

An integrated pest management program as a pests control strategy at the University of Botswana Library

Thatayaone Segaletsho
University of Botswana Library
Segaetshot@mopipi.ub.bw

augmented by provision of supportive structures of funding, coordination, policies, and management and planning prioritizations.

Abstract

Libraries and archives have the jurisdiction to acquire, protect, and provide information resource to the public for as long as possible. Consequently, libraries and archives are obliged to preserve collections in perpetuity. Preservation is a presiding managerial function of coordinating the endeavor to protect collections from deterioration. As part of preservation, libraries and archives have the responsibility to monitor and control pests within their collections. The general purpose of this study was to investigate the monitoring/inspections of pests, pest prevention, pest control and challenges observed at UB-Library with the view to make recommendations for improvement. The study was conducted using a survey methodology and data collection was conducted using observation and document analysis tools. The findings of the survey revealed a significant number of pests that are present in the UB-Library including badister bullatus, spiders, grasshopper, house cricket, birds-dove (columbidae), cockroaches, strawberry seed beetles, flea, silverfish, moth, ants and flies (Black and blue flies). Despite the presence of guidelines on inspection, prevention and pest control measures at UB-Library, lack of supportive structures to pest management programme such as funding procedures, prioritization, policies statements on pests and proper coordination of IPM programme was observed as major challenges. This study therefore recommends an adoption of a three step process of monitoring/inspection, prevention and control as an appropriate strategies for pest management and this should; provide effective early inspection and identification of warnings of infestation; identify high risk areas within collection and the surrounding buildings and pin point environmental sources of infestation, and outline prevention and control measures. Furthermore, the study recommends that integrated pest management strategies should be

Key terms: integrated pest management, pest's survey, preservation of library and archival materials

Introduction

Libraries and archives have the jurisdiction to acquire, protect, and provide information resources to the public for as long as possible, and for that reason, they have the responsibility to preserve collections. According to the International Federation of Library Associations and Institutions (IFLA) publication; Principles for the Preservation and Conservation of Library Materials, a Records and Archives Management Programme (RAMP Study) (Vinas, 1989:79) preservation “includes all the managerial and financial considerations, including storage and accommodation provisions, staffing levels, policies, techniques and methods involved in preserving library and archive materials and information contained in them.” In other words, preservation is a presiding managerial function of coordinating the endeavor to retard deterioration and prevent damage by creating conditions optimal for the continuation of cultural heritage materials as compatible with their social use. As part of preservation, libraries and archives are obliged to protect collections from pests. Appelbaum (1991:117) stressed that “actual occurrences of insects or mold damage to collections materials are often not publicly discussed by professionals, but can cause major disruption in the life of an institution, and can cause significant damage to collections, particularly where a large amount of materials is stored away and only infrequently inspected.” Pests are one of the drawbacks in ensuring long life

availability and access to information resources.

According to the International Standards for Phytosanitary Measures (Food and Agriculture Organization of the United Nations, 2001:04) pests are “any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products.” Pests are annoying or troublesome and nuisance creatures that harms or destroys garden plants, trees, households, animals and pose as a threat even to agro-ecosystems and agricultural productions (Campos et.al 2014). On the other hand, the Encyclopedia Britannica (2013) emphasized that the definitions of pests are subjective to the given different scenarios. However, they viewed pests as any organisms declared as inflictors of injury or pain to human beings or to their interests. Pests are the threatening perpetrators to human comfort, plants and other animals throughout the world. As a result, different institutions have/are continuously establishing pest control measures in order to minimize damages to their interests or belongings (The U.S. Environmental Protection Agency, 1993, Gibb & Al Fournier, 2006, British Library, 2014). Libraries and archives have equally importantly noticed the importunity of controlling pests and this is evidenced by different issues raised by library and archival institutions throughout the world. Some of these issues on pests in libraries and archives are discussed in the next sections.

Issues of pests in libraries and archives

Libraries and archives are continuing to disclose evidences of pests in their building environments (Ritzenthaler, 1993, Harvey, 1994, and Segaletsho, 2014). The pests observed in libraries and archives’ buildings are of different types or groups depending on

their breeding systems, location and nature. Ritzenthaler (1993) and Harvey (1994) noted that, among others, common types of pests in libraries and archives include cockroaches, flies, termites, grasshoppers, bugs, crickets, beetles and spiders. In addition, the Preservation Advisory Center (British Library, 2012) observed that woodworm/furniture beetles or woodborers like the anobium punctatum, stegobium panaceum and bookworms are also among the common pests in paper collections. Furthermore, silverfish, termites and book-lice were observed by Harvey (1994) and the British Library (2012) as some of the pests which are really worrisome in library and archival materials.

Given the varied types of pests observed in libraries and archives throughout the worlds, this implies that materials are subjected to different damages caused by these pests. Ngulube (2005) revealed that seven (63.6%) of the archival institutions and six (66.7%) national libraries in Eastern and Southern Africa had observed damages to materials caused by moulds and insects. Silverfish and booklice were observed by the British Library (2012) to be gracing on book surfaces. The British Library (2012) further observed that the larvae make tunnels in paper materials more especially in the big bound materials or stacked papers. Literature posits that the continuous pest infestations are exacerbated by the fact that pests generally live in moist areas, but can survive in dry areas as long as they have access to water and sources of food like starch, cellulosic materials, and animal glues in books and these pose different challenges to library and archival materials (Ngulube, 2005 & British Library, 2012). Pests can eat collections, stain collections with their remains, distort the authenticity of collections and in some instances they can completely deteriorate the context of collections (Harvey, 1994). Consequently, pests do not only pose

danger to collections but also to human health and safety through stinging or biting, and the damages are irreversible.

