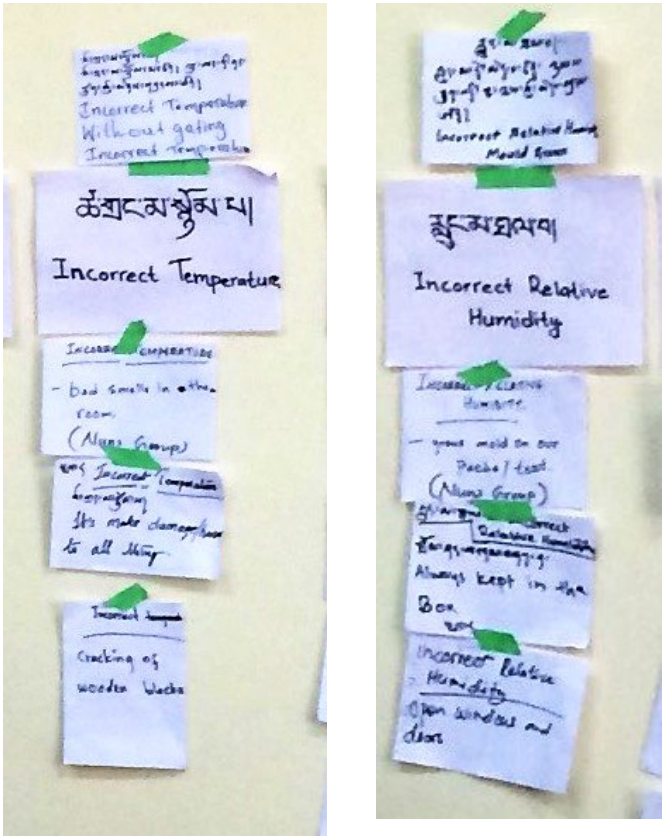
Risk Assessment: Temperature and Relative Humidity

Introduction



Monk and nun participants in Preservation of Monastery Treasures workshop share their own experiences of mold and other problems in their home monasteries and communities

Although you cannot control the weather, and thus cannot control temperature in the various buildings of your monastery, you can effect some control over how the

temperature affects your treasures. The changes in and the extremes of temperature, relative humidity, and light can help preserve, or destroy, your treasures. Figuring out how to use them to preserve is part of Risk Assessment.

The relationship between temperature and relative humidity is like brother and sister. Temperature and relative humidity depend on each other. When the temperature goes up, the air can hold more water. When the temperature goes down, the air loses its water and then you can have condensation, or water droplets form. To put it another way, when temperature increases, relative humidity decreases. When temperature decreases, relative humidity increases.

How Changes in Temperature and Relative Humidity Affect Monastery Treasures
Your monastery treasures can easily be damaged from extreme temperatures and changes in humidity that are found yearly in most climates of the world. High humidity can encourage mold growth, and low humidity can cause dryness, brittleness, and cracking. Mold never goes away; it just waits for dampness to return, so that it can spring to life.

It is a fact that a rapid shift in extremes of temperature and relative humidity can quickly cause damage, for example, on painted wooden statues. However, even normal room temperatures and resultant humidity, conditions that are comfortable and safe for humans, are unsafe for some of the monastery treasures, for example, media collections (cellulose nitrate films, analog tapes, CD discs, flash drives, etc.).

Different types of treasures react differently to temperature and relative humidity levels (low, high or fluctuating). For example, a metal statue will react differently than a statue made from glass or plastic resin, or a dameru made from a bone skull that has been painted.

High temperature can speed up deterioration of treasures according to how they were made, as well as what they were made from, how they are stored, and if they are exposed to air pollution.

Many monastery and community treasures have survived for centuries; in traditional situations, however, changes in care (invasive “cleaning”), lighting (fluorescent tubes), as well as exposure to air pollution have all contributed to more rapid deterioration along with changes in temperature and relative humidity.

Changes in temperature and relative humidity will affect these statues differently: the painted the copper-alloy statue, the unpainted copper-alloy statue, and the glass/resin statue.

Thangka was covered with plastic to keep the dust away. However, a microclimate formed inside, the silk became moldy, and the painting colours were damp from condensation

In the image above, someone decided to keep the dust off the thangka using plastic sheeting. When it got very warm during the day, moist air became trapped behind the plastic. Then, when it got cold at night, the air could not contain the moisture anymore because cold air cannot hold as much moisture as warm air, and therefore, the moisture started condensing onto the painting. This created a lot of mold, and made it look like the painting had water poured on it. You don't want to trap air next to your vulnerable treasures when you know there will be changes in temperature and relative humidity because that creates condensation.

