

Risk Assessment in Integrated Pest Management for Libraries: Postprint

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Abstract

To effectively prevent and control the insect and mold risks of library collections, this paper proposes a risk assessment framework based on the concept of integrated pest management, comprising two processes—risk identification and risk rating—thereby providing a novel perspective and methodology for library pest governance. Through risk assessment, institutions can promptly ascertain the risk status of their collections, allocate limited resources rationally, and formulate efficient response strategies. The article also presents specific assessment tables to enable readers to more clearly comprehend the process and outcomes of risk assessment, offering both theoretical reference and practical guidance for relevant institutions in addressing these challenges.

Full Text

Application of Risk Assessment in Integrated Pest Management for Libraries

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Abstract To effectively prevent and control pest and mold risks to library collections, this paper proposes a risk assessment system based on the concept of Integrated Pest Management (IPM), comprising two processes: risk identification and risk rating. This system provides a new perspective and approach for pest management in libraries. Through risk assessment, libraries can promptly understand the risk status of their collections, rationally allocate limited resources, and develop efficient response plans. The paper also provides specific assessment tables to help readers clearly understand the risk assessment process and results, offering theoretical reference and practical guidance for relevant institutions.

[Keywords] Integrated Pest Management; Collection risk rating; Environmental risk rating

Library collections often face threats from insects and molds that may cause damage. Traditional management methods primarily rely on remedial measures after infestation occurs. To address this issue, a new preventive approach based on maintaining proper preservation environments and internal management—Integrated Pest Management (IPM)—has been attempted and promoted by cultural heritage institutions primarily in the UK, US, Australia, and other countries since the 1980s.

Analysis and Management of Pest Risks in Collections and Environments

Without a risk assessment mechanism, relying solely on periodic inspections to detect pest activity in stack areas and taking remedial measures only after damage has occurred makes it difficult to truly achieve IPM objectives. Risk assessment forms the foundation and basis for implementing IPM in libraries. By comprehensively and objectively understanding collection preservation conditions and potential risks, accurately identifying and sorting risk factors in library environments (especially collection environments), and generating problem cluster indicators, libraries can provide data support for developing effective prevention and management plans. This not only helps clarify the necessity of IPM but also serves as a prerequisite for rational resource allocation and implementation of preventive conservation measures.

The Natural History Museum in London began actively exploring preventive pest control in 2003 and implemented an IPM program museum-wide in 2012. Shanghai Library started with pest monitoring as an entry point, significantly reducing pest numbers after implementing IPM. The National Diet Library of Japan implemented IPM practices and gradually recognized the importance and necessity of risk assessment during the process. After launching its IPM program, the library has not experienced large-scale mold infections, and pest numbers have remained low. The IFLA Preservation and Conservation Centre included IPM as a recommended collection preservation principle in 2015.

Although IPM has mature theoretical and practical foundations abroad, it remains in its infancy in domestic libraries, particularly regarding systematic research and application of risk assessment. Risk assessment serves as a preemptive control mechanism that maximizes collection protection while minimizing control costs and potential risks through monitoring, analysis, and evaluation of various risk factors.

1. Risk Assessment System

Considering the diversity of library collections and the complexity of risk factors, IPM risk assessment requires comprehensive consideration of different collection types and environmental factors. Under resource constraints, libraries must collect and analyze relevant data and information to efficiently identify potential

pest and mold risks, determine prevention priorities, and establish differential control measures for key protection objects.

This paper constructs a risk assessment system framework based on IPM concepts, including two key components: qualitative risk identification and quantitative risk rating. The framework adopts a multi-level hierarchical structure. Risk identification serves as the starting point of the entire system, requiring a holistic perspective to comprehensively review existing or potential pest risks in libraries and generate detailed risk inventories. Risk rating, built upon identification, further quantifies and compares risks to collections and environments, determining implementation priorities for improvement measures and enabling targeted, prioritized prevention efforts.

2. Risk Identification

Risk identification is a crucial means of proactively understanding the overall pest risk status in libraries. The process should cover the entire building where collections are housed, including collections themselves, building envelopes, and other aspects, while also addressing library management and maintenance. The objective is to comprehensively review existing or potential pest risks and form preliminary judgments and overall understanding.

Drawing on work experience and relevant standards, this paper develops a library pest risk identification table covering three main aspects: collections, environmental control, and housekeeping management. This table targets common pest risks in libraries, though individual institutions should adapt it to their specific circumstances.

Collections Risk Identification focuses on: - Susceptibility assessment: Verifying whether main collection types are vulnerable to pests/molds - Disease condition checks: Conducting inspections for damage, deterioration, and pest/mold conditions - Emergency response: Developing contingency plans for sudden pest/mold outbreaks and treatment protocols for small-scale infections - Technical capacity: Ensuring qualified professionals and appropriate facilities for collection rescue operations

Environmental Control Risk Identification examines: - Building integrity: Checking for structural vulnerabilities like cracked walls or loose flooring - Pest-proofing measures: Sealing pipes passing through stack walls, installing screened windows, and implementing termite control where needed - Water management: Ensuring proper drainage, preventing water accumulation, and avoiding condensation - Climate control: Maintaining functional HVAC systems with filters, regular maintenance, and real-time temperature/humidity monitoring

Housekeeping Management Risk Identification includes: - Quarantine procedures: Establishing dedicated isolation inspection rooms or disinfection steps before collection entry - Staff training: Conducting regular pest awareness education and knowledge training - Cleaning protocols: Implementing regular

cleaning schedules with appropriate supplies - Access control: Prohibiting food, plants, and permanent staff offices in stack areas

3. Risk Rating

After completing risk identification, collection risk rating prioritizes protection levels for different collections under resource constraints, while environmental risk rating assesses the pest/mold activity levels in collection storage and use environments.

