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Which strategies are used against insect pests: a survey in 120 institutions of public heritage

Abstract - A quantitative survey was conducted to identify the characteristics of infestations in contemporary art institutions. This survey helped us understanding the mechanism of infestation in French heritage institutions according to the type of institution. Our results show a correlation between the nature of the infestation, its understanding and the themes of the collection. This factual study provides a better assessment of institutions‘ risk management and their probable infestation depending on the type institution. Given these data, we are able to observe the typical features of contemporary art collections and their infestation by highlighting the fact that the insect is not only a pest, but is a constituent element of the artwork.

Key words: theme of collection, infestation risk management, typical behaviours, contemporary art, artist’s intentions.

INTRODUCTION

The biological and environmental factors that catalyse infestations are now mostly identified. Repeatedly we were confronted with recurrent infections, indeed chronic infestations of some contemporary works; it appeared that other factors interfere with these mechanisms.

To detect the peculiarities, if there are any, we made a comparative survey using typical features and variables according to the themes of the collections. This paper presents a first analysis of the results we obtained from a quantitative survey conducted in 2010.

METHODS

We developed a questionnaire of sixty questions classified into five parts. The first part, “General Information”, identifies institutions and individuals who responded, second, “Infestations”, collects attractive items in the collections, their conditions of conservation and storage, as well as the understanding of the risks of infestation, their detection and treatment. The third part, “Prevention”, focuses on repellents and insecticides existing or used in institutions, and the perception of their toxicity and efficiency;

and the fourth part, "Checking, surveillance and monitoring", detects regular maintenance of collections. The fifth part allows those who wished, to register their contact information in order to receive the results of the survey. Our sample was representative of the different heritage themes that concern us, that is to say, archaeology, contemporary art, modern, art, folk art and traditions, fine arts, ethnography, books and archives, industrial and technical heritage and natural sciences.

The questionnaire was sent as a mail link at 600 institutions (museums, Fonds Regionals d'Art Contemporain, and art centres, museums archives, ...); answers were recorded directly online during a period of three months. 121 institutions participated in the survey, 95 of these (78.5%) responded to all questions.

RESULTS

Out of 121 responses, 101 are from museums and 11 from FRAC and art centres. Thirty four per cent and 66% of institutions have respectively a monothematic or a multi-thematic collection (Tab. 1). Among the people who responded to the questionnaire, 38% (46) are registrars, 28.1% (34) are collection managers and 19.8% (24) are curators. The majority are female 61.5% (72 women to 45 men) between 30 to 45 years old. Eighty five of them (70.2%) have less than fifteen years of experience and 23.9% (27) said that they never received specific training for collection care.

Institutions	**Answers**		**Mention of themes**	
Multithematic collections	68	56%		
Archaeology	6	5%	55	14%
Contemporary art	11	9%	46	12%
Modern art	3	2%	39	10%
Arts & folk traditions	2	2%	53	13%
Fine arts	7	6%	65	16%
Ethnography	2	2%	48	12%
Books & archives	1	1%	35	9%
Industrial & technical heritage	3	2%	26	7%
Natural sciences	9	7%	29	7%
Other	9	7%		
Total replies	**121**		**396**	

Tab. 1 - Identification and distribution of monothematic collections and general themes.

Fifty seven of them (50%) have followed art history studies; 15% (17) come from history or archaeology; 12% (14) from biology and natural science and 8% (9) from fine arts. Their choice of university courses steered towards a type of institution. Indeed, 23% of those who come from a background of fine arts training are in contemporary art institutions and 16% are from modern art institutions, and 40% of those who come from a natural science background are in natural history museums. The training in art history seems a less decisive factor; in fact, 18% are in fine arts institutions, 14% in archaeology and 14% in contemporary art. It is important to note that in 2.6% of the cases (3) the registrar' service is vacant and in 44.7% of cases (51) it includes only one person. In most cases, institutions are small and medium size establishments 67.8% (82), with an exhibit area of less than 1000 m^2, and a storage area of less than 500 m^2. Sixty seven (56.3%) have outsourced storage areas. The exhibit buildings often are a historic home