Buildings themselves, whether monasteries or houses, react in a similar way. A microclimate inside the building reacts to the changes in temperature and relative humidity outside. Again, we can't control temperature outside, and the relative humidity is related to temperature. Depending on the time of day and the season, temperature will go up and down and the relative humidity will follow and also change. Just as

raising the heat will lower the relative humidity, lowering the heat will raise the relative humidity.

For some treasures, dry air, or air that fluctuates between being damp and being dry, can be damaging. Wood, for example, will expand with high relative humidity, and shrink with low relative humidity. This movement can lead to the wood cracking.

This framed thangka painting was up against an outside wall of the monastery. Sometimes the wall was hot, sometimes the wall was cold. The temperature of the room inside was often colder or warmer than the weather outside and this caused condensation within the frame. The painting is pressing against the glazing and condensation is continuing to damage it.

You don't want to create a situation like this where you have caused the damage yourself by trying to keep dust off an object but then you end up causing mold and water condensation. It all has to do with the science of temperature and relative humidity.

This statue inside a wooden case was getting damaged by heat as the lighting caused a rise in temperature

On metal, too much moisture can create corrosion. Many Buddhist statues are created from a mixture of metals, or alloys. For example, statues are often made from a copper alloy. It is becoming more common to find heavy lead mixed in with the copper alloy to reduce cost and to create a silver color. Both lead and active corrosion of lead are toxic to people.

This lion statue was created from a mixture of lead, copper, and other trace metals. It was on a wooden shrine in a humid area and shows active corrosion. Active lead corrosion can be seen near the tail as a loosely adherent white powder (lead carbonate). Active corrosion of the copper alloy is visible as light green powder and occurs where the relative humidity is over 55%. Both the lead in the statue and the corrosion are health hazards.

For wood, bone, and ivory, very dry conditions - low relative humidity - can cause cracking. Extreme and rapid changes cause the most damage.

Human bone kangling set into silver shows cracks where the fragile bone has reacted to extreme changes in temperature and relative humidity

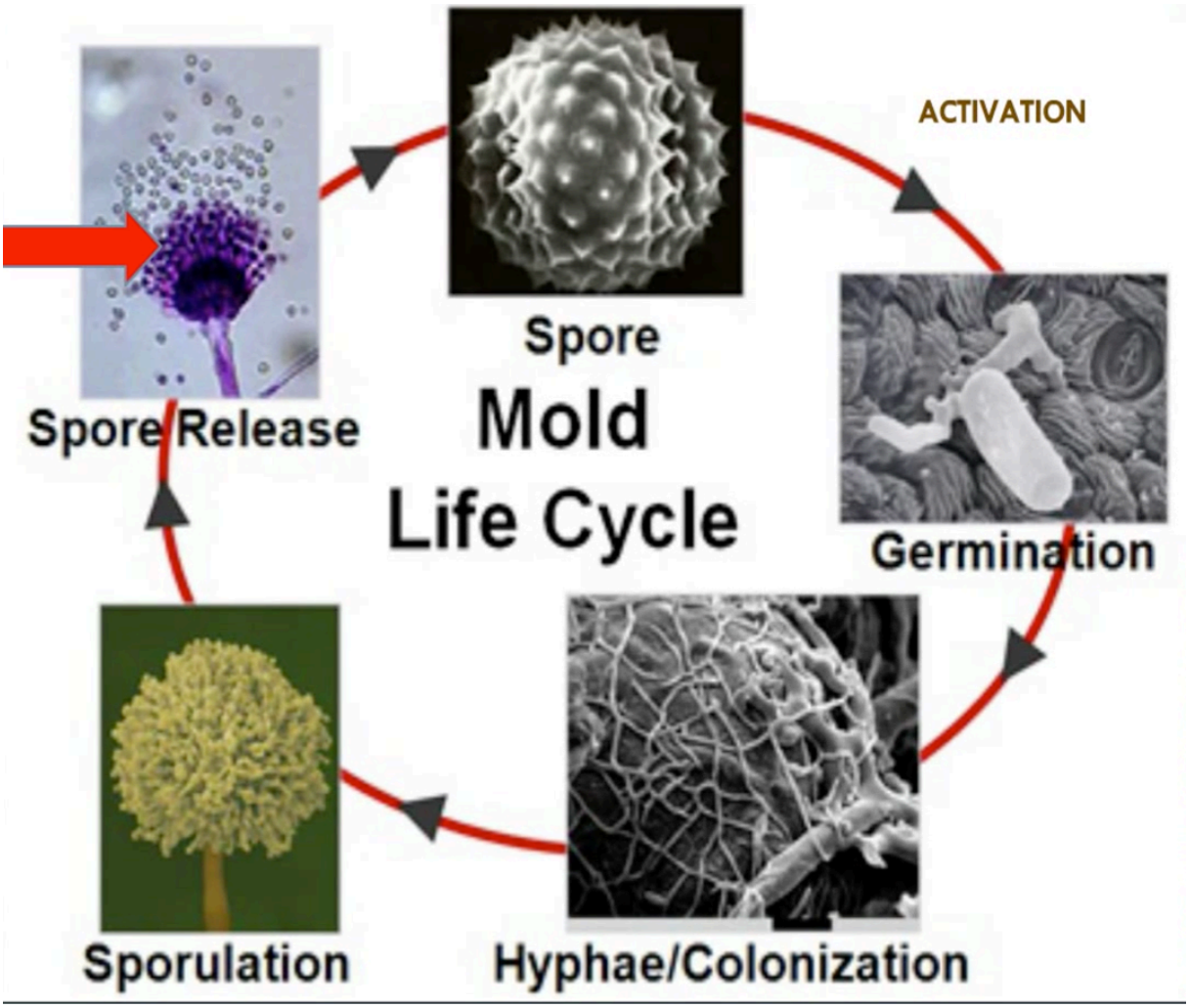
Traditional monastery chod drum is losing areas of fine painting as extreme changes in temperature and relative humidity cause painting to crack and flake due to expansion and contraction of drum surface below

