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Pest Control in Natural History Museums; A World Survey

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Museums contain considerable material resources of scientific, historical and educational importance. However, the organic composition of certain museum objects represents a potential food source for a range of pests, notably insects. Damage to zoological and botanical material, textiles, books, paintings, wooden artifacts, furnishings and buildings can result from the feeding, burrowing and defaecating activities of pests, causing damage ranging from minor, localised deterioration of individual objects to extensive and total destruction of entire collections. Traditionally, museums have relied on the application of chemicals as the principal strategy for prevention and control of pest infestations in collections; however, concern has been raised over the effectiveness of such treatments, hazards to human health (Croat,1978; Peltz and Rossol,1983; Irwin,1987; Williams and Walsh,1989), and potential damaging influences on specimens and materials (Jedrzejewska, 1967; Tilbrooke, 1978; Zycherman and Schrock, 1988; Hammick, 1989).

Until recently, little research had been undertaken on problems associated with pests in museums. A survey of pest control practices used in 27 New York city museums indicated that staff had little knowledge of the hazards, precautions and regulations relating to the use of pesticides (Peltz and Rossol,1983). Earlier, the Association of Systematics Collections surveyed pest control practices in American museums and published the results in 'Pest Control in Museums' - a status report (Edwards, Bell & Stanley, 1980). This represented the first comprehensive guide to pest control in museums and included the range of chemicals used, reactivity with materials and pests encountered, although information was not requested on health and safety aspects of pest control policies. Stansfield (1985) reported that no comprehensive survey had been undertaken to determine the status of collections in Britain and that inadequate information and few recommendations existed for pest control management programmes in museums. Linnie (1987) subsequently surveyed pest control policies in 89 museums throughout Great Britain and Ireland; however, little information remained on the status of collections worldwide.

To clarify the situation and establish priorities for further research, a survey of selected natural history museums worldwide was undertaken during 1987 and 1988. The survey was directed primarily at museums with holdings of zoological and/or botanical material. Information was requested

on building design and environmental conditions relating to control of pests, types of pests found, damage caused, collections affected, existing control strategies and the effects if any, of control practices on personal health. The six-page questionnaire used is reproduced at the end of this paper (*Figures 8-10*)

Results

The survey focused primarily on national, regional, city and university museums. A circulation list of 121 natural history museums worldwide was compiled from the Directory of Museums and Living Displays (Hudson and