	1 - Do you have a climate control system?			2 - If yes, is it regularly checked and maintained?			3 – Do you have a measurement system: thermohygrometer?			4 - If yes, are the measurements regularly taken?		
	Answers	No	Yes	Answers	No	Yes	Answers	No	Yes	Answers	No	Yes
Archaeology	53	29	24	29	7	22	55	12	43	47	9	38
		55%	45%		24%	76%		22%	78%		19%	81%
Contemporary art	41	17	24	27	4	23	44	9	35	39	8	31
		41%	59%		15%	85%		20%	80%		21%	79%
Modern art	36	15	21	24	4	20	38	7	31	34	7	27
		42%	58%		17%	83%		18%	82%		21%	79%
Arts & folk traditions	52	30	22	26	6	20	52	14	38	43	8	35
		58%	42%		23%	77%		27%	73%		19%	81%
Fine arts	63	33	30	33	6	27	65	9	56	60	10	50
		52%	48%		18%	82%		14%	86%		17%	83%
Ethnography	46	25	21	27	8	19	48	10	38	42	8	34
		54%	46%		30%	70%		21%	79%		19%	81%
Books & archives	34	17	17	18	5	13	35	4	31	32	4	28
		50%	50%		28%	72%		11%	89%		13%	88%
Industrial & technical heritage	26	15	11	12	2	10	25	5	20	21	4	17
		58%	42%		17%	83%		20%	80%		19%	81%
Natural sciences	27	14	13	13	3	10	29	6	23	24	2	22
		52%	48%		23%	77%		21%	79%		8%	92%
Total replies	117	66	51	61	14	47	119	27	92	99	17	82
		56%	44%		23%	77%		23%	77%		17%	83%

Tab. 2 - Climate management and its measurement in the exhibit areas.

72% (79) and date from before 1900 and 27% (30) before 1700. Sixty three per cent of cases (59) have been undertaken less than twenty years ago. After identifying individuals and institutions, we particularly studied infestations.

Fifty-eight cases (79.5%) were detected damages observed on the item and in 57.5% (42) the presence of insects or exuviae was observed. Fifty of them (68.5%) were detected during a periodic checking of the collection care, 15.1% (11) during a verification for loan and 16.4% (12) by chance. Fifty two (70.3%) observers reported they knew how to identify insect pests: 53 named the insect and then 72 entries have been listed in Tab. 6.

It seems interesting to cross-reference certain questions with the themes of collections to detect possible correlations. Most collections are multi-thematic, thus we cross-referenced each theme checked by the 121 institutions with twenty questions about climate management, prevention and risk monitoring, nature and recurrence of

	5 - Do you have a climate control system?			6 - If yes, is it regularly checked and maintained?			7 - Do you have a measurement system: thermohygrometer?			8 - If yes, are the measurements regularly taken?		
	Answers	No	Yes	Answers	No	Yes	Answers	No	Yes	Answers	No	Yes
Archaeology	53	27	26	32	8	24	54	19	35	37	6	31
		51%	49%		25%	75%		35%	65%		16%	84%
Contemporary art	42	16	26	29	4	25	44	6	38	38	4	34
		38%	62%		14%	86%		14%	86%		11%	89%
Modern art	37	13	24	28	5	23	39	9	30	30	4	26
		35%	65%		18%	82%		23%	77%		13%	87%
Arts & folk traditions	52	31	21	27	8	19	53	17	36	38	6	32
		60%	40%		30%	70%		32%	68%		16%	84%
Fine arts	63	28	35	38	6	32	64	14	50	51	7	44
		44%	56%		16%	84%		22%	78%		14%	86%
Ethnography	46	22	24	30	8	22	48	14	34	35	5	30
		48%	52%		27%	73%		29%	71%		14%	86%
Books & archives	34	17	17	17	3	14	34	7	27	26	2	24
		50%	50%		18%	82%		21%	79%		8%	92%
Industrial & technical heritage	26	12	14	16	3	13	25	7	18	20	3	17
		46%	54%		19%	81%		28%	72%		15%	85%
Natural sciences	27	9	18	18	1	17	29	5	24	23	3	20
		33%	67%		6%	94%		17%	83%		13%	87%
Total replies	119	59	59	71	14	56	120	32	87	93	14	78
		50%	50%		20%	79%		27%	73%		15%	84%

