



UDC 595.7:069.5

BIOLOGY OF MUSEUM PEST INSECTS AND PREVENTIVE PROTECTION MEASURES AGAINST THEM

Aytniyazova Gulnaz¹, Khabibullaev Amet Zhandullaevich

¹Independent Researcher

²Doctor of Philosophy (PhD) in Technical Sciences, Associate Professor, Karakalpak State University, Republic of Uzbekistan

ABSTRACT

Museum collections are susceptible to damage caused by various insect pests capable of destroying textiles, paper, wood, leather, and biological materials. The aim of this study was to investigate the principal museum insect pests and evaluate preventive protection measures against them. Based on an analysis of scientific literature, it was established that the most dangerous pests are representatives of the families Dermestidae and Tineidae, as well as silverfish and wood-boring beetles. The study demonstrates that effective protection of museum collections is ensured through regular monitoring, microclimate control, compliance with sanitary standards, and the application of modern insecticidal preparations. Phosphine-based products and fipronil-based insecticides showed the highest effectiveness.

KEY WORDS: Museum Entomology, Insect Pests, Museum Collections, Dermestid Beetles, Moths, Prevention, Monitoring.

INTRODUCTION

The preservation of museum collections is an important task in the protection of cultural heritage. Insect pests are capable of damaging textiles, paper documents, books, wooden and leather objects, as well as biological collections, leading to a reduction in their historical and scientific value. According to research data, about 50 species of insects are regularly found in museum collections. The most dangerous among them are representatives of the families Dermestidae (carpet beetles) and Tineidae (clothes moths), as well as certain species of the genus *Attagenus*. Termites also pose a significant threat to wooden artifacts, with approximately 120 species recognized as pests. The study of the biology of museum insect pests and the development of effective preventive measures are of great importance for the preservation of museum collections. The aim of this research is to investigate the principal museum pests and evaluate the effectiveness of modern methods of their preventive control and protection.

MATERIALS AND METHODS

The study was conducted in 2024–2025 and was based on an analysis of scientific literature on museum entomology, insect pest biology, and the conservation of museum collections. The study utilized methods of analysis, comparison, systematization, and generalization of literature data. Domestic and international publications on the species composition of museum pests, their life cycle characteristics, environmental requirements, and modern pest control methods were reviewed. Particular attention was paid to representatives of the Dermestidae and Tineidae families, as well as silverfish, wood beetles, and termites. A comparative analysis of preventive measures and the effectiveness of chemical and biological agents used in museums and archival repositories was conducted.

RESULTS AND DISCUSSION

An analysis revealed that insect pests are one of the main factors causing biological deterioration in museum collections. The most common museum pests are carpet beetles of the Dermestidae family. These insects are widespread in nature and exhibit high ecological flexibility. Their larvae feed on materials of animal origin, including fur, wool, feathers, dried insect remains, and leather goods.

Among the most dangerous species are the museum beetle (*Anthrenus museorum*), the carpet beetle (*Anthrenus picturatus*), the figwort beetle (*Anthrenus scrophulariae*), the Smirnov's carpet beetle (*Attagenus smirnovi*), and other representatives of the *Anthrenus* and *Attagenus* genera. Research shows that carpet beetles are the most damaging group of insects in museums, archives, and book depositories. Sixteen species of this family are classified as major pests of museum materials.

Members of the Tineidae family are a significant pest. Their larvae feed on wool, silk, cotton, and other natural fibers. They are particularly susceptible to damage to traditional costumes, carpets, antique fabrics, and decorative and applied art objects. The larvae's feeding causes holes in the fabric, weakens the material, and deteriorates the appearance of the exhibits.

The silverfish (*Lepisma saccharina*) poses a serious threat to archival and library collections. These insects feed on the starch, glue, and cellulose found in books, manuscripts, and archival documents. High humidity promotes their rapid reproduction and spread. Additional threats are posed by wood-boring beetles and termites, which damage wooden components of museum exhibitions, furniture, picture frames, and building structures. Their activity is accompanied by the formation of numerous tunnels within the wood, resulting in reduced material strength and the gradual deterioration of museum objects. An analysis of the biological characteristics of museum pests showed that most species undergo complete metamorphosis, including the egg, larval, pupal, and adult



stages. The larval stage is considered the most destructive because insects actively feed during this period and cause the greatest damage to museum materials.

The development of museum pests is significantly influenced by environmental conditions. The main factors include air temperature, humidity, availability of food sources, sanitary conditions of the premises, and the level of illumination. It has been established that temperatures ranging from 20 to 28 °C and relative humidity above 60% create favorable conditions for the development of most museum pest species. As a result of pest activity, various types of damage can be observed in museum objects. Paper documents exhibit feeding holes and gnaw marks, textiles develop perforations, and wooden artifacts lose their structural strength due to the formation of internal cavities. Entomological, zoological, and ethnographic collections are particularly vulnerable to insect damage. Consequently, the scientific, historical, and aesthetic value of museum collections is significantly reduced.