Collection Risk Rating

Collection risk rating correlates directly with potential losses from pest/mold damage. The rating system classifies collections based on two dimensions: value/susceptibility to pests, and susceptibility to molds.

Collection Value Classification divides collections into three levels: precious collections, relatively precious collections, and ordinary collections. This classification considers historical artifact value, academic value, artistic representational value, and preservation nature. These factors interact—older collections typically have higher historical value and should receive greater protection. The uniqueness and irreplaceability of content also enhance collection value.

Pest Susceptibility Classification categorizes collections into three levels: highly susceptible (a), moderately susceptible (b), and not susceptible (c). This classification is based on material composition, binding types, and documented pest history. Collections with identical materials and binding types show similar deterioration patterns. The classification should focus on materials with repeated pest damage history, as these require heightened attention.

Mold Susceptibility Classification also uses three levels: highly susceptible (A), moderately susceptible (B), and not susceptible (C). Unlike cryptic pest damage, mold growth shows visible signs and has clearer causes, primarily related to relative humidity and material moisture content. When certain collection types experience mass mold outbreaks under similar humidity conditions while others remain unaffected, they can be classified as highly mold-susceptible.

The final collection risk rating combines these classifications. For example, precious collections that are highly susceptible to both pests and molds receive the highest priority for protection.

Environmental Risk Rating

Environmental risk rating uses scoring tables to quantify factors affecting pest/mold activity and propagation. Each identification item receives a score based on its impact level and the proportion of affected collections.

Scoring Methodology: Each item is scored by multiplying its impact factor (0.25, 0.5, 0.75, or 1) by the proportion of affected collections (0.003–0.1 for

partial, 0.1–1.0 for majority, or 1 for all). The cumulative mean score determines the risk level: 0–0.75 = low risk, 0.75–1.5 = medium risk, and >1.5 = high risk.

Pest Risk Scoring Items include: pest carcasses in corners, active pests on shelves, pest outbreak history, monitoring trap results, high temperature/humidity conditions, poor sealing, presence of plants or debris, and lack of quarantine procedures.

Mold Risk Scoring Items include: mold outbreak history, visible mold on collections, poor air circulation, direct contact between collections and walls/floors, high humidity conditions, and water damage to walls or ceilings.

Special cases: If pests are visible throughout an area or collections mold annually, the environment is directly rated as “infested” without further scoring.

Comparing Collection and Environmental Ratings

By comparing collection and environmental risk ratings, libraries can determine whether the environment meets minimum requirements for collection protection and establish priorities for IPM implementation. Precious and susceptible collections in high-risk environments require immediate intervention to achieve low-risk standards. For less susceptible ordinary collections, medium-low risk environments may be acceptable, allowing resources to focus on critical areas.

4. Risk Assessment Practice

In practical application, assessment teams should comprise staff from different positions with IPM knowledge backgrounds. This diversity ensures professional and comprehensive evaluation from multiple perspectives.

After generating a risk inventory, teams should analyze whether risks are common or specific, clarify risk types, and determine collection environmental risk levels. When resources are limited and multiple environments require improvement, priority should be given to environments housing high-value, vulnerable collections.

Risk rating results should guide targeted environmental improvements. By tracking changes in environmental ratings, libraries can evaluate whether implemented measures are effective and distinguish these changes from seasonal variations.

Application Example: Shanghai Library’s First Rare Book Collection and a floor of its general stacks demonstrate the rating process. The rare book collection, containing highly valuable and pest-susceptible materials, received a collection risk rating of A*a (high value, high pest susceptibility) and A* (high value, moderate mold susceptibility). Environmental assessment revealed medium pest risk (score 2.0) and high mold risk (score 2.5), indicating the environment failed to meet minimum requirements for such precious collections and required immediate improvement.

The general stacks, housing less valuable Western language periodicals with leather covers, received a rating of C*b (ordinary value, moderate pest susceptibility) and C* (ordinary value, low mold susceptibility). While the pest risk was acceptable, the high mold risk rating signaled need for intervention to prevent large-scale mold outbreaks.

5. Conclusion

This paper enriches domestic practical research on library pest risk assessment by exploring risk identification and rating within an IPM framework. The assessment method offers certain universality and can enhance collection protection and management while promoting awareness of pest prevention among professionals.

However, limitations remain. Specific application of risk assessment requires further clarification and standardization, as identification and rating standards may be affected by subjectivity and randomness. Future work should conduct more empirical studies, collect and analyze application challenges, and refine risk factor classifications and weights to improve objectivity and scientific validity.

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