Tab. 3 - Climate management and its measurement in the storage areas.

	9 – Are some works identified as sensitive to infestations-risk by insect pests?			10 - Do you have a means of prevention to keep out insects pests?			11 - Have you installed a special device for infestation control?		
	Answers	No	Yes	Answers	No	Yes	Answers	No	Yes
Archaeology	35	7	28	43	35	8	41	27	14
		20%	80%		81%	19%		66%	34%
Contemporary art	33	7	26	34	27	7	32	18	14
		21%	79%		79%	21%		56%	44%
Modern art	24	6	18	25	18	7	23	15	8
		25%	75%		72%	28%		65%	35%
Arts & folk traditions	38	7	31	44	36	8	44	27	17
		18%	82%		82%	18%		61%	39%
Fine arts	43	9	34	54	42	12	51	32	19
		21%	79%		78%	22%		63%	37%
Ethnography	37	9	28	40	29	11	40	23	17
		24%	76%		73%	28%		58%	43%
Books & archives	25	3	22	31	24	7	30	18	12
		12%	88%		77%	23%		60%	40%
Industrial & technical heritage	22	5	17	23	14	9	22	9	13
		23%	77%		61%	39%		41%	59%
Natural sciences	24	4	20	23	15	8	23	15	8
		17%	83%		65%	35%		65%	35%
Total replies	85	19	66	97	74	23	94	57	37
		22%	78%		76%	24%		61%	39%

Tab. 4 - Prognosis, preventive and monitoring systems.

infestations as well as procedures and treatments. The first column of Tab. 1 shows the latter, the second column quantifies the number of times the theme is mentioned, (on average four to five themes are listed by an institution, such as archaeology, art and popular traditions, fine arts and natural sciences). In all the following tables "Total replies" records the responses by institutions and column "Answers" counts the responses by themes considering that the same institution could tick many themes.

Tabs. 2 and 3 show climate management and its measurement in the exhibit and storage areas.

Tab. 4 allows us to understand the perceived risk of infestation of the pest-sensitive works, as well as the monitoring devices and the insect-repellent systems.

Tab. 5 differentiates between occasional attacks and general infestations of collection, and the rate of diagnosis made post-infestation.

Tab. 6 lists the species recorded in the institutions and the recurrence of infestations

	12 - Have the collections been victim of attacks by insect pests?			13 - Have some heritage items been victim of attacks by insect pests?			14 - After infestation, have you made a precise diagnosis (species, extent)?		
	Answers	No	Yes	Answers	No	Yes	Answers	No	Yes
Archaeology	35	17	18	38	10	28	37	21	16
		49%	51%		26%	74%		57%	43%
Contemporary art	27	17	10	31	11	20	28	17	11
		63%	37%		35%	65%		61%	39%
Modern art	22	9	13	23	6	17	22	15	7
		41%	59%		26%	74%		68%	32%
Arts & folk traditions	37	14	23	36	10	26	40	22	18
		38%	62%		28%	72%		55%	45%
Fine arts	39	21	18	42	10	32	44	24	20
		54%	46%		24%	76%		55%	45%
Ethnography	32	11	21	33	6	27	36	21	15
		34%	66%		18%	82%		58%	42%
Books & archives	24	12	12	26	8	18	27	15	12
		50%	50%		31%	69%		56%	44%
Industrial & technical heritage	18	8	10	18	5	13	18	8	10
		44%	56%		28%	72%		44%	56%
Natural sciences	22	7	15	20	3	17	22	9	13
		32%	68%		15%	85%		41%	59%
Total replies	82	42	40	82	28	54	78	41	37
		51%	49%		34%	66%		53%	47%

Tab. 5 - Nature of infestations and accomplished diagnosis.

