Standardizing and communicating IPM data

Keywords: data, goals, targets, IPM, communication, influence

Abstract

The practice of integrated pest management is well defined, and a common approach is spreading internationally following the production of protocols and standards that describe good practice. One essential element of IPM is the collection of data. This paper explores the potentials and limitations of data collection and presentation as commonly practiced within IPM, in particular the potential for confirmation bias in data collection following patterns of placement of insect pest monitors where problems are already identified. The paper examines the outcomes being sought from using IPM and asks whether the data collection and presentation currently offered are a good fit. Many IPM research questions identify dynamic challenges, such as the migration of a new pest through a country, or the spread of an established pest within a collection but data representation is less well suited to dynamic change. The paper proposes that a greater focus on the needs of the audience and the goal of data presentation is necessary to generate an effective range of approaches for peers, technical experts, colleagues and decision makers. To resolve this, the paper recommends a fundamental change to the way that IPM data is collected and shared, using standardisation of data collection and a consideration of user needs in presenting the findings.

Good practice in IPM

IPM as a practice is extending its reach across cultural heritage institutions throughout the world (Crossman and Pinniger 2013). Good practice is established, defined and shared amongst professionals with responsibility for collection care (Pinniger 2008, British Standards Institute 2016). This leadership has led to clear practical guidance for avoiding, reducing and monitoring pest infestations. Furthermore, networks exist which share IPM resources such as monitoring the spread of infestation (Birmingham Museums and Art

Gallery nd), offering suppliers information on responses (Pinniger 2008) and sharing good practice in easy-to-follow guides (Museum of London 2013). Despite all this good practice there are surprising areas of IPM data management that that are not standardised, particularly regarding data collection, and areas where practice is under developed, such as data analysis and communication. These challenges are linked: the current methods of communicating pest data often obfuscate the lack of standardisation of data collection with potentially serious implications for data interpretation and subsequent action.

Current practice in data collection and communication

Communication of data

A review of publicly available reports on pest infestations in museums and other cultural heritage organisations revealed that a remarkably narrow range of options for data representation exist (Henderson, Baars and Hopkins 2017). The primary mechanism of reporting pests found in this research was a simple ordinal measure or count of the number of pests by type (Hopkins 2015). It is very common for spreadsheets to be developed which collect such data and which in turn are easily converted into traditional EXCEL style outputs such as bar and pie graphs. These familiar forms of data representation are often presented without commentary regarding their selection because their existence is ubiquitous and familiar, generating few questions about their validity. Beyond the bar and pie graphs the other common form of pest concentration representation is a map of pest numbers by location normally representing insects by colours or pictograms on floor plans. These diagrams aim to represent the scale of the problem but to be more precise they represent the extent of detection. The challenges for these forms of data management are two-fold: firstly, a challenge exists as to whether the data present an accurate reflection of the number of pests in a room and, secondly, whether data shared in this way is effective in serving the purpose for which the data was collected.

Accuracy of data

To be confident that any data are valid it is necessary to establish that the number of pests found correlates with the scale of the insect pest problem. It is the authors' hypothesis that in many cases the number of pests found in an institution correlates to the room size and the number and density of pest monitoring traps set, necessitating a more carefully defined method of counting and representing numbers, for example, using the Pest Occurrence Index (POI) described in Baars and Henderson (2019). Whilst there is a correlation between numbers of pest occurrences in a place and the number of pests caught in pest monitors, there is also one between the numbers of pests caught and the number of monitors. Figure 1 shows the numbers of pests trapped in the National Museum Wales over the period of 2013-2018.

<Insert Fig. 1: Here>

The first figure might suggest a plausible narrative of an increase in pest activity that would suggest a growing pest problem. Despite the familiarity of the expression 'correlation does not equal causation' the confirmation bias (McKenzie 2004) generated by the expectation of an increase in pest numbers, perhaps heightened by a greater focus on IPM within the organisation, means that creating a graph that appears to represent an increase in pest density would be easy to accept and act upon. Figure 2 represents the same total pest data on the y axis but replaces the timeline with the number of traps showing an equally plausible correlation between monitor and pest numbers. The comparison between the two graphs should prompt reflection on how the IPM managers organise the data collection process when reporting pest numbers (Baars and Henderson 2019).

<Insert Fig. 2 here >.