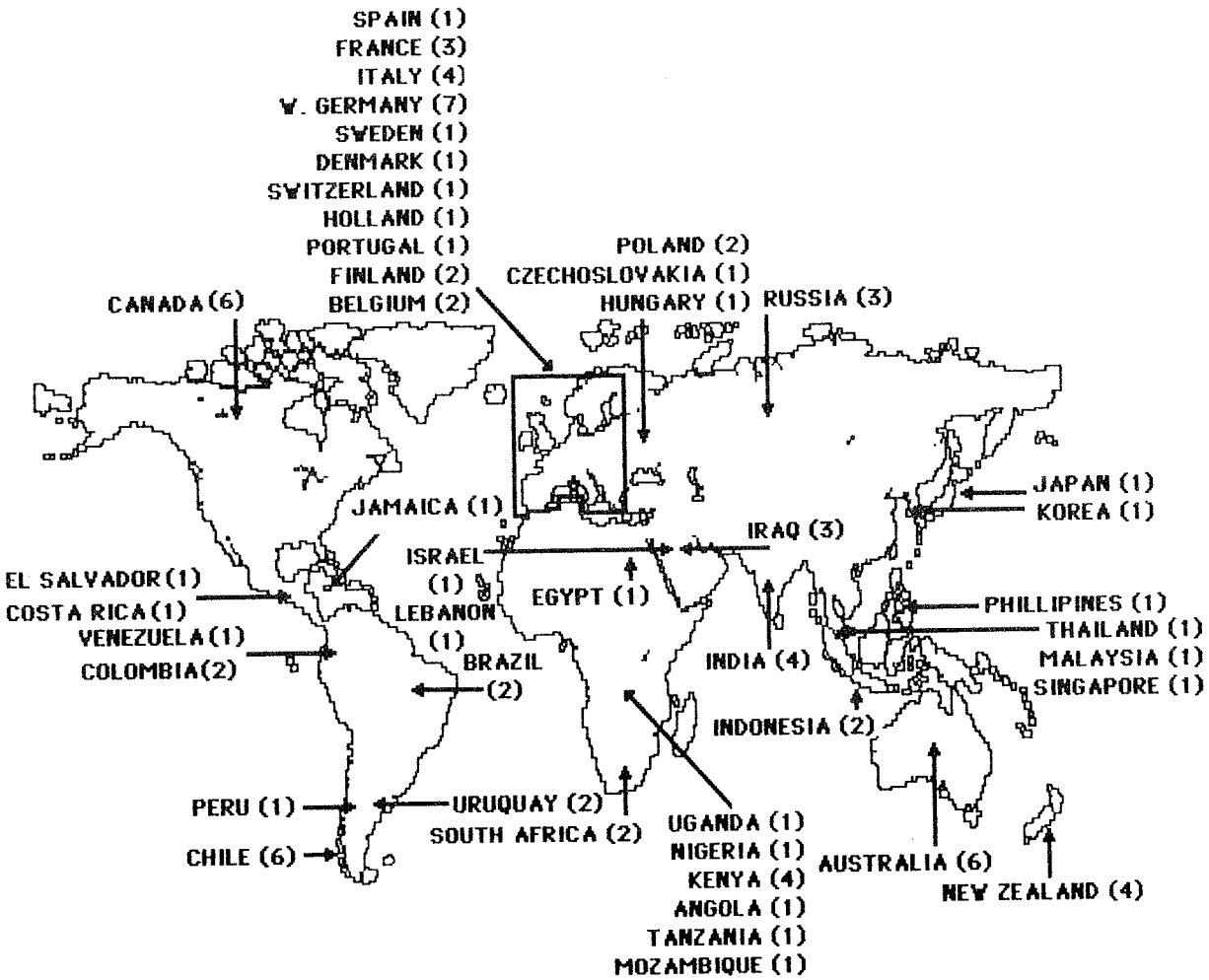

Fig. 1. Numbers and distribution of museums surveyed.

Nicholls, 1985). The United States, Great Britain and Ireland were excluded from the mailing list as they had been surveyed by previous workers (Edwards, Bell and Stanley,1980; Linnie,1987). From the 121 museums contacted, 92 completed questionnaires were received representing 72 museums in 46 countries (*Figure 1*). The results outlined represent percentages of completed returns and refer primarily to dried, perishable collections of animals and plants.

Types of collections managed by respondents.

The survey was directed primarily at museums containing collections of zoological and /or botanical material. However, although zoological collections were managed by 79 per cent of those surveyed, the majority of respondents were responsible for more than one type of collection. Botanical collections were managed by 22 per cent of respondents followed by anthropological/ethnographical collections by approximately 16 per cent. Other collections managed include decorative arts (1 per cent), technological (1 per cent), mineral (6 per cent) and palaeontology collections (3 per cent).

Quantities of specimens held in museums.

Collections varied in size from small museums with fewer than 5,000 specimens to national and regional museums with several million specimens (*Figure 2*). Thirty one per cent of the museums surveyed have over one million specimens in their care.

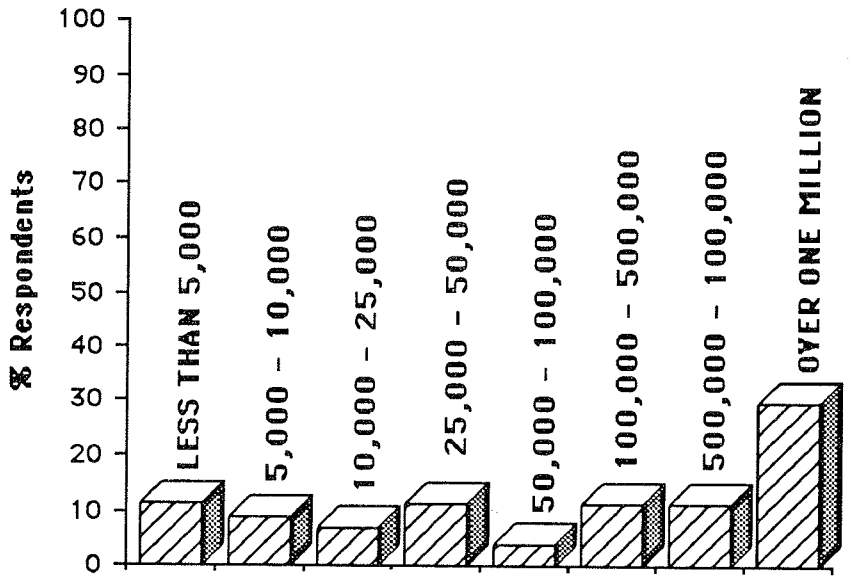

Fig. 2. Approximate quantities of specimens held by museums

Types of storage containers used in museums.

A wide range of storage containers and display cases are used in museums. Wooden storage units (92 per cent), large exhibition type cases (74

per cent) and enclosed drawers within cases as in entomological collections (62 per cent) are the most widely used. Metal storage case are used in 50 per cent of the museums surveyed and a considerable amount of material is stored on open shelving (35 per cent). Cardboard boxes are used to store specimens in 8 per cent of museums.