(between brackets the term used by the observer and its frequency). The column 1 mentions the terms used with their lack of precision and their mistakes. We kept the French term “vrillette” because it indiscriminately indicates the “petite vrillette” *Anobium punctatum* (DeGeer, 1774) or the “grosse vrillette” *Xestobium rufovillosum* (DeGeer, 1774) and the English translation does not preserve this lack of differentiation.

Tabs. 7 and 8 identify predominant species depending on theme of institution.

Tab. 9 allows to estimate measures and treatments depending on the type of collection. These results highlight the factual correlations between type of institutions, management of climate, understanding, control and potential for infestation.

Species	Answers	Percentage	15 – Are infestations of collections a recurring problem?	
			No	Yes
"Vrillettes" *(15* "vrillettes", 6 *Anobium punctatum* and 1 *Xestobium rufovillosum)*	22	30,60%	15 (79%)	4 (21%)
Anthrenus (10 *Anthrenus* and 2 *Anthrenus museorum*)	12	16,70%	7 (64%)	4 (36%)
Tineola bisselliella (7 clothing moths, 3 *Tineola bisselliella*)	10	13,90%	3 (33%)	6 (67%)
Stegobium paniceum	5	6,90%	3 (60%)	2 (40%)
Dermestes	4	5,60%		
Woodborer	4	5,60%		
Keratophage	2	2,80%		
House longhorn beetles	2	2,80%		
Termites	2	2,80%		
Black carpet beetle	2	2,80%		
Lepisma saccharina (silverfish)	2	2,80%		
Lasioderma serricorne	1	1,40%		
Ptinidae	1	1,40%		
Lepidoptera	1	1,40%		
Oligomerus ptilinoides	1	1,40%		
Oligomerus brunneus	1	1,40%		
Total replies	**72**		**52 (63%)**	**31 (37%)**

Tab. 6 - Species and recurrent infestations.

Species	Multithematic institutions	Monothematic institutions
Anobium punctatum	18	2 Fine arts
		1 Contemporary art
Anthrenus	8	4 Natural sciences
Tineola bisselliella	7	3 Sciences naturelles
Stegobium paniceum	2	2 Contemporary art
		1 Natural sciences
Total replies	**35**	**13**

Tab. 7 - Distribution of species in institutions.

	16 - What species have you identified?					17 – Are infestations of collections a recurring problem?		
	Answers	*Anobium punctatum*	*Anthrenus*	*Tineola bisselliella*	*Stegobium paniceum*	Answers	No	Yes
Archaeology	27	14	4	7	2	36	23	13
		16%	11%	19%	6%		64%	36%
Contemporary art	14	5	1	4	4	29	19	10
		6%	3%	11%	11%		66%	34%
Modern art	18	9	2	6	1	24	16	8
		10%	6%	17%	3%		67%	33%
Arts & folk traditions	26	14	4	6	2	38	19	19
		16%	11%	17%	6%		50%	50%
Fine arts	27	16	3	6	2	45	28	17
		18%	8%	17%	6%		62%	38%
Ethnography	26	12	6	6	2	39	22	17
		14%	17%	17%	6%		56%	44%
Books & archives	20	10	4	4	2	27	18	9
		11%	11%	11%	6%		67%	33%
Industrial & technical heritage	13	5	4	4	0	20	14	6
		6%	11%	11%	0%		70%	30%
Natural sciences	17	2	8	6	1	21	8	13
		2%	22%	17%	3%		38%	62%
Total replies	188	87	36	49	16	83	52	31
		46%	19%	26%	9%		63%	37%

Tab. 8 - Distribution of species depending on general themes of the collections.