Within the sector advice on placing monitors tends to follow a similar format: target areas where food is consumed and disposed, target reception areas, window sills, chimney breasts and dead spaces. There are sound entomological reasons why these locations are good places to monitor and the detection of pests in these contexts would indicate a threat. If the purpose of trapping is to detect the presence or absence of pests this method would have a simple validity. If the purpose is to monitor the change of scale of an infestation (increasing or decreasing numbers) and the total numbers of pest caught on monitors will be reported, then the number of monitors placed within each space needs to be factored in to standardise the data. A common response to the discovery of a pest on monitors in a particular space is to increase the number of monitors. This will limit the validity of any comparison of the density of insects in areas with fewer monitors per unit area because a subsequent increase in the number of pests caught in monitors may be the result of an increase in pest activity or an increase in monitor density, or both. If the actual cause of the increase in pests detected is not explored further, data interpretation may suffer from confirmation bias, resulting in the reporting of a potentially non-existent growing pest problem.

The authors recommend that pest counts are reported not as number of pests but as number of pests per monitor per m^2 in areas with a common density of pest monitors (Baars and Henderson 2019). Whilst it might feel inefficient to place monitors in areas where no threat was reported, some forms of data representation will be more consistent if the density of monitors per m^2 is controlled. The task of collecting null data is essential to good hypothesis and prevents any complacency-led oversight of pest movement. There is no need to standardise the density of monitors if the purpose of monitoring is simply to identify the presence of a particular pest within a specific location. This may be the case for example if finding a single pest in a temporary exhibition gallery may require action. Such a 'presence or absence approach' reflects the minority of IPM applications.

Purpose of data collection

Evidence based and resource effective collection care requires the collection of data. But data collection is only valuable if it addresses a specific question and is communicated to those who need to know the results in order to act. Many of the challenges within IPM represent dynamic situations where staff need to know: if a new pest is spreading through the sites of the museum; if a new hygiene regime in the kitchen is working; or whether a reduction in the temperature set points has led to a decrease in pest activity. Many of the representations of pest data traditionally in the heritage sector offer uniformity but do not demonstrate that they are tailored to a specific audience or intended to inform a dynamic situation (Henderson, Baars and Hopkins 2017). The challenge is to offer powerfully influential, accurate representations of pest data that support improved communication and more effective advocacy.

Communicating pest data

Once the method of measuring insect activity has been standardised, the next step is to consider how it is communicated. In any communication strategy there are many factors to consider, one of which is content: which can be a traditional message such as a report or email however an influence strategy need not be verbal. A message can also be a 'symbolic transaction' such as a bringing someone a cup of tea or sending a birthday card (Perloff 2014 p. 17). When evaluating attempts to communicate for influence, social interactions should merit equivalent levels of reflection to words. The way messages are constructed, the tone of language and presentation all matter, as do other factors such as the source of the message, the context in which the message is exchanged and the receiver of the message (Henderson 2001). When receiver needs are not fully considered, there is a danger that the communication will not be attended to, ignored, misunderstood or rejected.

Influence and communication

When planning a communication to influence a receiver, it is important to consider receiver needs. Pfau and Parrot (1993) identify five receiver decision stages. At each of these phases, a message should be constructed differently to achieve maximum effectiveness. The five stages identified by Pfau and Parrot are awareness, information seeking, discrimination, choice and post decision:

1. At the awareness stage generating awareness of the issue is the key objective.
2. At the information seeking stage the persuader should provide issue relevant information.
3. At the discrimination stage it can be useful to attack any alternative choices available to the receiver or encourage any pre-existing doubts about alternatives.
4. Once the receiver discriminates (decides) the opportunity to evaluate the effectiveness of persuasive communication arises.
5. After a choice or decision is made it is useful to reinforce the receiver decisions.

Theories of influence also identify the receiver's willingness and ability to process information as being critical factors to them considering it. Some influence techniques rely on simple heuristic triggers to illicit an instinctive response. Such simple measures can be effective even if the receiver allocates very little cognitive energy to considering the message. Where a complex message is being communicated it should be carefully developed to offer high levels of relevance to the target receiver and be presented in a format that the receiver is capable and willing to consider (Henderson and Waller 2016). As people are 'cognitive misers' the majority of their decisions are made under conditions of low engagement with the detailed argument, so when attempting mass communication simple, visual and compelling messages must be a feature.

