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Survey of insect pests in the manuscripts library of Coptic museum in Egypt

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ABSTRACT

Museums are the main sources of cultural, political, economic, scientific and historic information in the communities. Pests in a museum, library or archive environment can cause serious damage to highly valuable and irreplaceable materials. A survey was conducted in the Manuscripts Library of the Coptic Museum (Egypt) to determine the biodiversity of insect pests infest the place. Sampling were done monthly for a year (from October 2018 to September 2019) using sticky traps with a nontoxic sticky substance. The sticky traps were placed at the corners of the library, behind doors and on the windows edges. A total of 1047 specimens belonging to nine species under six families and five orders were collected and identified. The most abundant species was *Monomorium pharaonic* with a total of 639 collected specimens followed by *Ochetellus glaber, Thermobia domestica, Gibbium psylloides, Anthrenus verbasci, Periplaneta Americana, Lasioderma serricorne, Liposcelis bostrychophila, Attagenus fasciatus with total number of 193, 62, 45, 39, 23, 21, 13, 12 collected specimens.*

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1. Introduction

Egypt is a home to a quarter of the world's antiquities. From Alexandria in the north to the Sudanese border, from Siwa in the west to the Gulf of Aqaba, the country is wealthy with all types of antiquities (Gaballah et al., 2000). Among these antiquities, the Coptic Museum includes all the fabric necessary to review Christian history in Egypt. Due to his keenness for Coptic antiquity, in 1908 Marcus Simaika Pasha creates the Coptic Museum that links Pharaonic, Greco-Roman and Islamic antiquity. The Museum is positioned inside the walls of the fort of Babylon, part of the old city walls built by Emperor Trajan in 98 A.D., that additionally homes the old churches of Cairo: St. Sergius and St. Barbara of

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the fourth century and therefore the Hanging Church "El Muallaqa" of the sixth century. The Museum has a collection of 16,000 works of art including doors and iconostatic screens, panels presenting events from the life of Christ, liturgical objects, altars, crosses and lecterns. There is a treasure of cloths which highpoint a wide diversity of techniques and materials. The library of the museum holds 6000 papyrus manuscripts of which both the Psalms of David and the manuscripts of Nag Hammadi are the most important (Zaki, 2008).

The collections of museums, libraries, archives and artefacts which be made up of organic materials, such as fur, wood, linen, plant material, wool, etc., can be endangered by a variety of insect pests, constituting a serious threat to their conservation. Most heritage areas have collections which are at risk, including archaeology, drawings and prints modern art installations, folk art, fine arts, ethnography, books and archives (Trematerra and Pinniger, 2018). Egyptian antiquities are also a vital economic resource so museum entities need special consideration concerning their protection and maintenance. If collection contents are damaged or permitted to be destroyed not only the museum loses a treasured quality, but also human kind misses a part of its cultural or scientific heritage that may be unique (Edson and Dean, 1996).

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Fig. 1. The Manuscripts Library at Coptic Museum.

Identification of the species of pest causing the problems is the cornerstone in order to undertake preventive and curative measures and is the initial part of an IPM program (Querner, 2015). Incorrect identification may result in large amounts of time and resources being wasted in controlling the wrong pest (Pinniger et al., 1999; National Park Service, 2008). Accordingly, this study is conducted to explore and identify the insect pests that affect the Manuscripts Library, Coptic Museum and which are a great challenge against its preservation in addition to determine their abundance during the year.

2. Materials and methods

The insect pests which harbor the Manuscripts Library (Coptic museum) (Fig. 1) were surveyed during the period from October 2018 to September 2019. Victor sticky traps (Branded in U.S.A) were used to trap insect pests, these are a cardboard construction often used as triangular or wedge shaped in cross section with the interior surfaces coated with a nontoxic, non-drying sticky substance. Usually have no attractant substance, so insects walk onto the sticky surface and caught. The sticky traps were placed on the floor (at the corners of the library), on the windows edges and doors behind the textiles and manuscripts in all directions of the library to cover the whole area (Fig. 2). The traps were checked monthly and the stickiness of the trap is also checked at the same time (Fig. 3). The trapped specimens were mounted and examined. Insects were identified using stereomicroscope. All information

about the date, site of traps in the library and collected insects were recorded.