DISCUSSION AND CONCLUSION

Our results highlight a wide variation in resources, and potential prevention of infestation according to the type of collection. Collections of contemporary art and modern art are better equipped to control and measure climate (Tabs. 2 and 3). The equipment is regularly maintained and checked. Collections of archaeology and folk art are not so well equipped, nor maintained. Collections of fine arts, ethnography, books and archives obtain overall average results with the following peculiarities: collections of fine arts, books and archives are better equipped with thermo-hygrometers, but only for the latter measurements are performed regularly. The ethnography collections have

	18 – Do you have a procedure in the event of infestation?			19- Did you make a curative treatment of infested cultural properties?			20 - Did you undertake an insecticide treatment of storage and exhibit of areas?			21 – Has the treatment of the infestation been done by an internal department of the institution?		
	Answers	No	Yes	Answers	No	Yes	Answers	No	Yes	Answers	No	Yes
Archaeology	46	20	26	34	2	32	24	10	14	30	15	15
		43%	57%		6%	94%		42%	58%		50%	50%
Contemporary art	37	18	19	23	3	20	20	10	10	21	13	8
		49%	51%		13%	87%		50%	50%		62%	38%
Modern art	29	11	18	20	2	18	13	5	8	17	9	8
		38%	62%		10%	90%		38%	62%		53%	47%
Arts & folk traditions	46	21	25	36	5	31	30	13	17	33	17	16
		46%	54%		14%	86%		43%	57%		52%	48%
Fine arts	55	20	35	42	4	38	31	12	19	39	20	19
		36%	64%		10%	90%		39%	61%		51%	49%
Ethnography	42	17	25	34	4	30	27	12	15	30	16	14
		40%	60%		12%	88%		44%	56%		53%	47%
Books & archives	32	14	18	22	1	21	18	8	10	23	10	13
		44%	56%		5%	95%		44%	56%		43%	57%
Industrial & technical heritage	23	7	16	18	1	17	16	8	8	17	8	9
		30%	70%		6%	94%		50%	50%		47%	53%
Natural sciences	25	7	18	22	1	21	20	5	15	22	8	14
		28%	72%		5%	95%		25%	75%		36%	64%
Total replies	104	45	59	72	6	66	56	22	34	68	34	34
		43%	57%		8%	92%		39%	61%		50%	50%

Tab. 9 - Procedures and treatment of infestations.

the poorest maintenance of air conditioning in exhibit and storage areas. The natural sciences are in the average for equipment in exhibit areas, with a system of regulation and measurement which is regularly maintained and checked. Their uniqueness lies in fact with the equipment of storage areas: their maintenance and the recording of climate measurements are significantly better equipped than the average of other collections.

The natural sciences, books and archives are those which most regularly measure the climate, and they are also those which better predict risks of infestations (Tab. 4, n°9). Preventive systems to keep away insects are mainly installed in the collections of natural sciences and technical and industrial heritage. Natural sciences are those that