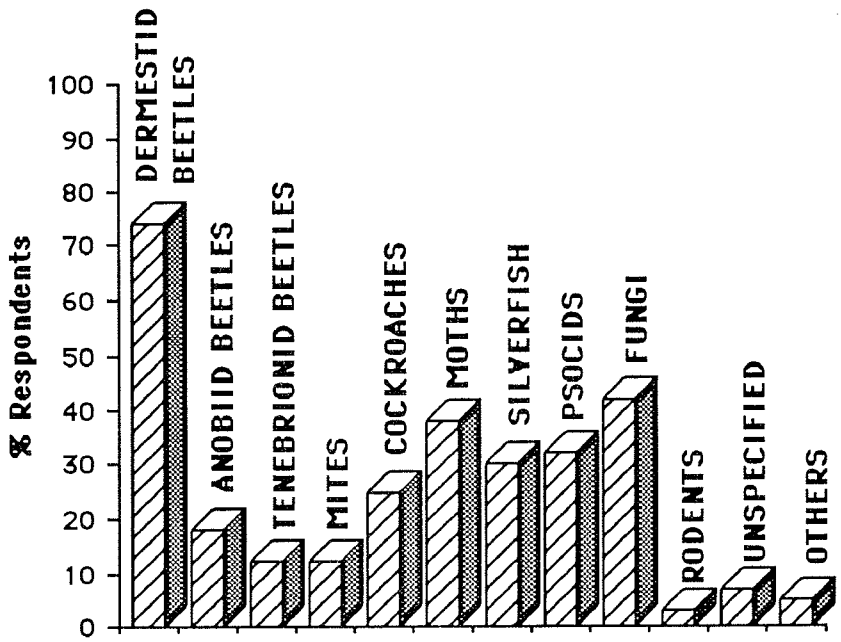

Fig. 3. Range of pests encountered in museums

Pests fully identified and described as 'serious' problems were;

COLEOPTERA	: Dermestidae	Trogoderma angustum (Solier)	1 account
		Reesa vespulae (Milliron)	3 accounts
		Anthrenus verbasci (Linnaeus) 'Varied carpet beetle'	2 accounts
		Anthrenus sp.	7 accounts
		Attagenus sp.	2 accounts
	: Anobiidae	Stegobium paniceum (L.) 'Biscuit' or 'Drugstore beetle'	2 accounts
		Lasioderma serricorne (Fabricius) 'Cigarette beetle'	2 accounts
	: Tenebrionidae	Tribolium sp.	1 account
LEPIDOPTERA	: Tineidae	Tineola bisselliella (Hummel) 'Common clothes moth'	1 account
RODENTIA	: Muridae	Mus sp.	1 account

Table 1

Environmental conditions reported in museums.

Eighteen per cent of respondents reported controlled temperature levels throughout their museums including storage and display areas while 11 per cent reported controlled humidity levels, although little information was provided to indicate if such controls were dictated by specific collection requirements. Twenty one per cent of museums have some method of recirculating air although only 8 per cent use air filtration units. Fifty nine per cent of museums have storage areas with windows opening directly to the building exterior with no evidence of screening to prevent pest entry, while 17 per cent have doors in storage areas which open directly to the outside.

Range of pests encountered in museums.

Ninety seven per cent of respondents reported evidence of past or recent pest infestations, with the hide, bacon and carpet beetles, (Coleoptera/Dermestidae) the most widely encountered and distributed affecting 54 museums in 37 countries. Twelve different 'groups' of pests were reported by respondents (*Figure 3*). Of these, the Dermestidae were considered the most serious threat to collections by 47 per cent of respondents followed by 'moths' at 17 per cent, and anobiid beetles (Coleoptera/Anobiidae) at 10 per cent. Other pests which created serious problems for some museum workers although at very low occurrence rates included, mites, psocids, flour beetles, rodents and miscellaneous unidentified beetles. Fungi, although not strictly pests, presented 'serious' problems for 19 per cent of respondents and are therefore included in the results. The pests fully identified and described as 'serious' problems are shown in Table 1.

Damage to museum specimens and materials caused by pests.

Damage to collections resulting from the activities of pests was reported by 78 per cent of respondents. Most of this damage (35 per cent) which ranged from minor isolated accounts to major and extensive damage to entire collections was caused by Dermestidae (*Table 2*). Thirteen per cent of those surveyed attributed the total loss of insect and other collections to Dermestidae.

Reesa vespulae, (Coleoptera/Dermestidae), a parthenogenetic species responsible for extensive damage to insect and herbaria collections in Finland (Makisalo, 1970; Hamalainen and Mannerkoski,1984), was positively associated with three separate accounts of serious damage to insect and bird collections while freeze dried material was also attacked. Other damage caused by the range of pests listed includes weakening and surface damage to ethnographical material, loss of strength and appearance of holes in wooden artifacts, the complete destruction of a collection of musk-ox horns and the general spoiling of objects due to accumulation of insect frass, while the value of one particular collection was seriously undermined by the destruction of labels and information material caused by mice. Fungi were responsible for general degradation of zoological, botanical and ethnographical material including severe discolouration and staining of specimens.

Pest Group	Main collections affected	Extent of damage	Occurence rate (%)	Comments
Dermestidae (hide , bacon and carpet beetles)	Skins, mounted specimens, dried insect collections, skeletal material.	Minor and localized to total destruction of material	35	Mostly by 'dermestids', also included Anthrenus spp., Attagenus spp., and Reesa vespulae
Anobiidae (furniture beetles)	Pulverization of dried plants, powdering of wooden arefacts, holes in herbarium sheets and wooden artefacts.	Minor to serious	7	Caused by Stegobium paniceum and Lasioderma serricorne
Moths	Fur and feather loss in mammal skins. Insect collections and ethnographical material	Minor to serious	13	Feather and skin damage by Tineola bisselliella
Psocoptera ('booklice')	Insect and botanical collections	Minor to total destruction	4	Cruciferae and Ranunculaceae affected
Fungi	Zoological, botanical and ethnographical collections	Minor to serious	20	Disfigurement, discolouration and staining of material. Weakening and rotting of wooden artefacts.

Table 2

Suspected source of pest infestations in museums.