3. Results

The result indicated the infestation of the library by several pests which identified under nine species belonging to five orders (Hymenoptera, Coleoptera, Thysanura, Psocoptera, Blattodea) and six families (Formicidae, Ptinidae, Dermestidae, Lepismatidae, Liposcelidae, Blattidae) (Table 1).

As presented in Table 2 a total of 1047 insects were collected during the study period from October (2018) to September (2019).

Monomorium pharaonis was the most abundant species and recorded all over the months, with its highest occurrence (145 individuals) during July 2019, followed by 103 individuals in June (2019). This was followed by *Ochetellus glaber* which was recorded at all months except November and December, with the highest abundance (46 individuals) in June (2019). While only one individual was recorded during October 2018.

Only one individual of *Gibbium psylloides* have been collected during February, Mach and April (2019). The highest occurrence (17 individuals) was recorded in July (2019), while no insect was recorded in October, November and December (2018) and January (2019).

Also, only one individual of *Anthrenus verbasci* was recorded only during April, June, July and August (2019). Contrariwise, *Attagenus fasciatus* was recorded only from May to September (2019) with its highest occurrence (5 individuals) during May. *Lasioderma serricorne* was occurred during all months except November and December (2018). Data indicated that, *Thermobia domestica* have been collected during all the months of investigation except in January (2019), with a number of individuals ranged from 1 to 9.

The existence of insects in the studied library was higher during summer months, ranged from 108 to 222 individuals, compared with 4–23 individuals trapped during winter months.

As a result, the existence of insect pests and their abundance varied from place to another inside the library. 277 individuals (30%) were collected from windows. The highest occurrence of pests was in corners with 628 individuals (60%); the lowest occurrence of insect pests was beside doors with 105 individuals (10%) (Fig. 4).

4. Discussion

In this work insect pests infest the Manuscripts library in the Coptic museum were collected and recorded monthly from October 2018 to September 2019.



(A)

(B)

Fig. 2. The position of traps in the library: A. Beside the window, B. Beside the inner door.





Fig. 3. A trap showing the collected insects.

Table 1

The names and classification of pest species infest the library.

Insect order	Insect family	Insect species
Hymenoptera	Formicidae	Monomorium pharaonic (Linnaeus, 1758) Ochetellus glaber (Mayr, 1862)
Coleoptera	Ptinidae Dermestidae	Gibbium psylloides Paweł Czenpiński, 1778 Lasioderma serricorne (Fabricius, 1792) Anthrenus verbasci (Linnaeus, 1767) Attagenus fasciatus (Thunberg, 1795)
Zygentoma Psocoptera	Lepismatidae Liposcelididae	Thermobia domestica (Packard, 1873) Liposcelis bostrychophila Badonnel, 1931
Blattodea	Blattidae	Periplaneta Americana (Linnaeus, 1758)

The used sticky traps found to be effective in collecting a wide variety of museum insect pests this is in agreement with Child et al. (2011) who explored that non-baited sticky traps is more effective in grasping a wide array of insect pests of museum.

A total of 1047 specimens were identified under nine species which belonging to five orders and six families. These pest species were: *Monomorium pharaonis* and *Ochetellus glaber* (F: Formicidae) order Hymenoptera, <u>Anthrenus verbasci</u> and Attagenus fasciatus (F: <u>Dermestidae</u>), Lasioderma serricorne and Gibbium psylloides (F: <u>Ptinidae</u>) order Coleoptera, Liposcelis bostrychophila (F: Liposcelididae) order Psocoptera and Periplaneta americana (F: <u>Blattidae</u>) order Blattodea. These results comply with Notton (2018), Trematerra and Pinniger (2018) and Shima et al. (2020) and who documented these species as the main museums pests.

The occurrence of insect pests in the studied library was higher during summer months compared with winter months which may be due to warmer and humid climate that accelerate the rate of pest development. The same findings have been reached by Child and Pinniger (1993) who reported that, insect pests were more abundant during July compared with April. Also, Antonie and Teodorescu (2009) noted similar observations to be due to warmer climate during summer season.