The various damages to collections posed by pests signify the evidence of different challenges that overwhelm libraries and archives institutions throughout the world. Selatolo (2012) was of the view that challenges on pest equally include the rapid production of the young ones which also brings about huge amount of destruction to collections. It is, therefore, important to monitor, control and destroy breeding cycles of pests in library and archival institutions. In overall, libraries and archives are further faced with general challenges of training staff on proper methods of pests control, financial challenges, lack of policies and lack of expertise when it comes to preservation work (Tamuhla, 2001, Ngulube, 2005 & Selatolo, 2012).

Despite the different challenges in preservation work, libraries and archives embrace different methods of admonishing and controlling pests. These include fumigation with pesticides, insecticides, using of pest traps, and adoption of Integrated Pest Management systems (IPM). However, most of the chemical methods are faced with different challenges. Chicora Foundation (1994) observed that there are increasing concerns over indoor air quality, increasing sensitivity to certain chemicals either through inhalation or physical contact, and increasing allergic reactions to a wide variety of products. Segatsho & Mnjama (2012) further opined that using of pesticides in library building without functional air condition systems pose a threat to air quality due to gases that may be produced by decaying pesticide chemicals. The chemical methodologies have negative impact to the environment and can be extremely dangerous leading to diseases and even death to human. Gibb & Al Fournier (2006:03) highlighted the dangers of using

pesticides arguing that the “concern about the use of pesticides in school environments and the potential effects of pesticide exposure on children’s health have driven many states to implement laws that affect the use of pesticides in schools.”

As a result, institutions prefer economically cheap, less toxic and environmentally friendly methods of pests’ control. The proper control of pests require that institutions should develop official policy statement that provides a useful first step in changing from a conventional pesticide program to user-friendly programs (National Service Center for Environmental Publications (NSCEP), 1993). Environmentally friendly measures of pests control were also observed at the British Library which implemented IPM program and have quarantine rooms for pest control measures (British Library, 2014). The importunity of user-friendly pests control methods was clearly stated by the Chicora Foundation (1994:01) when they posited that “we need to more aggressively pursue mechanical and cultural changes which build or starve pests out, making museums, libraries, archives, and historic sites less attractive to things that destroy collections.” It is, therefore, paramount that libraries and archives should harmoniously integrate different approaches of analyzing pests, monitoring, prevention and control through programs like IPM.

Integrated Pest Management (IPM) Systems

The United States (US) Environmental Protection Agency (2014:01) defined an Integrated Pest Management (IPM) as “an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices.” It is an economically cheap process that anchors

on user-friendly strategies of preventing pests from accessing the environments under protection. In developed countries like in America and United Kingdom (UK), professionals acquire IPM certification in order to verify that their pest management systems use the key steps of IPM program. Chicora Foundation (1994) argued that true IPM program requires that an institution should develop a program of devising the threshold level of action on which monitoring to identify the pests present is critical. In doing so, the institution develops the knowledge of understanding the biology and lifecycles of the pests involved so that the institution can realistically develop strategies of mechanical, cultural and biological control and evaluate the enacted control measures. The process is anchored on identifying pests, studying their leaving habits, feeding methods and their breeding lifecycle such that prevention strategies could be implemented in order to break and disturb their lifecycles.

There are three major steps guiding IPM program and these include (1) monitoring/inspection, (2) prevention and (3) control in IPM programs (The U.S. Environmental Protection Agency, 2014). However, some institutions tend to separate the first stage of pest inspection and monitoring into two distinctive steps (California Environmental Protection Agency, 1995). The first step of monitoring or inspection of pests is the basic starting point in the realm of integrated pest management programs (Orkin Pest Control, 2014). During the first step of IPM program, the Professional Pest Control Products (2014) observed that in residential areas, pests more especially cockroaches live in basements, around pipes, toilets and sewers, and may migrate to outdoor areas during warm weather. As observed by Duchemin (1996) hidden pests including silverfish, bookworm, cockroaches, and termites can cause damages

such as destruction by chewing, gnawing and stains from droppings. It is therefore paramount that when implementing strategies of monitoring pests one should always inspect cracks and crevices of porches, foundations, and gardens adjacent to buildings under care (U.S. Environmental Protection Agency, 1993). Simple methods and tools for monitoring and inspection of pests include using pest traps to capture pests, plastic vials for collecting and storing pests, small brushes for manipulating small insects, and hand-lenses or microscopes to better identify pests (Duchemin, 1996). Augustin et. al (2012) emphasized that another equally important tool for capturing pests include using aggregation pheromones which are used to bait funnel traps, windows traps and cross-vane traps.

The second step in IPM involves preventive tactics, nonchemical tactics on which an institution tries by all means to avoid pests in the building. Prevention tactics should include managing the crops, vegetation and lawn in surrounding areas, sealing cracks in walls, proper housekeeping and avoiding food in storerooms (U.S. Environmental Protection Agency, 1993 & British Library, 2012). The third step considers the use of pesticides only after an intolerable pest population has been observed within a building (The University of California, 2014). Targeted areas include wall/floor angles, cracks in woodwork, behind and under shelves/cabinets, and dead spaces such as ducts, and any hidden places like sewage lines and pipes line. However, the Preservation Advisory Center (British Library, 2012) was of the view that using aerosols or airborne sprays of pesticides should not be recommended since the spray chemicals can cause air pollution or acidification on collections. It is also paramount that direct application of pesticides to collections be avoided. The Preservation Advisory Center (British Library, 2012:13) further emphasized

that “Prevention is better than cure”, as such the control measures should be the last resort of pest control. In other words, the overall pest control method should place great amount of focus on inspection/ monitoring and preventive measures and these are the core activities of an IPM program.