An assessment of receiver needs and abilities should be undertaken prior to communicating an IPM message. If the receiver has no awareness of the challenges of IPM, the message must aim to target the need for pest management and the potential consequences of inaction. In this context the message should catch the receiver's attention, which is achievable through both visual and verbal means such as an image of pest damaged objects or a verbal report suggesting that an effective IPM strategy will help with their concerns such as the current accreditation application / funding bid / benefactor event.

In the information seeking phase the receiver is ready for data and will be looking for issue relevant data that helps answer the questions they are asking. It is essential to remember that what matters here are the questions the receiver is asking, not the questions the source wishes the receiver to ask.

The discrimination stage is where a person chooses between options that, in this context, may include: providing a new quarantine area, spending the money elsewhere or deciding who should be invited onto the new food waste disposal policy working group. An effective influencer will take time to work out the alternatives to their proposal and prepare a defence. In times of austerity the alternative may often be 'do nothing, we cannot afford it' and in that context offering explanations about how a proposed solution requiring resources might be the most cost effective will increase the chance of it being considered. If the decision is about the selection of cleaning contractors, then identifying critical clauses to include in contracts will be more positive than a more general message about the advantages of IPM.

One aspect of receiver decision making easily neglected is post decision change. Influence can be described as the shaping, changing or reinforcing a target's beliefs, attitudes or behaviours (Miller, 2002). In a post decision situation where pest trapping, quarantine and housekeeping are all part of the daily life of the organisation, reinforcement of the value of these actions is essential. Participation in self or external evaluations, such as 'Benchmarks in Collections Care' (Dawson 2011) or accreditation where reporting is part of the process, is a standard way to reinforce practice. Reinforcement can be in the form of normal activity management reports but can also be communicated in a more inclusive manner such as through posters celebrating vigilance and noting how everyone shares in the maintenance of best practice.

<Insert Fig. 3 here>

Communication goals

In devising an effective IPM communication strategy the definition of communication goals and the outcomes required from the pest management activity will be fundamental in defining, delivering and assessing success. It is in this area that the performance of the main modes of communication currently in use in the sector could be challenged. The goals of IPM communication will tend to be themes such as:

- monitor the spread of a new threatening species (Goddard et al. 2016),
- measure the effectiveness of pest control measures,
- achieve staff behavioural changes that would result in improved cleanliness,
- provide reassurance to lenders or insurers that good practice is being maintained,
- provide managerial authority to support the IPM manager's recommendations.

Each of these themes goes beyond the detection and identification of a species within a space and relates to a changing state, normally the changing distribution and composition of pest populations. Yet IPM recording tends to prefer formats which show static indicators of presence and total numbers. Even in a museum where the goal is simply to eliminate pests and set a goal of zero occurrences, few museums can deliver such clinical conditions and reporting would still focus on the change in pest population towards the desired level. In almost all cases, as with other agents of deterioration, the target in pest management will be an optimised cost benefit consideration: aiming to create a situation that is better than before or at least no worse. The goal in most pest reporting must therefore be to communicate change.

Research questions

Establishing the purpose of research should influence the nature of that research. A well-defined research question helps ensure that data collected can be used and interpreted, that unnecessary data is not collected, and that data collection serves a purpose. Research questions can be open or closed, from 'We are just starting to consider IPM and want to establish which pests we have and where', through to 'Which species of silverfish are active in store 2?' Research into open questions is as hard to manage as research into closed questions. With complex questions there is a natural human heuristic for attribute substitution where when faced with a difficult question someone responds to an easier to answer question instead (Kahneman 2003). Attribute substitution is not uncommon in collections care, in this context a broad but poorly focussed enquiry such as 'What pests do we have and where are they?' can easily morph into research that answers 'How many pests have we trapped in the locations where we have placed monitors?' As a simple guide, looking at the titles given to your pest trap data may provide insight into what question is being answered and from this suggest who the data is for. A graph titled 'Numbers of pests trapped in store 3' may only be of interest to the person checking the monitors in store 3.

Visual communication and decision goals

Effective sharing of IPM data is therefore connected to the research question and to the needs of the receiver(s) being offered the information. Effective communication of IPM data to a message receiver who is at the awareness stage will be about drawing attention to the issues to try to push it up their mental agenda. In this context, a powerful visual message will activate their attention, and the sense of potential loss should activate concerns (Kahneman and Tversky 1979). Threat-based messages are often ineffective (Miller 1987) so it is wise when communicating with decision-making colleagues to avoid saying 'If you don't stop people eating in store bad things will happen' whereas the same message framed positively can activate their powerful loss aversion heuristic. A more positive message such as ‘If you authorise the deep clean we can prevent the spread of this pest’ might prove more effective. In this context, a visual image of an infested item (one which your receiver considers to be valuable) with a carefully worded message will be far more evocative than a bar graph for decision makers in the awareness phase. Influence need not be restricted to verbal messages, for example giving key staff or, for that matter, the public (Xavier Rowe et al. 2018) pest monitors to place in their home is a symbolic transaction that could increase awareness especially if the receiver discovers moths in their own wardrobe.