Forty seven per cent of respondents directly associated pest infestations with the integration of new acquisitions and the return of loan specimens while 37 per cent linked pest entry with ventilation systems. Other suspected modes of entry were associated with visitors clothing (one account), entry through unscreened windows (three accounts) and one account of entry from a birds nest in a museum wall. Two accounts of collection damage were attributed to endemic pest populations within other areas of the museum. Thirty eight per cent reported a seasonal pattern in the occurrence of infestations with noticeable increases in late spring and early summer.

Pest control strategies used in museums.

In the majority of museums surveyed, 83 per cent use some form of pest control strategy and 80 per cent reported the use of pesticides in collections. However, non-chemical methods including humidity and temperature controls are also used (*Figure 4*). Pesticides are used in fumigant treatments and for ongoing residual protection in display and storage cabinets. Forty eight per cent of respondents use three or more different pesticides with naphthalene and p-dichlorobenzene (PDB) being the most widely used substances (*Figure 5*). Dichlorvos, (2, 2-dichlorovinyl dimethyl phosphate) in the form of polyvinyl chloride slow-release resin strips is also in popular use but uncommon in

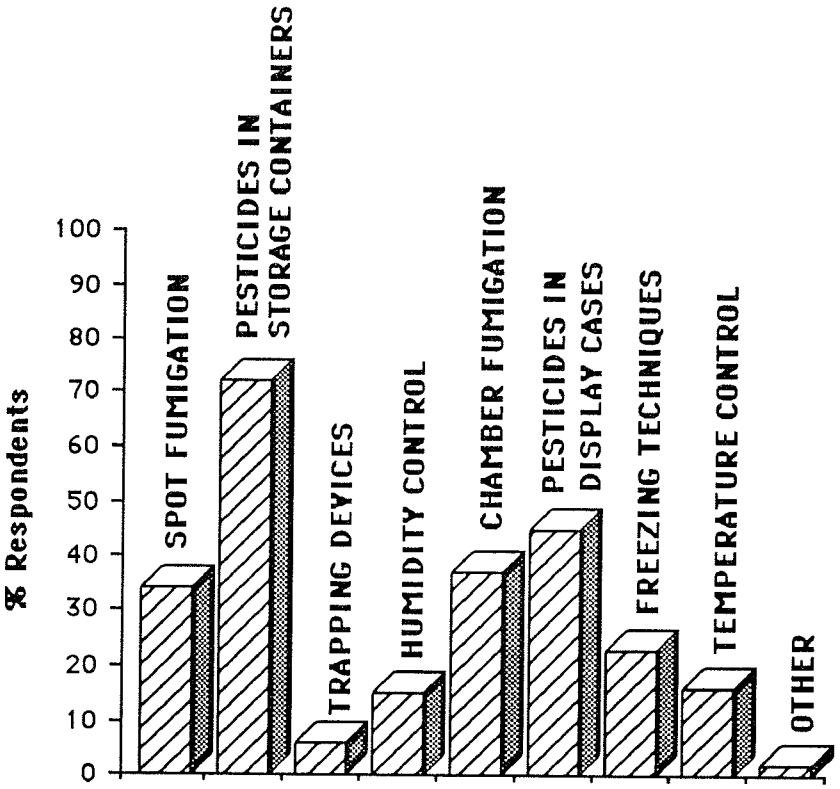

Fig. 4. Pest control strategies used by museums.

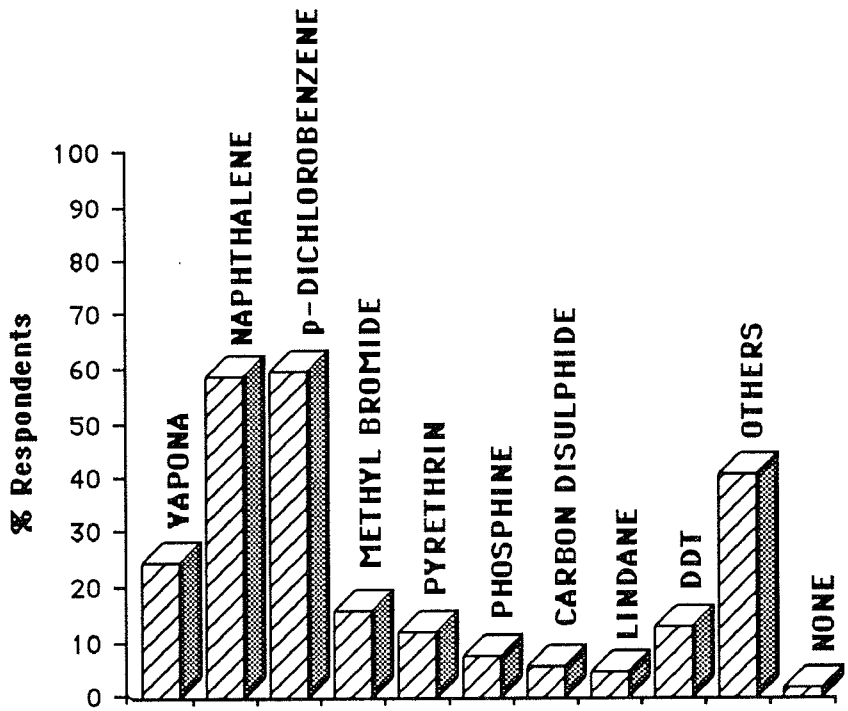

Fig. 5. Chemicals used in museums to protect collections.