UB-Library Integrated Pest Management (IPM) program

Since the establishment of the Special Collection Unit at the UB-library, the library has been working hard on achieving its preservation program. In doing so, the Special Collection Unit has been observing deterioration effects in most of its collections both in open shelves and the special collections areas, and among others, these deterioration effects include pests’ damages (Segaletsho & Mnjama, 2012). As part of its preservation program, the Special Collection Unit introduced an Integrated Pest Management (IPM) program in around 2013 with the aim of monitoring and minimizing damages caused by pests. The program was introduced to provide advice and remedy regarding the prevention of library materials from biological agents such as pests. The mandate of the IPM program was to monitor/inspect pests and come up with prevention and control strategies (The University of Botswana, 2014). Despite the good efforts on the establishment of the IPM programme, a significant number of ups and downs on pest management have been observed. Segaletsho (2014) observed that the UB-Library was challenged by issues of food and eating in certain library areas, lack of strategic pest management guidelines and procedures, and uncontrollable environmental conditions. Furthermore, observed issues of concern that needed address, among others, include the limited or inappropriate monitoring/inspections of pests, weak pest prevention measures, pest control and lack of

proper strategies for improvement. Given these challenges, it is clearly significant that continuous studies on cost effective and environmentally friendly activities that innovatively aim at eradicating, monitoring and controlling pests need to be conducted in order to improve on pests’ damages.

Research objectives

The general purpose of this study was to investigate the monitoring/inspections of pests, pest prevention, pest control and challenges observed at UB-Library with the view to make recommendations for improvement. The specific objectives of the study were;

1. To investigate the monitoring or inspection of pests within the library building specifically focusing on assessing the types of pests observed and determining the months, location and frequency on which the pests are observable within the UB-Library.
2. Identify the effective and environmentally friendly methods of pests prevention used at UB-Library.
3. Investigate how pests are controlled at UB-Library where preventive measures seems not to be working.
4. Identify the challenges emanating from or during the running of IPM programme at UB-Library.
5. Make recommendations for improvement on pest management at UB-Library and elsewhere.

Research questions

The study was aimed at addressing the following research questions;

1. What are the monitoring or inspection measures, types of pests observed, months, location and frequencies on which pests are observable at the UB-Library?
2. What are effective and environmentally friendly methods of pests prevention used at UB-Library?
3. What are the pests control measures used at UB-Library where preventive measures seems not to be working?
4. What are the challenges emanating from or during the running of IPM programme at UB-Library?
5. What recommendations can be adopted for improvement on pest management at UB-Library and elsewhere?

Methodology

This paper presents a survey study on management and control of pests at the University of Botswana Library main campus, specifically on strategies of monitoring/inspection, prevention challenges and pest control measures. As a result, it was necessary that the study adopt a survey research methodology as its data collection strategy. Research methodologies are paramount steps in research endeavour that aid or assist researchers to identify sequential steps to follow in gathering data (Saunders, Lewis & Thorthill, 2012). Concomitant to the nature of this study, survey methodologies are commonly used in preservation work due to their advantages of cheap process, easy to follow and their ability to provide correct information (Reis & Judd, 2000). The study mainly used observation as a tool of data collection. This was a daily activity for the year 2013 which involved inspection of areas inside the storerooms, all library floors, and seminar rooms, learning commons area/circulation area, the library kitchen and

the surroundings of the library building. Sproull (1995) posited that observation is a data collection method that employs the tactics of carefully watching with directed attention to the researched phenomenon, and recording information about the characteristics of the researched phenomenon.

During the survey observations, quantitative information on pests observed was recorded in a spreadsheet of a Microsoft Office Excel and the data was then grouped according to the pests' locations, types, and months and analysed using graphs and tables. The data collected through the observation was supplemented through qualitative information obtained through a guidance of an observation checklist in order to get detailed information on the description of the types of pests, locations, and control and prevention measures of pests observed at the UB-Library. This method was found appropriate for the study because it allowed obtaining both quantitative and qualitative information on different pests in the library and allowed analyzing data in a simple and easy format. Indeed as expressed by Tashakkori & Teddie (1998) combination of qualitative and quantitative elements can be compatible in a study allowing pragmatism. The observation checklist guide used allowed harmonious capturing of both qualitative and quantitative data. Document analysis was also executed in order to get further information on pests. Different documents on pests, their description and how they are controlled and monitored, policies and preservation standards were scrutinized. Professional work experience of the researcher as a conservator, (7 years work experience), in the institution was also vital in the study.

Results and discussions

Deterioration of collections due to pests is one of the major barriers of information

accessibility in most libraries and archives. Fungi, insects and rodents are among the major pests which causes damage to collections. Segaletsho & Mnjama (2012) reported a significant evidence of presences of pests in UB-Library. While the library was aware of the presence of pests, the level or the extent to which collections are deteriorated due to pests was still to be ascertained. However, this paper presents the findings of a survey on monitoring/inspection focusing on types of pests' observable in the library, location and months on which the pests were observed. The paper further presents challenges, and prevention and control strategies adopted by the UB-Library.