The Problem of Mold
The growth of mold growth is encouraged by food (your treasures) and water (high relative humidity). Because mold spores are everywhere in the environment, you have to try to create an environment that does not offer the mold both food and water. Several types of mold are really toxic for people.

Mold is living. During the dry season, you may think you have conquered your mold problem, but even then, the mold is still there in spore form. Mold rarely goes away, it just waits for the right situation to reproduce and burst into life. You may think that during certain seasons you have no mold but it's not true; the mold is just dormant.

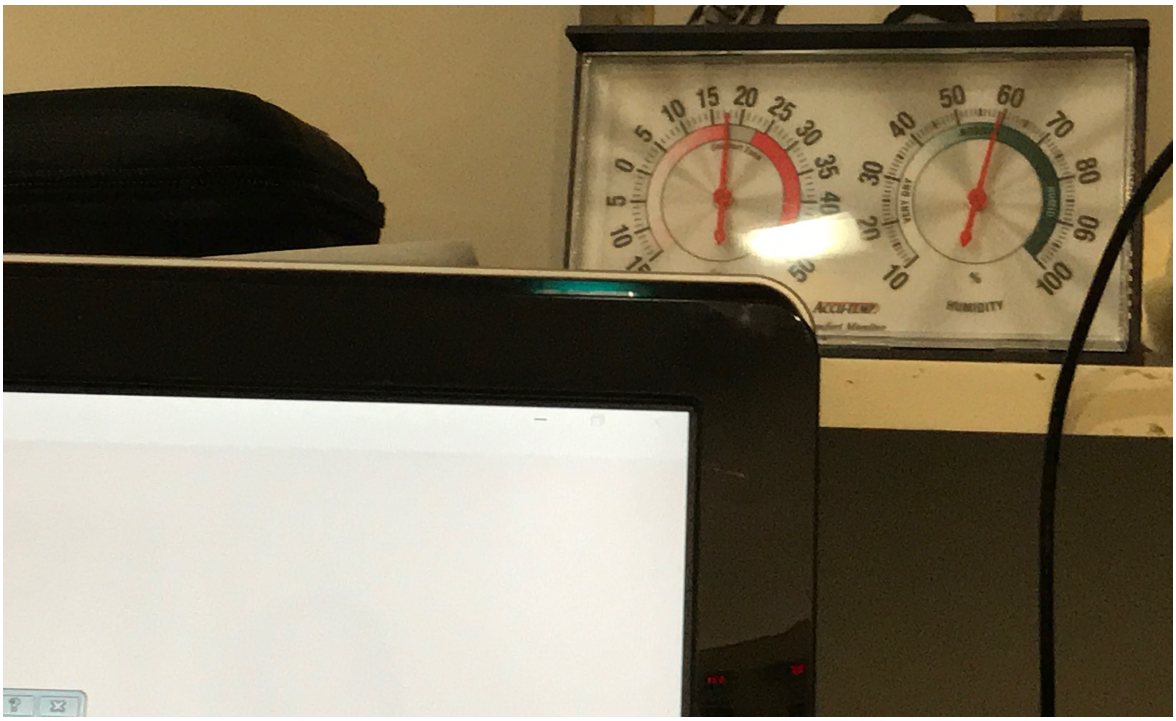
Toxic mold growing on the back side of a framed thangka. The frame was against a damp concrete wall during the monsoon season.