Asian and African museums. Other substances recorded but of minor use include, ethylene oxide, magnesium phosphide, eulan, camphor, phenol, alcohol, formaldehyde, cobalt acid, creosote, aluminium phosphide, carbon tetrachloride, magnesium chloride, silica gel and thymol.

One account of arsenic was reported and 13 per cent of respondents reported the presence of DDT in collections but it is not clear if these substances are still being applied. DDT, an organochloride insecticide received considerable use in museums in the past but has now largely been withdrawn because of associated health and environmental risks. However, because of its persistent, residual properties it may remain in museum objects for considerable time (Dawson, 1987). Studies into the use of DDT have shown that trace amounts of hydrogen chloride and chlorine can be produced by this substance under normal conditions. The rate of production can be increased by light, heat, and the presence of catalysts such as aluminium, chromium and certain iron salts (Metcalf and Flint,1962; Martin and Worthing, 1977).

Despite the number of infestations attributed to new accessions (47%), only 37 per cent of respondents routinely fumigate or otherwise screen incoming material for potential pests , while 37 per cent treat collections 'only if infestation is suspected'. Pesticides are replaced or topped up 'only when needed' by 38 per cent and between three and six months by 30 per cent. While 45 per cent of respondents apply pesticides in predetermined quantities or concentrations 42 per cent do not specifically control or measure the

amounts used. Respondents choose pesticides and other chemicals used for a variety of reasons including apparent effectiveness (66 per cent), availability (36 per cent), ease of handling (36 per cent), traditional reasons (30 per cent), safety (30 per cent), economical reasons (22 per cent), and legal obligations (13 per cent).

Effects of pesticides on museum specimens and materials.

Thirty four per cent of respondents reported 'noticeable' changes in specimens related to the use of pesticide treatments while 36 per cent recorded adverse effects on storage and display materials. Accounts of specimen discolouration were attributed to PDB (2 accounts) and with naphthalene, formalin, phenol, carbon tetrachloride, DDT and carbon disulphide (single accounts). General deterioration of specimens was reported by 5 per cent and was associated with naphthalene, arsenic acid, phenol, formalin and neocidal 60. Recrystallisation of pesticides (mainly PDB and naphthalene) onto specimens was reported by 28 per cent of respondents. Paper discolouration reported by 10 per cent of workers was linked with naphthalene and naphthalene impurities, arsenic, phenol, camphor and PDB.

Ten per cent of respondents reported the melting of pinning foam associated with the use of PDB. Single occurrences of melted pinning foam were also linked with carbon disulphide, phenol and carbon tetrachloride, while adverse effects on plastics also including melting, were observed by 12 per cent. These were attributed mainly to PDB (8 per cent), but also phosphine, phenol, carbon disulphide, carbon tetrachloride, and vapona. Corrosion, mostly affecting pinned insect collections was reported by 11 per cent of respondents and linked with PDB, carbon disulphide and vapona. Other effects reported include the 'fogging' of glass in display and storage cabinets caused by PDB and 'unsightly' brown deposits caused by naphthalene.

Health and Safety.

Respondents were also requested to provide information on personal medical ailments which they associated with their particular occupational conditions and practices. The results are primarily drawn from the personal experiences and opinions of the particular respondents and not on actual medical reports. Where diagnosis has been confirmed by medical opinion, this is stated in the text.

Respondents claimed to be of satisfactory health ranging from 'average' to 'excellent' although 71 per cent attributed some form of medical ailment to working conditions, while 46 per cent reported more than one recurring ailment. Complaints included digestive disorders, headaches, sore throat, sore eyes, chest pains, dizziness and dermatitis. Factors attributed to these conditions include ambient temperature (17 per cent), ambient humidity (17 per cent) and pesticide and chemical usage (47 per cent). Other contributory factors but considered of minor importance include prolonged microscope use, dust particles, specific allergies, fluorescent lighting and ambient pollution.

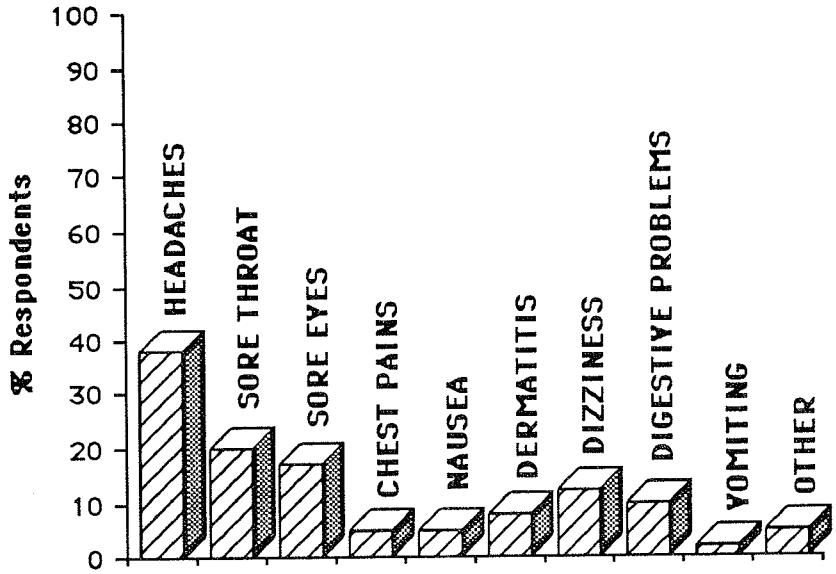

Fig. 6. Medical complaints associated with use of chemicals.