First objective: Monitoring/inspection of Pests

The survey study conducted regular (every day in a week for the year 2013) inspections to collections for any signs of pest activity, particularly feeding and infestation. The focus of monitoring and inspection objective was on determining locations, types and months on which pests were observable in the UB-Library.

Types of pests

Different types of pests were observed at the UB library. The pest references (table 1) tabulates a significant number of pests including Badister Bullatus, Spider (Pholcidae, Cellar Spider, daddy long-legs spider, granddaddy long-legs spider, daddy long-legger etc), grasshopper, house cricket, birds-Dove (Columbidae), cockroaches, strawberry seed beetles, Flea, Silverfish, moth, ants and flies (Black and blue flies). Similar types of pests within the UB-Library main campus were also observed by Segaletsho & Mnjama (2012). General observation showed that these pests are among the most common

pests observed in most libraries and archives. Their damages are discussed in literature as one of the major challenges faced in preservation work. Harvey (1994) and Segaletsho & Mnjama (2012) posited that frequent observation of pests indicates that collections might be in danger of staining and tearing. Libraries and archives predominantly have paper materials as the major collection development. Paper materials are mainly organic composition with cellulosic glucose as the major monomer of the paper structure; therefore, the paper materials serve as food to pests.

Pest frequency

A plot of pests against frequency indicated that the most frequent pests observed in the library were the spiders particularly the Pholcidae or cellar spider which is observable in African continent. The spiders were observed 52 (34%) times followed by cockroaches 5 (7%) times, House Cricket 4 (5%) times, and Strawberry Seed Beetle 4 (5%) times (figure 1). Spiders are commonly found in dark and damp burrows in undisturbed areas in buildings, dry places, such as household windows and attics. They eat tegegnaria spider species, flies and other small species of insects (Orkin Pest Control, 2014). The ability of spiders to inhabit on both hot, dump and cold areas allows the spiders to be resistant to cold temperatures in Special Collections area. Significant numbers of cockroaches, silverfish and beetles suggested the possibility of deterioration due to pests eating and staining of materials. Different detailed damages that can be posed by these pests are discussed in literature (Harvey, 1994). Other pests were mostly observed incidentally in different locations. Detailed recommendations on improvement are stated below under pest reference section.

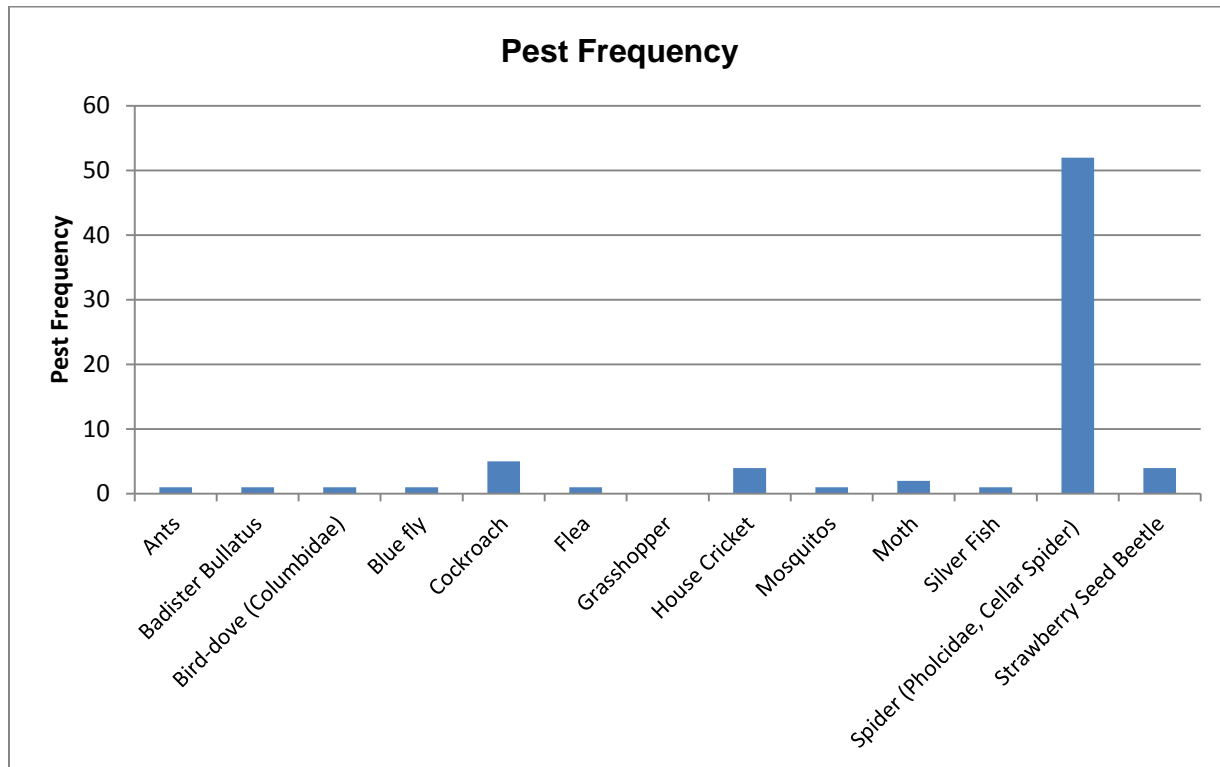


Figure 1 Plot of Pests against their Frequency in UB-Library Main Campus

Locational pest frequency

A plot of locational pest frequency indicated that most pests were observed in the Special Collection areas as shown in figure 2. Attributes to this observation are still to be ascertained. However it is suspected that this might be due to the fact that the Special Collections area is in the lower ground area and is exposed to too many doors to the outside of the building including the entrance to the auditorium, emergency exit doors and doors leading to the loading zone areas. The doors could be the major entrances for pests from the surrounding areas. Pests like cockroaches prefer dark, moist places to hide and breed. They live and feed in the dark. Cockroach droppings are usually visible during infestation but this was not yet observed in the library. Most cockroaches