It might be imagined that at the information seeking phase the bar graph would come into its own. This however, requires the graph to communicate meaning to the receiver. In evaluating this, the priorities of the receiver or target need to be considered carefully; while some conservators have managers who want to know the ratio of larval to adult stages and the breakdown of proteinaceous and keratinaceous pests, many managers want to be informed about procedural things like: ‘Are we deploying our staff time effectively?’ or ‘Do we have to clean the gallery carpet again?’ In these contexts, the title of the graph should indicate that it answers the receiver’s questions, for example ‘Silver fish numbers since the last carpet clean’. We do not argue for a cessation of the creation of bar graphs with total pest numbers but to use them as an interim point in data collection and interpretation, not as a communication tool.

Looking at post decision processing the influence goal would be the reinforcing of attitudes and behaviours. A manager who has identified IPM as a core task for their team will be pleased to be offered evidence of the success of their decision. Evidence to support good management is more likely to be passed on by that manager as evidence of their abilities, and this reinforcement and public restatement of the value of the task will contribute to reinforcing the manager’s commitment to their team. Success, in this context, can lead to null data. Null data is a hard thing to work with but this image of moth traps from Eton conservators provides a quick and simple visual reassurance that the IPM strategy to reduce moths is working. This visual communication might be sufficient to reinforce decisions that the current practice is effective and should be supported.

<Insert Fig. 4 here>

Conclusions

Improved communication of IPM data can enable more support and resourcing for its practice and is therefore an essential feature of an effective IPM strategy. This paper has identified that there is a weakness in how pest data are analysed, interpreted and represented in many heritage contexts. The weakness applies both to the accuracy of the data and the efficacy of its communication. Effective IPM requires that actions are taken, decisions are made, budgets released or practice changed. To achieve this more work is required on the consistent and influential representation of pest data. At present, much of pest data representation is static, standard and dull. To better represent and communicate IPM data the rational for its collection must be considered, the basis of its collection standardised and the target for communication considered. Data collection intended to affect change must be informed by the change that is sought. Data collection that serves only to fulfil the goal of collecting data will have limited interest for anyone but the data collector. In identifying the person, group or institution that the IPM manager aims to communicate with, it is important to consider their needs, pre-existing knowledge, engagement in the topic, IPM's place in the receiver's priorities and the time and space in which they will consider the message.

Standardisation improves shared data resources, but this is only meaningful if that standardisation is based around a well-considered model. There is a need for a measurement of pest occurrence within a heritage institution that is neutral to the density of pest monitors and room size and that provides a stable index against which change can be measured. This leads to the proposal for a consistent reporting unit for pest density: the pest occurrence index (Baars and Henderson 2019).

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Figures and captions

Fig 1 Shows pest count (y axis) by date (x axis) with colour to differentiate spring/autumn total catch.

Fig 2 Shows pest count (y axis) by number of pest traps (x axis) with colour to differentiate spring/autumn total catch.

Fig 3 Example of a possible poster (inspired by building site safety) celebrating vigilance in pest management.

Fig 4 Several months of Moth traps from Eton College showing a decrease in moth infestation. Courtesy of Sarah Spillett.