Pesticide and chemical usage were frequently associated with headaches, sore eyes, and sore throat (*Figure 6*) while other complaints included dermatitis, loss of smell and sensitivity to naphthalene, dizziness, digestive disorders, skin and nasal irritation, breathing problems, chest pains and general body weakness. One incidence of hepatitis was associated with pesticide usage and another worker reported a severe glandular throat reaction after exposure to methyl bromide following chamber fumigation of specimens (medical diagnosis). Twenty six per cent of respondents reported medical complaints in colleagues associated with the use of pesticides. The main complaints noted in other workers include headaches (15 per cent), dizziness, dermatitis, sore eyes and sore throat, while reports of nausea, chest pains and digestive orders were also reported. Of major concern was one report of exposure to phosphine which induced vomiting and chest pains and resulted in lung, heart and immune system damage (medical diagnosis). Other incidents included the loss of consciousness in one worker caused by exposure to naphthalene, while two cases of vomiting caused by exposure to PDB and naphthalene were also reported (medical diagnosis). Symptoms associated with pesticide usage generally occurred when working in particular areas or when working with particular materials. Thirty per cent of workers associated their medical complaints with the application of pesticides, the handling of museum material previously treated with pesticides and with working in close proximity to areas of pesticide usage.

PDB and naphthalene being the most widely used substances were also associated with the majority of complaints particularly in relation to headaches, sore eyes, sore throat and dermatitis. Other substances associated with medical complaints include dichlorvos, phosphine, phenol, and formaldehyde.

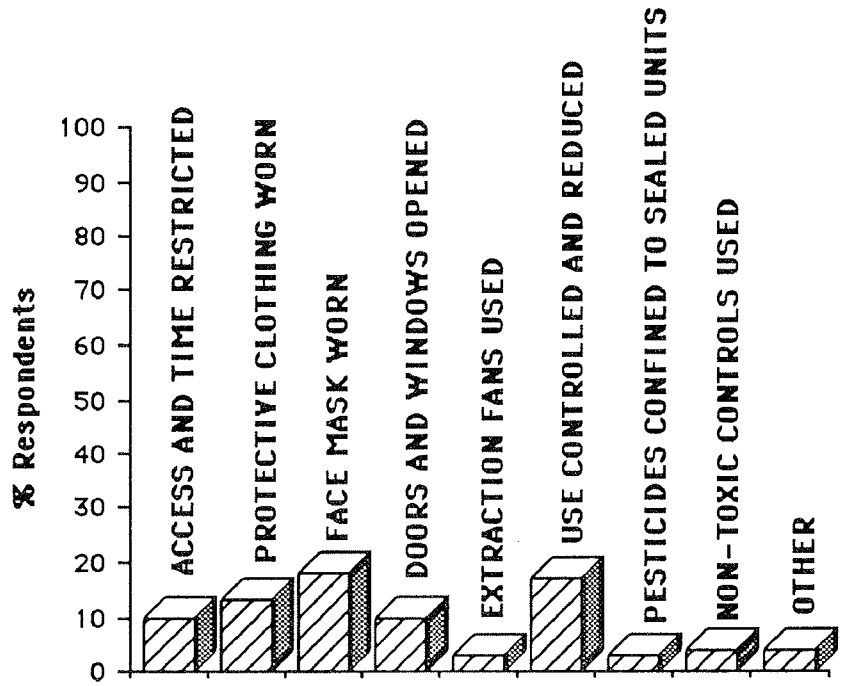

Fig. 7. Precautions taken to reduce exposure to chemicals

Precautions taken to minimise health risks associated with pesticide usage were taken by 67 per cent of respondents and included the use of face masks, protective clothing and the ventilation of work areas (Figure 7). Other measures taken involved controlled or restricted access to storage areas and the provision of special drinks (usually milk) after work with pesticides. Alternative control methods using sub-zero temperature, microwave and gamma radiation were also reported but did not produce adverse symptoms.

Discussion

The quantity and value of museum specimens and materials damaged or destroyed by pests is difficult to assess, however information gathered in this and recent surveys suggests that many important collections are under serious threat of irreversible damage through attack by pests, particularly insects. Various authors have proposed integrated pest management schemes for use in museums (Story, 1986; Zycherman and Schrock, 1988; Pinniger, 1989). These are designed to minimise the use of chemicals through a targeted approach concentrated on preventive rather than remedial action and although some are restricted to specific collection types, they contain common guidelines which may be applied to collections generally.

The results indicate that by introducing more stringent requirements for the treatment of incoming museum material, and improving the pest proofing of buildings, the potential for the entry of pests into the museum environment could be significantly reduced.