observed were mainly within Special Collections areas and this could be due to excessive handling of food in Lower ground (LG) seminar rooms. However, this could not be affirmed since there was still no confirmative method to justify infestation of these pests within the library. However, there are possibilities that pests could be brought into the library through books which have been loaned to customers since they take them to the outside of the library building. Similarly, pests can be brought into the library building through infested collections that are donated to the library. It is therefore important that staff should always try by all means to inspect collections during arrival into the library. Local door seals (available from the local markets) were recommended to be used to minimize the possibility of pest entrance from the surrounding areas.

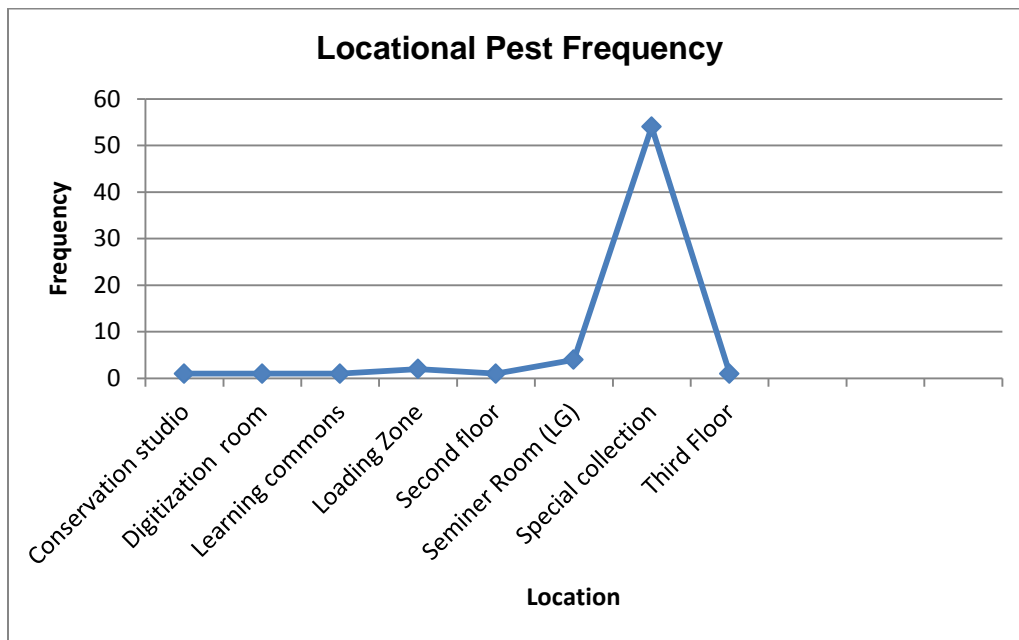


Figure 2 Plot of pest Location against frequency at UB-Library Main Campus

Pest monthly frequency

Another monitoring activity aimed at identifying which months of the year are mostly challenged by pest infestations. A plot of pest against their existence frequency indicated that most pests were observed around October and November (figure 3). A significant number of pests were also observed around June, July and August.

However, during the survey it was premature to predict if the pests were due to seasonal changes or other factors. One could associate the high increase of pests around October and November to be due to the fact that this is the period in which rains starts to rain and most vegetation start to be green providing food and shelter for most pests. The weather at these months is conducive for most pest infestation and survival.