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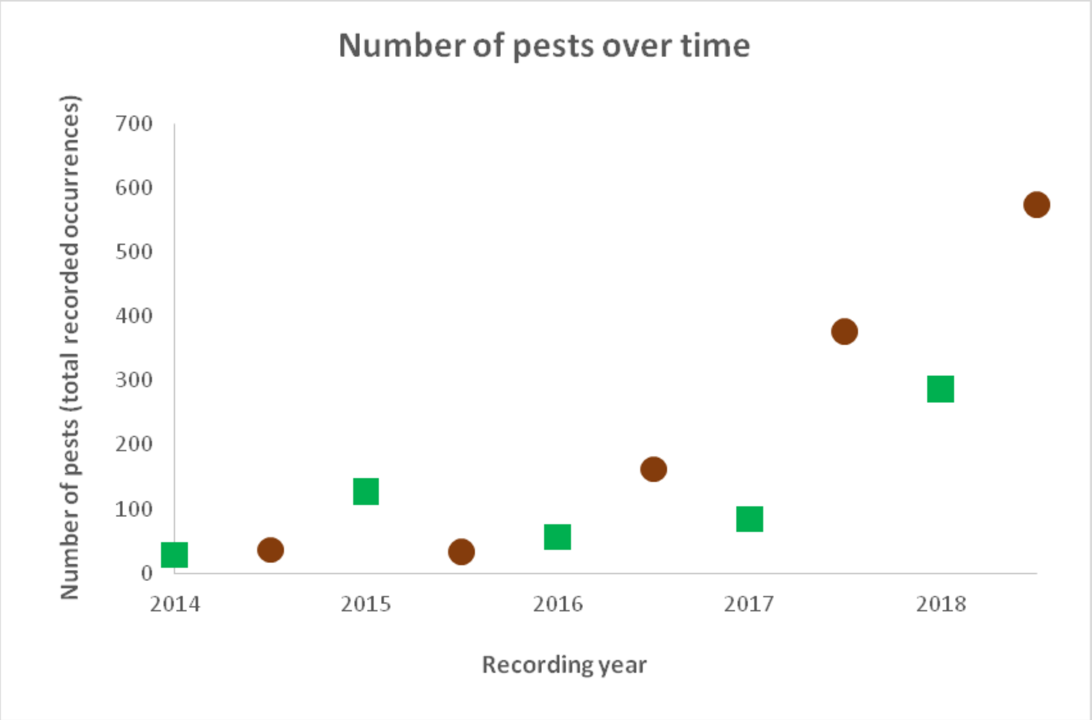

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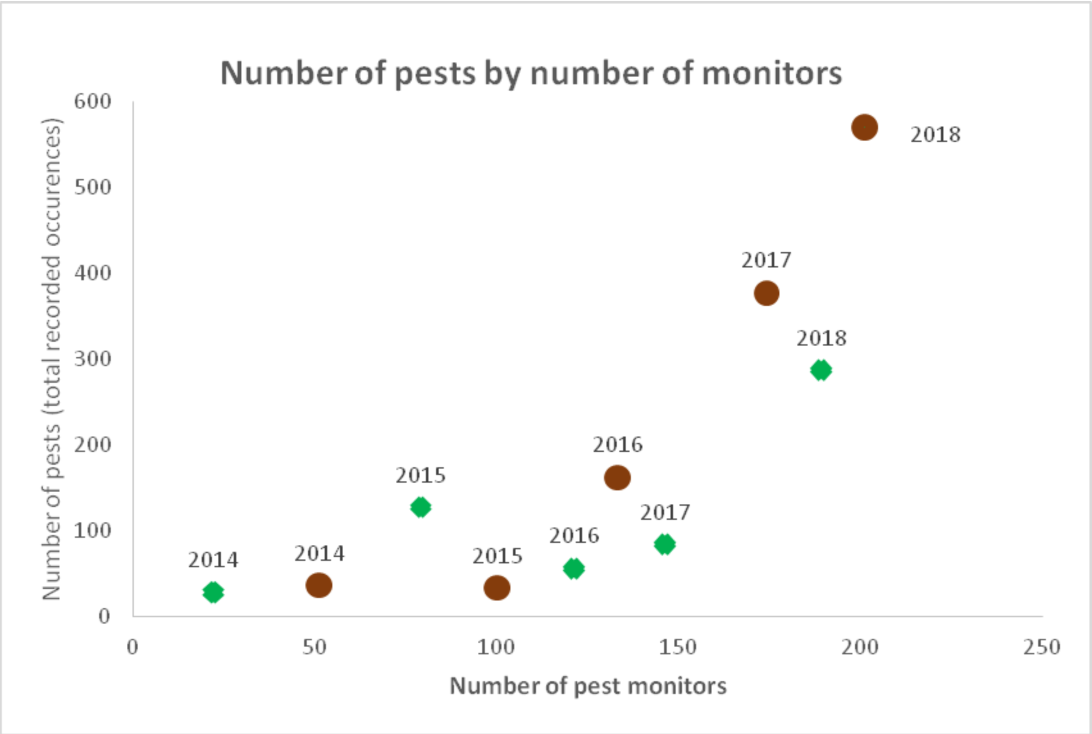

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