have the fewest surveillance systems of infections; the most equipped are collections of contemporary art and industrial and technical heritage (Tab. 4, n°10-11). The collections of natural sciences and ethnography are the most attacked by insect pests both in the collections and in isolated items (Tab. 5, n°12-13). Collections of Fine Arts are more often victims of isolated attacks. Note that collections of contemporary art are among the lowest percentages of attack by pests. It is important to remark that with modern art, they are among those that report few diagnoses of post-infestations (species, range), contrary to collections of industrial and technical heritage and natural sciences (Tab. 5, n°14). Of the 72 species, four are actually identified by their number and the identifiable name of the species: the "vrillette", the *Anthrenus*, the *Tineola bisselliella* (Hummel, 1823) and *Stegobium paniceum* (Linnaeus, 1758) (Tab. 6). The most cited are the "vrillette" 30.6% (22) after the *Anthrenus* 16.7% (12), the *Tineola bisselliella* 13.9% (10) and finally the *Stegobium paniceum* 6.9% (5). Note that recurrence of infections is predominantly negative 63% (52) (Tab. 6, n°15 and Tab. 8, n°17). This rate coincides with the rates found with *Anthrenus* 64% (7) and *Stegobium paniceum* attacks 60% (3). This is lower than with the common furniture beetle 79% (15). Only *Tineola bisselliella* 33% (3) and collections of natural sciences 38% (8) are characterized by a positive rate of recurrence of infestation. The "vrillette" appears to prefer multi-thematic collections (Tab. 7) with a penchant for fine arts (Tab. 8, n°16). The *Anthrenus* and *Tineola bisselliella* are proportionately more present in the collections of natural sciences. *Stegobium paniceum* tends to attack collections of contemporary art and natural sciences (Tabs. 7 and 8, n°16). After infestation, the collections of natural sciences as well as industrial and technical heritage distinguish themselves again because they have the most specific procedures in the event of infestations (Tab. 9, n°18). They also better treat infested property and areas (Tab. 9, n°19-20). Collections of contemporary art with the arts and folk traditions treat infested areas and property the least. They declare having the fewest procedures in the event of infestation. It is important to note that generally half of the treatments are undertaken out of house (Tab. 9, n°21). Only the collections of natural sciences, industrial and technical heritage and books and archives make in house treatments. As we have shown, there are factual particularities according to the theme of the collection. This pragmatic survey allows us to better identify the specificity of contemporary art towards infestations. According to our investigation, these collections represent 9% (11) of the monothematic institutions and 12% (46) of cited themes (Tab. 1). They are much more equipped with air conditioning and thermo-hygrometer both in exhibit and storage areas (Tabs. 2 and 3). Sensitive insect pests are identified at 79% (26) (Tab. 4, n°9) but there are less surveillance and repulsive systems in these cases (Tab. 4, n°10).

Collections of contemporary art are less often attacked than average as in isolated infestations as well as in general infestations of collection (Tab. 5, n°12-13). They preferentially are the victims of *Tineola bisselliella* and *Stegobium paniceum* (Tab. 8, n°15). The recurrence of infections is slightly below average (Tab. 8, n°17). They have few diagnoses of post-infection (Tab. 5, n°9) and they do not treat infested areas and items sufficiently. When attacks are detected, 13% of artworks and 50% of areas are not

treated (Tab. 9, n°19-20). In conclusion, the most remarkable feature is that collections of contemporary art have more resources than most institutions in equipment, but do not have enough repulsive and preventive systems. They also inadequately manage infestations when they are declared. These contemporary artworks, which are very attractive to insect pests indeed, are cyclically infested for short periods. Materials that are shaped and assembled by artists are today very varied. In the collection storage areas of Contemporary Art Museums, for example, bread (Raymond Waydelich), chocolate (Dieter Roth), dried insects (Jan Fabre), stuffed specimens (Maurizio Cattelan) or faeces (Gérard Gasiorowski) are conserved. But it is remarkable that we reveal a contradiction with the integrated pest management (IPM). Sanitizing patrimonial institution is absolutely necessary to prevent infestation, which contradicts some art installations that contain insects or living animals with their own pests in exhibit areas (Damien Hirst). But the real problem is spontaneous infestations of some contemporary artworks. At the request of the artist, they are sometimes not identified as a corruption of the material, but as a natural evolution of the artwork. In the following example the injunction submitted by an artist after the notification of the infestation of his work was: "do not clean, keep the superposition of layers of detritus accumulated with each passing exhibitions". Thus the infestation becomes one of the constituent materials and must be maintained, which gives the conservators a new set of problems.

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