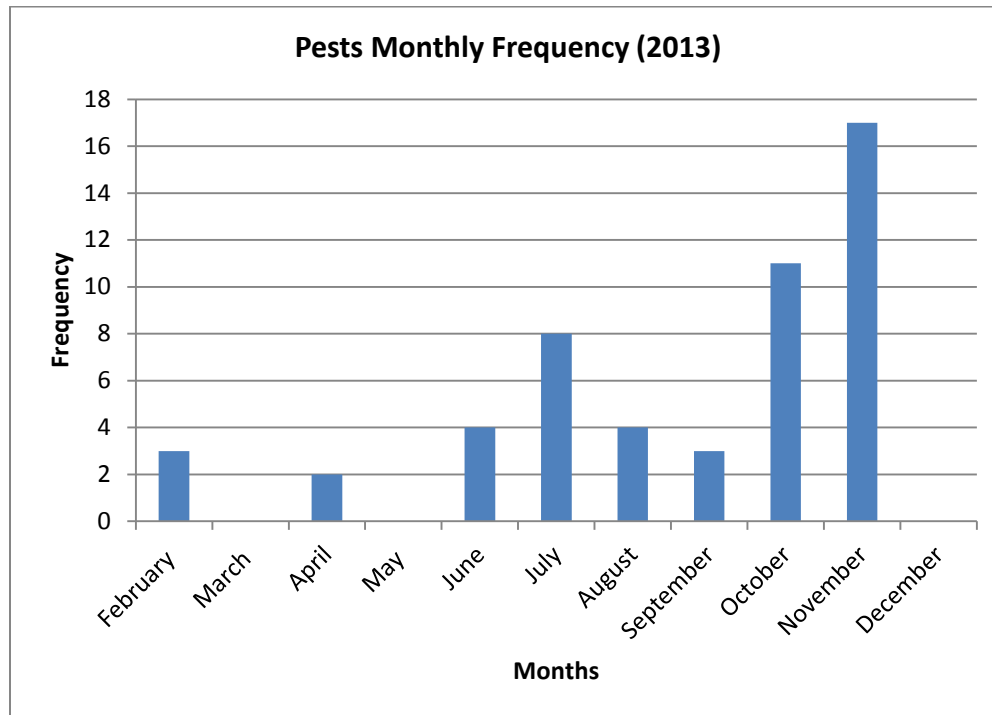





Figure 3 Plot of pests against their monthly frequencies in 2013



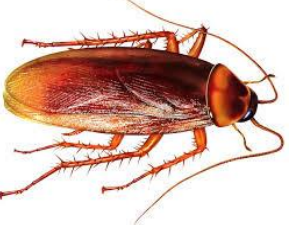
Second objective: pests prevention




The study revealed that UB-Library adapted a strategy of preventive methods which are very efficient, cost-effective and present little to no risk to people or the environment. These employed measures that discourage pests activity in the library building and surrounding areas. The UB-Library established a reference database of all pests observable in the library.



Information on description and nomenclature of pests was obtained from different sources available in the internet, journal articles, print and e-books and communication with colleagues and other related professionals. The UB-Library used the database as the pest reference on which names of pests, their description, prevention and their pictures are available for staff and public to consult (table 1).

Table 1 Pest reference at UB-Library

Pest Name	Pest Description	Pest Prevention	Picture
<p>Badister Bullatus</p>	<ul style="list-style-type: none"> • They have black head, bright orangey pronotum and orangey-brown elytra with black markings. • Found in moss or litter in a variety of habitats including ditch banks woodland and gardens • eat flies eggs, different types of plants, soft plant matter and insects 	<ul style="list-style-type: none"> • Presence of these pests shows indication of sources of food e.g. insects. Always do a thorough inspection of collection and always use vacuum cleaning to limit their sources of food. • Presence of the pests also indicates comfort in temperatures and relative humidity. • Inspect the surrounding, these pest might be migrating from the soundings and entering through open doors and windows. 	 <p>Badister Bullatus</p>
<p>Spider (Pholcidae, Cellar Spider, daddy long-legs spider, granddaddy long-legs spider, daddy long-legger etc)</p>	<ul style="list-style-type: none"> • Quite commonly found in dark and damp burrows in undisturbed areas in buildings, dry places, such as household windows and attics. • They eat Tegenaria spider species, and are known to attack and eat redback spiders and huntsman spiders. 	<ul style="list-style-type: none"> • Always do a thorough inspection of collections, dark and damp areas. • Always use vacuum cleaning and use further dusts to remove the spider webs. • A sign of the spiders might indicate presence of bucks and flies which they feed on. 	 <p>Spider</p>
<p>Grasshopper</p>	<ul style="list-style-type: none"> • Brown, with some darker markings. • Visible in spring and summer, but are most noticeable in the autumn. • Areas with many grasses, small "vacant" lots and gardens are good places to start looking. 	<ul style="list-style-type: none"> • These mainly survive in gardens, plants and other vegetations. Their presence in the building indicates easy access from outside the building. Always Inspect accessibility into the building. • Damages include staining and they might become source of food to other pests. 	 <p>Grasshopper</p>

Pest Name	Pest Description	Pest Prevention	Picture
<p>House Cricket</p>	<ul style="list-style-type: none"> Typically gray or brownish in color. Growing to 16–21 millimeters. Males and females look similar, but females will have an ovipositor emerging from the rear, around 12 millimeters (0.47 in) long (Orkin Pest Control, 2014). 	<ul style="list-style-type: none"> Are more likely to be found in warm ducts and in paneling behind heating installations. Always Inspect warm areas Crickets are eaten by lizards; their presence in the building might attract lizards. Their eggs are deposited in damp areas; water leakages should always be inspected. 	 <p>House Cricket</p>
<p>Birds-Dove (Columbidae)</p>	<ul style="list-style-type: none"> Pigeons and doves constitute the bird clade Columbidae, that includes some 310 species stout-bodied birds with short necks feed on seeds, fruits, and plants. They feed on grass, insects and pests. They build nests and reproduce by laying eggs. 	<ul style="list-style-type: none"> These mainly get into buildings through open windows, doors and any other openings of the buildings. Always avoid unnecessary opening of windows and doors to inhibit birds from easy entering. Alternatively use window shutters Inspect roofing for openings. Most birds make their nests in roofing's. Birds don't necessary eat paper materials but the damage caused includes insects/pests like fleas in them, staining by their remains and loose feathers all over. 	 <p>Dove (Columbidae)</p>
<p>Cockroach</p>	<ul style="list-style-type: none"> They prefer dark, moist places to hide and breed They live and feed in the dark. Cockroach feces will be visible during an infestation. 	<ul style="list-style-type: none"> Cockroaches are better at hiding than you are at finding them; always do a thorough inspection of collection. Their eggs are naturally protected from many over-the-counter insecticides. Without special equipment, materials and know-how, cockroach control can be a losing battle. Always use vacuum cleaning to remove eggs as much as possible. Avoid food dropping, stains, and any other source of food. 	 <p>Cockroach</p>