The majority of respondents expressed concern over the use of chemicals in museums, particularly in relation to potential adverse health effects. While this has highlighted the need for research into non-chemical methods of prevention and control, virtually all of the museums surveyed continue to use chemical methods for the protection of collections against pest attack, despite chemical usage being linked with a range of medical ailments by 47 per cent of respondents. These complaints were most frequently associated with p-dichlorobenzene and naphthalene.

Despite variations in legislative policy regarding the use of chemicals in museums throughout different countries, there is a general trend towards a gradual reduction in usage. Several substances previously cleared and considered safe for museum applications are now recognised as hazardous to health (Hall,1988) and as safety threshold limits move increasingly downwards (Health and Safety Executive,1985) this may lead to a reassessment of collection management policies. Against this background, there is now an urgent requirement to research safe, workable methods of both chemical and non-chemical pest control methods feasible for museum situations and to provide sufficient resources to allow implementation of integrated pest control strategies.

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References

Edwards, S.R., Bell, B.M. and Stanley,E.M. (1980). Pest control in museums: a status report.
Association of Systematics Collections: Lawrence, Kansas.

Croat, T.B. (1978). *Survey of herbarium problems.* Taxon. **27**: 2/3 pp. 203 - 218.

Dawson, J.E. (1987) *Dealing with the insect problem in museums: chemical control.* CCI Technical Bulletin, **No. 15.**

Hall, A.V. (1988) *Pest control in herbaria.* Taxon. **37**: 4, 885 - 907.

Hamalainen, M. and Mannerkoski, I. (1984).*Occurrence and distribution of dermestids (Coleoptera, Dermestidae) in Finland.* Not. Ent. **64**:167-184.

Hammick, S. (1989). *Dichlorvos resin strip fumigation* Supplement to the Textile Conservation Newsletter, Canada.

Health and Safety Executive (1985). *Occupational exposure limits, guidance note EH 40/85.* HMSO: London.

Hudson, K. and Nicholls A. (1985). *The directory of museums and living displays (3rd ed.).* Macmillan Pub. Ltd.

Irwin, R.R. (1987). *The hidden menace of PDB.* Amat. Ent. Soc. 1220.

Jedrzejewska, H. (1967). *The damaging influence of disinfecting agents on sensitive ancient materials.* Contributions to the London conference on museum climatology, pp. 95-101.

Linnie, M.J. (1987) *Pest Control: A survey of natural history museums in Great Britain and Ireland.* Museum Management and Curatorship. **6**, 277-290.

Makisalo, I. (1970) *A new pest of museums in Finland - Reesa Vespulae Mill. (Col., Dermestidae).* Ann. Ent. Fenn. **36**: 4. pp. 192 - 195.

Martin, H. and Worthing, C.R. (1977). *Pesticide manual (3rd ed).* London: British Crop Protection Council.

Metcalf, C.L. and Flint, W.P. (1962) *Destructive and useful insects: their habits and controls.* (4th ed., revised by R.L. Metcalf). New York: McGraw- Hill Book Co. Inc.

Peltz, P. and Rossol, M.S. (1983). *Safe pest control procedures for museum collections.* Centre for Occupational Hazards, New York.

Pinniger, D. (1989) *Insect pests in museums,* Institute of Archaeology Publications, London.

Stansfield, G. (1985) *Pest control - a collection management problem,* Museums Journal, **85**, pp 97-99.

Stoate, C. (1987) *Beetles in store.* Museums Journal. **86**:4, pp. 196-7.

Story, K.O. (1986) *Approaches to pest management in museums,* Conservation Analytical Laboratory, Smithsonian Institute, Maryland, USA.

Tilbrooke, D.R. (1978). *The problem of naphthalene in ethnographical collections.* ICCM Bulletin: **4**, pp. 55-63.

Williams, S.L. and Walsh, E.A. (1989) *Developing chemical pest control strategies for museums,* Curator, **32**/1, pp34-69.

Zycherman, L.A. and Schrock, J.R. (1988). *A guide to museum pest control.* Foundation of the American Institute for Conservation of Historic and Artistic Works and the Association of Systematics Collections, Washington.

PEST CONTROL IN MUSEUMS SURVEY

INDICATE ANSWER BY INSERTING A TICK IN THE APPROPRIATE BOX E.G. ☑

Section A - General Information

1. Name:

2. Museum Address:

3. How long have you been employed in the museum?
   Less than one year ☐ 1 - 5 yrs ☐ 5 - 10 yrs ☐
   10 - 15 yrs ☐ 15 - 20 yrs ☐ more than 20 yrs ☐

4. Indicate type(s) of collections you are personally involved with.
   Zoological ☐ Botanical ☐ Anthropological ☐
   Other ☐ (please specify)

5. Indicate size of museums holdings (perishable dried material only)
   Less than 5,000 specimens ☐ 5 - 10,000 specs. ☐ 10 - 25,000 ☐
   25 - 50,000 ☐ 100 - 500 ☐ 500 - 1 ml. ☐ Over 1 ml. ☐

Section B - Environmental Conditions

6. Indicate types of storage containers used:-
   Exhibition type cases ☐ Metal storage cases ☐
   Wooden storage cases ☐ Enclosed drawers within cases ☐
   Open shelving ☐ Other ☐ Please specify.