This is the life cycle of a mold: it dries up, then it gets activated when it's wet and colonizes. It then spreads and releases spores everywhere. These spores are hardy and can survive when there is no moisture in the air through the winter. In the spring, when there is lots of moisture in the air and it is monsoon season, the mold is activated, germinates, and colonizes again, releasing spores that can last through the entire winter, even though it may be cold and dry. This cycle continues with the seasons, so autumn and spring are good seasons to look out for mold growing on your treasures.



The life cycle of mold

Monastery treasures can be food for the mold. You can continually measure relative humidity with inexpensive devices and in some weather reports, but most people can feel changes when the air is damp inside. In general, most common types of mold do not live in low temperatures (below 10°C) and low relative humidity (below 70%).



Buddhist center archives office uses inexpensive device to measure and display current temperature and humidity inside the library

There are also digital temperature and humidity meters that continuously measure and can be accessed remotely on your mobile device and downloaded in the form of graphs and/or tables/charts. For example, a monastery might want such a device within a storage room for lineage treasures. More expensive forms of these digital meters read the temperature, relative humidity, levels of light (how bright), and also the UV (ultraviolet content) of the light.

Digital data logger measures temperature and relative humidity and can be accessed by your mobile device and computer

Mold growth encouraged by damp walls, leaking roof, and broken pipes, all of which provide moisture they need for the dormant spores to become active

In most monastery buildings it is not possible to control the climate, to control the temperature and relative humidity in order to prevent mold growth and dry out the existing colonies of mold. When it is dry during certain seasons of the year, some experts suggest that is a good time to remove all "inactive" mold colonies, so that when seasons change and the temperature rises, causing the relative humidity to rise, the mold will not spring into rapid growth again.

Sometimes it is possible to reduce existing mold colonies by vacuum. This must be done carefully - you need instructions before you try to vacuum near your treasures, and there are a number of caveats you will need to keep in mind. For example, you need to cover the vacuum nozzle with filtering fabric, and use or make a bleeder valve so that you can reduce the vacuum strength; you can use a brush to direct mold into the vacuum nozzle; do not use vacuum directly on the treasures. If you work in a well-

funded museum or library you can purchase special vacuum cleaners that have a filter to collect the visible mold you are removing from your treasures in order to prevent mold spores from entering your lungs and making you ill.

Nilfisk GM80 Museum Model HEPA Vacuum

$1,572.40

Nilfisk Vacuum Bags #107418525

$25.75

Nilfisk Hepa Cartridge #01727631

$243.18

Nilfisk Micro Filter #11730410

$43.10

Nilfisk ULPA Cartridge #01737631

$294.20

Nilfisk Micro Tool Kit #01702300

$41.10

Nilfisk GM80 Variable Speed Control M90029

$506.08

Although this example is expensive, you could find a similar product locally. Be sure to cover your face and wear gloves! Wrapping a cloth over the nozzle of the hose can prevent the treasure being pulled into the vacuum!

It is important to remember that any vacuum you use on or near your treasures needs to have very little suction. Ideally you can control the amount of suction so that you are not damaging your treasures. A vacuum can be a useful tool in controlling mold, but it can damage your treasures and spread mold spores around further.

We are not all fortunate enough to be able to purchase a $1000 vacuum cleaner for use just for cleaning treasures, a vacuum with adjustable suction, a hepa-filter, and perhaps one designed to wear on your back so that you can access treasures more easily, and with backup battery power in case your electricity is limited or unstable. Not even most museums and archives in the world have this type of vacuum. Vacuum cleaners can be helpful in dealing with mold problems, but if used incorrectly, can damage both the treasures and your health.

Summary

You can help to prevent damp conditions in your monastery with a good roof, including good drainage of rainwater, and repairing cracked walls. It may be one temperature and relative humidity outside; however, inside your monastery, those conditions can vary by room depending on windows, type of building construction, and also differences within a room; for example, the exterior walls can have condensation. Dampness that encourages mold can also come up from the floor.

Air circulation is encouraged: moving air discourages mold growth, so good circulation can help even in damp places. Move your treasures away from damp or cold surfaces.