Pest Name	Pest Description	Pest Prevention	Picture
<p>Strawberry Seed Beetle</p>	<ul style="list-style-type: none"> • 11-16mm. Black and dull but with the elytra covered with short yellowish hairs. • Legs and antennae are reddish-brown. • Very often found under stones and logs in open, dry situations, especially arable fields • They lay eggs in weedy soil (Orkin Pest Control, 2014). 	<ul style="list-style-type: none"> • These pests mainly eat seeds of fruits and insects. Always inspect surrounding areas for falling seeds from trees and monitor their access to the building. • Use door seals and window seals to avoid easy entrance. • Their presence in the building might also indicate presence of other pests. 	 <p>Strawberry Seed Beetle</p>
<p>Flea (are insects forming the order Siphonaptera)</p>	<ul style="list-style-type: none"> • You can identify them by their dark brown color. They are wingless, with mouthparts adapted for piercing skin and sucking blood. • Fleas are external parasites, living by hematophagy of the blood of mammals and birds. • They go through the four life cycle stages of egg, larva, pupa, and imago (adult). 	<ul style="list-style-type: none"> • Always do a thorough inspection of collection; fleas can hide under mats with fur. • Their presence might be due to presence of small mammals like squirrels' and birds which might be hiding in roofing. • Their damage is mainly staining and eggs. Always use vacuum cleaning. • Fleas also sucks human beings causing itching and some people and animals suffer allergic reactions to flea saliva resulting in rashes. 	 <p>Flea</p>
<p>Silverfish</p>	<ul style="list-style-type: none"> • A small, wingless insect in the order Thysanura. • Silverfish are nocturnal insects typically 13–25 mm (0.5–1 in) long. • They inhabit in moist areas, requiring a relative humidity between 75% and 95% (Orkin Pest Control, 2014). 	<ul style="list-style-type: none"> • Presence of silverfish might indicate comfort in temperatures and relative humidity • Always inspect for water leakages and dump areas that might encourage presence of silverfish • Clean thoroughly since they can be source of food to other pests and insects. 	 <p>Silverfish</p>

Pest Name	Pest Description	Pest Prevention	Picture
<p>Moth</p>	<ul style="list-style-type: none"> • An insect related to the butterfly. • Nocturnal insectivores often feed on moths; these include bats, some species of owls and other species of birds. • Moths are also eaten by some species of lizards, cats, dogs, rodents, and some bears. 	<ul style="list-style-type: none"> • Presence of moth might invite presence of other insects and rodents; always remove moths from the building. • Use door seals and window seals to avoid easy entrance. • The surrounding areas might be having vegetation which attracts moths, always monitor surroundings to avoid easy access to the building. 	 <p>Moth</p>
<p>Flies (Black and blue flies)</p>	<ul style="list-style-type: none"> • Different types observed in the region • They eat also most anything eaten by human beings • Survives mostly in summer 	<ul style="list-style-type: none"> • Always keep windows and doors closed if necessary. • Use flies' traps • Maintain clean environment. • Flies are source of food to other pests, they can stain both collections and walls, it is, therefore, important to eradicate flies immediately when observed in building. 	 <p>Blue Fly</p>

Source: field data, 2014

Third objective: pest control

In cases where pests were observed to be frequently appearing, investigations indicated that the UB-Library aimed at applying immediate pest control and prevention of pests from further infestation. For example, towards May 2014 the library had an outbreak of termites, and cockroaches which needed agent eradication. The library decided to consult Pest Control specialists around in order to use pesticides to kill the pests. The Preservation Advisory Center (British Library, 2012) posited that during pest control measures the choice of remedial treatment depends upon the severity of the infestation, the type of material and the value of the

items. As such, UB-Library considered an adoption of a pest control activity bearing in mind that the consultant company provided information on the type of pesticides and insecticides used; their decay periods, side effects, and details of how to monitor the chemicals used. The activity involved installation of tamper proof bait stations and the rodents were given 4-5 weeks for full eradication. The IPM program then continued to evaluate pests' existence and monitor the treated areas in order to remove dead rodents that may produce offensive odour.

Fourth objective: challenges observed at the UB-Library IMP programme

Literature has continuously observed different challenges on preservation programs amongst which include pests' control issues uh as economic crises, lack of funding, political and social challenges, educational and technical issues (Appelbaum, 1991). Similar trends of challenges were also observed in the IPM program at UB library. During the process of the survey, the study observed that limited resources and financial incapability made it difficult to monitor and inspect certain areas of the UB-Library. Among others, this was due to shortage of instrumentation, lack of knowledge and skills on pests and limited financial support. Furthermore the UB-Library suffered from minimal information on pest monitoring statistics. The same general preservation challenges have been also expressed by varied researchers in literature (Ngulube, 2005). One such challenge to the UB-Library was that pests' infestations attributed to food existence in the library were still not well understood, henceforth monitoring eating and use of food still remained a challenge and the same gap was observed by Segaletsho & Mnjama (2012). Lack of supportive structures such as funding procedures, prioritization, policies statements on pests and proper coordination of IPM programs was observed as major challenges. Equally importantly the use of pesticides during the control measures of the UB-Library program posed the library to the concerns over indoor air quality, increasing sensitivity to certain chemicals either through inhalation or physical contact, and increasing allergic reactions to a wide variety of products and dangers to human health which can culminate into death.