The most effective way to prevent infestation is through preventive measures. Insects can enter museums

through open windows and doors, ventilation systems, cracks in building structures, and together with newly acquired exhibits, packaging materials, and even visitors. Therefore, preventive actions should be carried out systematically and include a combination of organizational, sanitary, and technical measures.

Preventive protection involves regular cleaning of premises, preventing dust accumulation, controlling air temperature and humidity, quarantining new acquisitions, and conducting periodic inspections of collections. Particular attention should be paid to the examination of dark corners, spaces under carpets and furniture, display cases, cabinets, and other hard-to-reach areas where pest larvae frequently concentrate. Monitoring plays an important role in preventing infestations. Pheromone and sticky traps are widely used for the early detection of pests, enabling museum staff to identify the presence of insects in a timely manner and implement the necessary control measures. Regular monitoring is considered one of the most effective components of an integrated pest management system for museum collections (Table 1).

Table 1.

Effectiveness of Preparations Used for Preventive Pest Control in Museums

№	Preparation	Active Ingredient	Method of Application	Target Insects	Mode of Action	Effectiveness (%)	Area of Application
1	Nomolt	Teflubenzuron	Surface treatment	Anthrenus, Tinea, Stegobium	Inhibits insect development at the larval stage	70–85	Storage rooms, museum exhibits
2	Regent	Fipronil	Aerosol and contact application	Dermestes, Stegobium, Trogoderma	Affects the nervous system	85–95	Warehouses, enclosed spaces
3	Dichlorvos	Organophosphate	Fumigation	Broad spectrum of insects	Affects the respiratory system	80–90	Enclosed buildings and rooms
4	Permethrin	Pyrethroid	Spraying	Beetles, moths	Contact action	75–90	Walls, furniture
5	Boric Acid	Mineral compound	Powder form	Lepisma and small insects	Disrupts the digestive system	60–75	Dark corners and inaccessible areas
6	Phosphine-based Preparations	Aluminum phosphide	Gas treatment	All pest insects	Inhibits cellular respiration	90–98	Large storage facilities
7	Lavender Oil (Biological Agent)	Essential oil	Natural repellent	Moths, beetles	Repellent effect	50–65	Museum exhibits
8	Naphthalene	Organic compound	Vaporization	Moths	Repellent effect	60–70	Clothing and textiles

An analysis of the presented data revealed that aluminum phosphide-based products are the most effective, killing up to 98% of pests. Regent, whose active ingredient is fipronil, also demonstrates high results. These products target the insects' nervous system and provide reliable protection for museum collections.

Organophosphate insecticides and pyrethroids also demonstrate high effectiveness and are widely used for the treatment of storage facilities, museum repositories, and

exhibition halls. At the same time, interest in environmentally friendly pest control methods has increased in recent years. These include essential oils and naturally derived repellents, such as lavender oil and naphthalene. Although their effectiveness is relatively lower, they can be used for the preventive protection of particularly valuable artifacts where the application of toxic insecticides is restricted. The obtained results indicate that the most effective approach is an integrated pest management system combining regular monitoring,



sanitary and hygienic measures, microclimate regulation, and the rational use of modern pest control products.

CONCLUSION

Museum insect pests pose a serious threat to the preservation of cultural heritage. The most dangerous are carpet beetles, moths, silverfish, wood beetles, and termites, which damage various organic materials. Pest development depends on temperature and humidity, so microclimate control, regular monitoring, sanitation measures, and quarantine of new acquisitions are essential. The most effective pest control methods are phosphine-based products and fipronil-based insecticides. A comprehensive approach to preventative and protective measures can significantly reduce the risk of damage to museum collections.

REFERENCES

1. Abdullaev H. *Entomology of the Environment*. – Tashkent: O'qituvchi, 2018.
2. Aitniyazova G.M., Zhuginisov T.I., Ruzimatova F.Sh. *Bioecological features of insect pests of historical museums of Uzbekistan*. – Nukus, 2023. – P. 636–639.
3. Child R., Pinniger D. *Integrated Pest Management for Collections*. – Museum Handbook, 2018.
4. Florian M. *Heritage Eaters: Insects and Fungi in Heritage Collections*. – London, 2019.
5. Pinniger D. *Pest Management in Museums, Archives and Historic Houses*. – New York, 2020.
6. Ruzimatova F.S., Juginisov T.I., Duisengaliev E.S., Ayniyazova G.M., Kubaev J.E. *Coleoptera, Cerambycidae oilasi mo'ylovdor qo'ng'izlarining zararkunandalik xususiyatlari* // Termiz, 2024. – P. 85–87.
7. Yuldashev A. *Museum of Natural History*. – Samarkand, 2021.