7. Indicate environmental conditions in the museum

	Entire Building		Storage Area		Display Area	
Is the temperature controlled	Yes ☐	No ☐	Yes ☐	No ☐	Yes ☐	No ☐
Is the relative humidity controlled	Yes ☐	No ☐	Yes ☐	No ☐	Yes ☐	No ☐
Is the air filtered	Yes ☐	No ☐	Yes ☐	No ☐	Yes ☐	No ☐
Is the air recirculated	Yes ☐	No ☐	Yes ☐	No ☐	Yes ☐	No ☐

8. Are there access doors opening directly to building exterior?
   Main building Yes ☐ No ☐ Storage area Yes ☐ No ☐ Display area Yes ☐ No ☐

9. Are there windows opening directly to building exterior?
   Main building Yes ☐ No ☐ Storage area Yes ☐ No ☐ Display area Yes ☐ No ☐

Section C - Museum Pests

10. Have your collections ever been attacked by pests? Yes ☐ No ☐

11. List pests encountered in your museum
    Dermestid Beetles ☐
    Anobiid Beetles ☐
    Tenebrionid Beetles ☐
    Mites ☐
    Cockroaches ☐
    Moths ☐
    Silverfish ☐
    Psocids (Book Lice) ☐
    Fungi ☐
    Unspecified pests ☐
    Others ☐

12. Indicate pest which posed the greatest threat to the collections:

13. Indicate damage caused:-

14. Indicate suspected mode of entry of pests you have encountered -
Integration of new material ☐ Through ventilation system ☐
Return of loan specimens ☐ Unknown ☐ Other ☐

15. Have you noticed any seasonal variation in pest infestation?
Yes ☐ No ☐

Section D - Pest Control Procedures

16. Does the museum have a specific pest control strategy Yes ☐ No ☐

17. Does this strategy involve any of the following? Please specify.
Spot fumigation ☐ Chamber fumigation ☐
Pesticides in storage cases ☐ Pesticides in display cases ☐
Trapping devices ☐ Freezing techniques ☐
Humidity control ☐ Temperature control ☐

18. How often does the museum fumigate its collections?
Never ☐ Regularly ☐ Occasionally ☐
Only when infestation is suspected ☐

19. Does the museum fumigate incoming specimens?
Always ☐ Never ☐ Occasionally ☐ Only when infestation is suspected ☐

Section E - Pesticides

20. Indicate pesticides currently used in your museum
Vapona ☐ Pyrethrins ☐
Napthalene ☐ Phosphine ☐
Paradichlorobenzene ☐ Carbon Disulphide ☐
D.D.T. ☐ None ☐
Methyl Bromide ☐ Others ☐ Please specify

21. If used as a preventative measure, how often are they replaced?
Every 3 months ☐
Between 3 - 6 months ☐
Only when needed ☐
Very irregularly ☐
Other, please specify. ☐

22. Are these pesticides applied in specific concentrations or quantities?
Yes ☐ No ☐

23. Indicate reasons for using the pesticides you have listed
Effectiveness ☐ Safety ☐
Ease of handling ☐ Economy ☐
Tradition ☐ Availability ☐
Legality ☐ Other:- ☐

Section F - Effects on Specimens and Materials

24. Indicate pesticides used in your museum that have caused any of the following adverse effects on Specimens only

	Pesticide(s)
Discolouration of specimens -	_____
Deterioration of specimens -	_____
Condensation on specimens -	_____
Recrystallization on specimens -	_____
Others -	_____

25. Indicate pesticides used in your museum that have caused any of the following adverse effects on storage or display materials

	Pesticides
Paper discolouration	
Pinning foam melts (entomology)	
Plastic melts	
Glues/adhesive melts	
Textile discolouration	
Metal corrosion, pins etc.	
Others: Please specify	

Section G - Health and Safety

26. Do you work in close proximity to where pesticides are in constant use?

Same building Yes ☐ No ☐
Same room Yes ☐ No ☐
Same section Yes ☐ No ☐

27. Approximately, how much of your time is spent in this area?

Over 75% ☐ 25% - 50% ☐
50% - 75% ☐ Under 25% ☐

28. How many other people work in this area?

1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ 8☐ 9☐ Over 10?☐

29. Which of the following categories describes your health?

Excellent ☐ Good ☐ Average ☐ Bad ☐

30. Do you suffer from any of the following symptoms while at work?

	Often	Sometimes	Never
Digestive disorders			
Headaches			
Sore throat			
Sore eyes			
Nausea			
Dizziness			
Chest pains			
Dermatitis			
Vomiting			
Others, specify if you wish			

31. Do you think that any of the following factors contribute to these symptoms?

	Yes	No	Perhaps
Ambient temperature	☐	☐	☐
Ambient humidity	☐	☐	☐
Pesticide useage	☐	☐	☐

Others, please specify.

32. Do these symptoms appear when working in any particular area?

Yes ☐ No ☐ If yes, please specify _____

33. Do these symptoms appear when working with any particular materials?

Yes ☐ No ☐ If yes, please specify _____

34. What safety precautions do you take to minimise health hazards caused by certain pesticides?

Please specify:- _____

_____

_____

_____

35. Have you observed any adverse physical effects on other museum staff caused by use of pesticides? Yes ☐ No ☐

If yes, please specify.

_____

_____

_____