Fifth objective: recommendations for improvement

This study recommends that, subsequent to the outcomes of the initial steps of the UB-Library IPM programme, the library should produce detailed guidelines governing the management and control of pests. First and foremost, the UB-Library should come into the common grounds that Integrated Pest Management programme should be regarded as the cost effective and environmentally friendly activities that vest upon eradication or control of pests within the library collections. Given the challenges of shortage of instrumentations and finance, this should be a daily activity which involves inspection of collections, areas inside the storerooms, library floors, and seminar rooms, learning commons areas/circulation area, repositories, library kitchen and surroundings of the buildings. The program should provide effective early inspections and identification of warnings of infestation, identify high risk areas within collection and the surrounding buildings and pin point environmental sources of infestation. Furthermore, the programme ought to allow for monitoring of effectiveness of treatments and eliminate infestation of items incorporated into the collection. In so doing, institutions should adopt the following recommendations as the major steps in implementing IPM programs;

- **Setting an Action Threshold;** this should be a set of point number of the population on which the sighted pest will be regarded as a threat. This could be determined through continuous monitoring and provision of databases on the pests that would be observed.
- **Monitoring/Inspections;** these should be conducted at regular intervals (everyday in a week) to check the collection of any signs of pest activity, particularly feeding.

- Choosing a very representative sample of the collection to work with. The sample could be chosen based on the type of collection and risk factor attached to each type of collection.
- Having a standard procedure outlining what the inspector should look for should be in place (U.S. Environmental Protection Agency, 1993 & British Library, 2012). This could be included in the pest reference database.
- Presenting the results of inspections should be presented in a 'Pest Reference' database which will include recommendations on how to deal with whatever situation was discovered.
- Ensuring that the conditions inside the storerooms are not conducive to pest activity. These conditions include low temperatures, appropriate relative humidity, no dust etc.
- Ensuring that the presence of pests is detected at an early stage, possibly before the collection is attacked. This could be done by placing traps in strategic places in the storerooms and checking them every day. Identification and recording of numbers of these pests should be done daily. These pests (or possible pests) should be put together to form a reference collection for pest control. The results in the databases could be used to decide whether or not there is a risk of infestation by pests, and whether to engage control measures or not.
- Inspecting all items that are acquired from outside. During the inspection the items should be treated with consideration that most pests have four life stages and resistance to treatment depends on the stage at which the pest is in. In order to achieve this point, the British Library (2012) has freeze rooms on which pests' infestation is controlled.
- **Prevention;** These prevention methods can be very effective and cost-efficient and present little to no risk to people or the environment. The Chicora Foundation (1994) stated that prevention measures should employ measures that discourage pests' activity in the library building and surrounding areas. These include clearing all areas around the Library building in order to make the building free from vegetation growth and be kept clean at all times. Vegetation harbours insects (all life stages), which makes it difficult to detect any possible pest activity around the library.
- Always switching off lights when not needed. Lights attract a whole lot of insects, including pests and should be kept away from building where possible. The insects gather around light at night and have to retreat somewhere during the day and possibly feed or undertake other life related processes. Cracks on the walls should be filled as these are good hiding places for most pests (U.S. Environmental Protection Agency, 1993)
- Breaking of the lifecycle of all identified pests that are regarded as a threat is important.
- **Control;** once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, IPM programs should then evaluate the proper

control method both for effectiveness and risk. The British Library (2012) suggested that in cases of quarantine, deep freezing for a period not less than 7 (seven) days followed by treatment with insecticide to kill the surviving adult pests are paramount in pests' control.

- Any pests discovered in items should be collected, identified and incorporated into the pest reference collection for pest control.
- In case of using contracted companies, the library should always inspect pesticides used. Among others, this should include clear specifications on; Manufacturing dates of the pesticides, decay rate and expiry dates, chemicals used, and monitoring and inspection of the pesticides used.

As an argumentation to the above recommended procedures, institutions should have clear outlines of financial funding strategies, management and planning of IMP activities, and the preservation policies should have clear statement of intent that captures pest management. The means of monitoring and controlling pests in most African libraries and archives are limited in literature. Though many Writers have indicated observation of pests in many libraries and archives in Africa, little, if not nothing, has been said on Integrated Pest Management (IPM) strategies for heritage institution in Africa. It is therefore recommended that further studies be conducted on how to implement, manage or coordinate pest management programme in heritage institutions.

Conclusion

This survey indicated that a significant number of pests including *Badister Bullatus*, Spider (*Pholcidae*, Cellar Spider, daddy long-

legs spider, granddaddy long-legs spider, daddy long-legger etc), grasshopper, house cricket, birds-Dove (*Columbidae*), cockroaches, strawberry seed beetles, Flea, Silverfish, moth, ants and flies (Black and blue flies) were observed at the main campus UB-Library. This was attributed to the then apparent weaknesses in the management of pests within the library. The observed pests at UB-Library have been also observed in literature. Among others, challenges observed in the IPM program include minimal information on pest monitoring statistics. Nevertheless, observations indicated that the library should be worried about the pests' infestation levels. Significant numbers of pests were observed in the Special Collections area which is the main section that holds the library heritage collections and has too many neighboring doors leading to the outside of the building. One such challenge to the IPM program was that Pests' infestations attributed to food existence in the library were still not well understood. This was something that needed to be addressed in future. As a result, implementation of the proposed IPM guidelines on monitoring, prevention and control of pests remains paramount for the UB-Library and other institutions for successful control of pests. Consequently, the UB-library IPM program still need further investment on using suitable equipment like pest traps. In a nut shell, the UB-Library collections have the potential to be damaged due to inadequate pest monitoring and control measures in place. Therefore the findings of the survey suggests that the UB-Library and other institutions elsewhere should continue strategizing IPM programme activities on funding, management, prioritization and planning in order to remedy pests' damages.

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