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Original article

Past, present and future effects of climate change on a wooden inlay bookcase cabinet: A new methodology inspired by the novel European Standard EN 15757:2010

Dario Camuffo[a,*], Chiara Bertolin[a], Achille Bonazzi[b,c], Francesca Campana[c], Curzio Merlo[d]

[a] Institute for Atmospheric Sciences and Climate (ISAC), National Research Council (CNR), Corso Stati Uniti, 4, 35127 Padua, Italy
[b] University of Parma, Earth Science Department, Parco Area delle Scienze, 157/A, 43100 Parma, Italy
[c] Office for Ecclesiastic Cultural Heritage, Piazza S. Antonio Maria Zaccaria, 5, 26100 Cremona, Italy
[d] University of Siena, Post-Graduate School in Historical and Cultural Heritage, Via Roma, 56, 53100 Siena, Italy

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ABSTRACT

This article illustrates a preventive conservation methodology for wooden collections and objects based on the respect of the historic climate, as established by the European standard EN 15757:2010. This requires the knowledge of the past indoor climate that should be kept unchanged in the present and the future, because discontinuities would be noxious for conservation. To this aim, a very vulnerable object, i.e. a wooden inlay bookcase cabinet built by G.M. Platina in 1477 AD has been considered. The paper illustrates the methodology used to reconstruct the historic climate, i.e. with proxy data from 1500 to 1715 and from 1716 to 2009 with instrumental observations. For the present, the indoor climate of the exhibition room and the cabinet response have been investigated to remove the perturbing factors that are damaging the cabinet. For the future, the ENSEMBLES model has been used for a probabilistic forecast of the temperature and humidity over the next century, the sustainability and the potential risk for conservation connected with the expected climate change. This research constitutes an example of a novel methodology based on the relevance of the Historic climate, and includes a synergistic effort of climatologists, material scientists and conservators, to be applied for preventive conservation and to evaluate and face the negative impact of the expected climate change.

1. Research aim

The first aim is to develop a new methodology based on the novel EU standard EN 15757:2010 concerning the temperature and relative humidity for conservation of hygroscopic organic materials and recommending the priority of the historic climate of the object. A wooden artefact, i.e. a wooden inlay bookcase cabinet built in 1477, was taken as an exemplary case study. The past climate of the artefact has been reconstructed over 500 years and the future climate has been modelled over the next 100 years in order to calculate from it the indoor climate that is expected inside the exhibition room.

The second aim is to study the effects induced by climate changes. The artefact was subjected to two types of climate changes: the influence of natural variability over the last five centuries and the consequences of a few relocations and present-day exhibition in a museum. The quality of the new environment has been monitored with field surveys.

This research constitutes an example of a novel methodology, including a synergistic effort of climatologists, material scientists and conservators, to be applied for preventive conservation and to evaluate and face the negative impact of the expected climate change.

2. Introduction

Any historic building had in the past a particular indoor climate, determined by the external regional conditions, weather, building envelope, use and other factors. Furniture and collections were conditioned by, and adapted to, this particular climate. No object can be conceived without memory of its past and present-day living conditions. The temperature (T) and especially the relative humidity (RH) have interacted with the wood structure determining internal tensions to which objects have adapted either with reversible or irreversible shrinkage and swelling, maybe generating permanent yield, or creating expansion joints to respond to the microclimate levels and variability.

* Corresponding author. Tel.: +39 0498295902; fax: +39 0498295619.
E-mail addresses: d.camuffo@isac.cnr.it (D. Camuffo), c.bertolin@isac.cnr.it (C. Bertolin), achille.bonazzi@unipr.it (A. Bonazzi), beniculturali@diocesidicremona.it (F. Campana), curzio.merlo@crforma.it (C. Merlo).

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Fig. 1. The wooden inlay bookcase cabinet built by Platina in 1477. Wooden inlay doors representing famous palaces, stringed instruments, animals and saints. On the internal side of the open door, a geometrical decoration is visible.

The present-day state of conservation of objects and collections vulnerable to mechanical damage depends on the T and RH conditions experienced in the past that are synthetically summarized in terms of "historic climate", i.e. the climate in which an object has always been kept, or has been kept for a long period of time and to which it has acclimatized. The European standard EN 15757: 2010 "*Conservation of Cultural Property – Specifications for temperature and relative humidity to limit climate-induced mechanical damage in organic hygroscopic materials*" [1] recommends that objects should be preserved without departing from the historic climate because levels or fluctuations in RH different from those to which an object is used is risky and may cause severe damage. Following the above Standard, the only acceptable changes are improvements that reduce fluctuations in the climatic conditions. This means to reduce the variability range and in particular to keep indoor climate unchanged over the whole year.

This article follows the latter possibility that is recommended, especially in the case of complex objects composed of more than one material, and illustrates a preventive conservation methodology based on the respect of the historic climate.

With reference to the historic climate, the Standard recommends that knowledge should be based on all available past climate records which should cover a period of one or more calendar years. This article will explore how back in the past is possible to reconstruct the historic climate of an object, making reference to existing data and reconstructing the missing ones.

Wood is the most sensitive "sensor" that detects microclimate changes, and the study of indoor climate is strictly connected with wood conservation [2–10]. Indoor climate is the input that causes mechanical wooden decay; decay is the result, i.e. the negative effect.

In this paper, a very vulnerable object, i.e. a wooden cabinet has been considered as a clear example to elucidate how indoor climate and wood conservation are strictly related between each other and how they should be managed.

3. The object, its past history and related damage

A wooden inlay bookcase cabinet was built in 1477 by Giovanni Maria Platina to store books, manuscript documents, antiphonaries and sacred objects for liturgical use in the Cathedral [11,12]. The cabinet is composed of thirty doors distributed on three rows (Fig. 1). It is made of walnut with wooden inlay doors representing on the external side famous churches and palaces in Cremona and other towns, stringed instruments, animals and saints (Fig. 2).

On the internal side, only geometrical decorations are made, sometimes with polychrome colour coating. Each door is made of a single or a double walnut panel and external and internal inlays are made of wooden essences, i.e.: *Acer, Pyrus, Abies, Populus, Tilia, Cupressus* and *Juglans.* The cabinet size is 7,74 m length; 2,66 m height; 70 cm main body depth, 80 cm at the basement, and 90 cm on the top [13]. However, in the following we will disregard its specific peculiarities of the cabinet and we will concentrate on the general methodological approach used to investigate and recognize the historic climate of the cabinet in order to keep it as a target reference for preventive conservation of the wooden collections preserved inside.

In 1477, the cabinet was built and located in the Sacristy of the Cathedral of Cremona (Fig. 3), made of brick and stones, a large Romanesque temple that had been over time readapted with elements in Gothic, Renaissance and Baroque style. The Renaissance works, which started in 1491, mainly concerned the upper part of the façade and the completion of the marble covering, but left untouched the Sacristy that hosted the cabinet from 1477 to 1928. The Sacristy was located in the Eastern part of the Cathedral, with an external wall adjacent to the houses of the Priests. The Sacristy was unheated, and the thick brick walls allowed slow seasonal changes in temperature and RH, with reduced range and phase shift in comparison with the outdoor values. In 1928, the houses of the Priests adjacent to the Cathedral were destroyed and the Sacristy room as