The collected pest species are divided to the following categories according to National Park Service (2008) and Trematerra and Pinniger (2018):

1. Textile pests

Most insect destruction to textiles is formed by carpet beetles (family Dermestidae) where their larval stage feeds on fabric, fur, feathers or virtually anything made of animal fibres. They also feed on dead insects.

1.1. *Anthrenus verbasci* (varied carpet beetle) can damage taxidermy, woollens, wall hangings, carpets, hides, horns, and bone artefacts as well insect collections.

1.2. *Attagenus* (fur and carpet beetles) are mainly scavengers on the dead animals and dusts In historic buildings.

1.3. *Gibbium psylloides* (the humpback spider beetle) are frequently present in historic buildings where they live under floorboards feeding on plant materials and cause damage to textiles.

1.4. *Lasioderma serricorne* (the cigarette beetle) their larvae of feed on paper, book covers using leather, parchment, cardboard, wood or wooden shelves. It can cause severe destruction to many objects in ethnographic collections because of its rapid development and reproduction.

2. Paper pests

2.1. Pests associated with mold and high humidity

2.1.1. *Liposcelis bostrychophila* (Booklice) nourish on microscopic mold growing on paper and in the starchy glue in the binding. Psocids also infest manuscripts. Although damaged by a few booklice may be insignificant, large numbers of booklice will scratch the surface of books and papers. In addition, their existence often designates a moisture problem and presence of damaging molds.

2.1.2. *Thermobia domestica* (Firebrat) feed primarily on debris, mold, human skin or hair (textiles, cotton, silk), but can

Table 2

Number of insect species collected during each month.

Insect species	No. of insects during months												
	Oct. 2018	Nov. 2018	Des. 2018	Jan. 2019	Feb. 2019	March 2019	April 2019	May 2019	June 2019	July 2019	August 2019	Sep. 2019	Total
Monomorium pharaonic	14	8	5	1	1	44	60	93	103	145	86	79	639
Ochetellus glaber	1	-	-	1	2	18	22	34	46	38	28	3	193
Gibbium psylloides	-	-	-	-	1	1	1	2	11	17	9	3	45
Lasioderma serricorne	1	-	-	1	1	3	1	2	4	2	3	3	21
Anthrenus verbasci	-	-	-	-	-	-	5	-	7	6	10	11	39
Attagenus fasciatus	-	-	-	-	-	-	-	5	4	1	1	1	12
Thermobia domestica	7	1	3	-	7	9	5	3	9	6	8	4	62
Liposcelis bostrychophila	-	-	1	-	-	-	1	-	2	4	3	2	13
Periplaneta Americana	-	1	1	1	4	1	2	1	2	3	5	2	23
Total	23	10	10	4	16	76	97	140	188	222	163	108	1047



Fig. 4. The percentage of insects collected using traps at different positions.

also damage paper, book bindings, wallpaper, papier-mâché, starch glue and cellulosic materials.

2.2. General pests including cockroaches, ants and other common pests can attack and cause problems in museums

2.2.1. *Periplaneta americana* (The American cockroaches) are omnivorous and feed on leather, glues, paper, wool fabrics, hair and animal skins. Identification of the insect adults, nymphs and egg cases and an understanding of its life cycle are important to define what the hazards are and measure the most suitable control strategy.

2.2.2. *Monomorium pharaonis* (Ants) feeding on fatty and sugary substances including all kinds of food, carrion dead insects

5. Conclusion and recommendation

The most abundant museum pests are ants, silverfish, carpet beetles and cigarette beetles. All are feeding on animal fur and textiles made with animal fibers, feathers or felt. Dust and dead insects are the main food source for many pests and should be avoided. Adaptable the climate and vacuuming to reduce dust, microscopic fungi and other organic matter are two essential ways to prevent the presence of humidity related pests. The infested objects in the library must be treated as soon as possible to prevent further spread and damage.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author contributions

G.M.M.A and **N.H.A** conceived and designed the idea, methedology, Investigation, writing—original draft; **G.M.M.A**. identify specimens, writing—review & editing and data curation, **S.A.A** and **S.A.** validation and consultation. All authors have read and agreed to the published version of the manuscript.

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