When you see mold, you need to protect yourself hopefully with a protective mask and gloves; you don't want to breathe it in because it can cause serious lung and skin damage and mold can be fatal. Flu-like symptoms, skin rashes, and nausea can all show you that you have been exposed to mold and that it is negatively affecting your health.

Thank you to funders for ***Preservation of Buddhist Treasures Resource*** including The Pema Chodron Foundation, Khyentse Foundation, Shambhala Trust, Shelley and Donald Rubin Foundation, Anne Thomas Donaghy, Henry Ming Shen, and many more.

Relative Humidity and Water Damage Suggestions for Monasteries

- If possible fans must be used occasionally to ensure dry storage rooms
- Statues must be placed away from walls and some distance must be kept between statues when stored
- Pecha cabinets must be periodically cleaned, aired but then must be closed
- Spouts necessary on higher floors to prevent water from flowing down the walls and creating damp walls
- Always place treasures on raised platform, not directly on the floor to avoid risk from dampness, especially ground floors
- Periodic check for cracks on upper floors necessary . Keep watch for damp walls and trace water entry point. Especially after earthquakes/aftershocks
- Framed photos stuck to the glass susceptible to damage – ensure space between photo and glass
- Place treasures in drier places during monsoons

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དགོན་པའི་གནའ་དངོས་གཅེས་སྡུད་སྐྱོང་བརྡར་ཚོགས་པ།

Digital inventory འཕྲལ་ཆས་ཐོག་ནས་དངོས་ཐོར་འགོད་པ།
Risk assessment and disaster mitigation ཉེན་ཁ་སྤོན་འགོག་དང་ཇ་དྲན་གདོད་ལེན།
Recording digital interviews with elders མི་རྒན་རབས་དང་འཕྲལ་ཆས་ཐོག་ནས་བཅར་འདྲིས་སྤྱད་བྱེད་པ།
Scientific research ཚན་རིག་ཉམས་ཞིབ།

Current project དངྟའི་ལས་འཛར།
Free online preservation resource for communities and monasteries
དགོན་པ་དང་ཕྱི་ཚོགས་ཀྱི་ཆེད་དུ་གནའ་དངོས་གཅེས་སྡུད་ཐབས་ལམ། ཞིན་ཏར་ནེ་ཐོག་རིན་མེད་དུ་ཕྱལ་བ།

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Preservation of Buddhist Treasures

RISK ASSESSMENT ཉེན་ཁ་དཔྱད་ཞིབ།

- **Pandemic** ཡོངས་གྲྭབ་རིམས་ནད།
- **Earthquake** ས་ཡོམ།
- **Fire** མེ།
- **Water** ཆུ།
- **Theft** རྒྱག་མ།
- **Pests** གཙོད་འབྲུ།
- **Temperature and Relative Humidity** དྲོད་ཚད་དང་ཚྭོས་བཏས་ཀྱི་བཞའ་ཚན།
- **Human Choices** མིའི་འདམ་གཏ།
- **Pollution** འབགས་བཙོག།
- **Light** སྣང་མེ།

EMERGENCY PLANNING AND DISASTER MITIGATION ཕ་དྲག་འཚར་གཞི་དང་རྒྱུན་དན་ཞི་འཇམ།

SAFE STORAGE ཉེན་མེད་ངོས་ཁང་།

DOCUMENTATION ཡིག་ཆ་ཐོ་བཀོད།

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Basic Elements of Emergency Plan for Monasteries and Communities

1. People First

2. Who Do You Call?
   - Who is in charge?
   - Emergency phone numbers
   - Full monastery residence list, to text, WeChat, WhatsApp , etc.

3. Who Should Salvage Collections?
   - Monastery Treasures Salvage Team (trained previously)

4. Where to Bring Damaged Treasures
   - Another monastery?
   - Your monastery dining room, classrooms, etc.

5. What Do You Salvage First?
   - Decide your priorities, preferably before an emergency
   - Mark the location of these priority treasures on floor plans

6. Where Are the Emergency Supplies?
   - Stockpile supplies before an emergency occurs
   - Mark the location of supplies on floor plans
   - Contact local vendors for additional supplies

7. Who Provides Security During an Emergency?
   - Monastics, community members, or government?

8. What Information Technology Will You Need to Replace?
   - Survey your hardware and software currently in use
   - Store monastery files in "cloud" or duplicated offsite

9. Do You Have Insurance?

10. Who Has the Plan?
    - Make a list of who has copies of your Emergency Plan
    - Update Emergency Plan and Team

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