

Table 1 IPM related building design features at the Natural Heritage Building: their incorporation, function, effectiveness and improvement

IPM related building features	Part of Original Design	Addition to original design	Change to original design	Function of IPM building design feature	why an addition or change to the original design was necessary	IPM feature functioning effectively	How to improve the effectiveness of IPM building design feature
The NHB Exterior							
<i>The building envelope</i>							
Foundation/walls/roof:							
gaps around conduit lines, piping and ventilation ducts properly sealed	X			keep pests out		Y	
all exterior holes, cracks, gaps and crevices sealed/caulked	X			keep pests out		Y	
vents fitted with screens	X			keep pests out		Y	
building exterior fabricated of a light colour	X			aids in visual inspection of pests		Y	
Doors:							
properly fitted door sweeps	X		X	keep pests out	changing the door sweeps is part of regular building maintenance	Y	
weather-stripping along both sides of doors and across tops	X			keep pests out		Y	
main entrances utilize two sets of doors	X			keep pests out		Y	
loading dock cargo door equipped with bird netting		X		pest deterrent while cargo doors are open	a few years after opening we had some problems with birds nesting in the space atop the loading dock doors. The netting was added and we have been incident free since then.	Y	
Windows:							
do not open	X			keep pests out		Y	
Landscaping:							
vegetation free zone	X		X	pest deterrent; visual inspection aid; protects foundation from roots; better air circulation along walls	over time seeds and soil fall into the vegetation free zone. If not weeded on a regular basis this zone can become full of plant life and loose its effectiveness as an important IPM building feature. This is what has been happening to our vegetation free zone over time.	N	maintenance (weeding) of this area is necessary for it to work effectively; appropriate funds need to be allocated for its upkeep
no window boxes or elevated planters	X			avoided because: harbourage for rodents; can accumulate debris and food trash		Y	

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no tree or shrub should come in contact with any part of building	X		X	avoided because: shelter pests; easy access for climbing pests; fire risk; difficult visual inspections; increase moisture content along foundation walls	the trees and shrubs have been allowed to naturalize. Although they were an appropriate distance away from the building when first planted they are now coming into contact with the building.	N	maintenance (pruning) of the trees and shrubs on the grounds are necessary; appropriate funds need to be allocated for its upkeep
ground slopes away from building	X			results in no standing water next to building. High moisture areas promote mould/mildew growth that can then support pests		Y	
areas around building well maintained and clutter free	X			aids in visual inspection; no harbourage areas for pests		Y	
Garbage:							
garbage receptacles available on site	X			good housekeeping practices		Y	
garbage receptacles emptied on a regular basis	X			good housekeeping practices; limits pest food source; deterrent to pests;		Y	
dumpster a minimum of 15 meters (50 feet) from doors	X			limits pest food source		Y	
dumpster lids seal properly	X			keeps pests out; no food source available		Y	
dumpster is rodent proof	X			keeps pests out; no food source available		Y	
Lights:							
positioned and directed away from entrances and ventilation intakes	X			discourage pests from building entrances; draw pests away from building openings		Y	
sodium vapour bulbs used		X		lighting is less attractive to insects	A change was made to sodium vapour lighting primarily for their energy efficiency. An added bonus is their being less attractive to pests.	Y	
reduce interior lighting visible to the outside		X		helps reduce amount of pests attracted to building	With the need to reduce energy consumption came the turning off of many lights that had once been visible during the night hours. This energy saving reduction also had the effect of reducing the number of pests being attracted to our building.	Y	

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Interior of NHB							
Overall Building Layout:							
three separate collection pods	X			environmental control; collections isolated from one another thereby reducing risk of migration of pests from one area to another		Y	
Dynamic buffer zone around collection pods	X			keeps pests out; no cold external walls; no external openings; aids in RH and temperature regulation		Y	
collection pods are single storey	X			keeps pests out; reduces risk of pests entering via connection to above floors		Y	
cafeteria away from collections	X			keeps pests out; areas with highest chance of pests kept farthest away from collections		Y	
office spaces away from collections	X		X	keeps pests out; areas with highest chance of pests kept farthest away from collections	For a variety of reasons many staff members who also have space available in lab areas have taken to working primarily in these locations. As these lab spaces begin to function more as office spaces IPM procedures are often forgotten.	N	A space allocation project is currently underway to better utilize the office and lab spaces available to staff. This should eliminate the need of some staff to treat lab space as their primary office.
labs separated from collection pods by corridor	X			keeps pests out; reduces risk of pests to collections due to water sources and human activity		Y	
central security desk located at main entrance	X			keeps pests out; all visitors must sign in and given brief orientation - no bags, food or drinks in collection and lab areas		Y	
loading dock area separated from collection areas	X			keeps pests out		Y	
dedicated garbage room off loading dock	X			keeps pests out; contains any occurrence of pests attracted to garbage		Y	

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dedicated IPM area:	X			keeps pests out; all potentially contaminated material (anything coming into the NHB and destined for collections or labs) is processed through this area.		Y	
unpacking room	X		X	keeps pests out; corrugated cardboard and packing materials stored here.	Was intended to be a well organized area, with users responsibly discarding dirty packing material and storing reusable materials neatly. This room is now full of dirty boxes etc. thrown in piles.	N	multiple users and lack of responsibility among them for this space have left it a constant mess. Increase in staff awareness of IPM (required yearly IPM re-orientation or training specific to this room) may help
three walk in freezers and various chest freezers	X		X	keeps pests out; our most used tools for handling contaminated materials		Y	
temporary holding room	X		X	keeps pests out; unclean items waiting to be dealt with stay here	Originally designed to be a "temporary holding area" while items wait for available freezer space, etc. This room is now full of field gear, miscellaneous items, etc.	N	this has become somewhat of a dumping ground for items no one wants to deal with. Once in this room they seem to remain forgotten. An annual cleaning of this space with unclaimed items being discarded/recycled may help
CO2 bubble room	X		X	keeps pests out; was to be used for IPM purposes	this space was never used effectively for its intended purpose and has recently been turned into a "dirty lab" space allowing researchers to work with material not able to enter the collection and lab corridor because it hasn't passed through the proper IPM procedures	N	although not being used effectively for its originally intended purpose this room's designation as a "dirty lab" is the positive result of having an effective IPM program in place.

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Collection pods:							
divided into 4 zones each with specific environmental set points	X			keeps pests out; RH and temperature control discourages some pests		Y	
each zone is on its own HVAC system	X			keeps pests out; RH and temperature control discourages some pests; reduces migration of pests from one zone to another		Y	
one zone designated a fur vault	X			most susceptible collection to pests; keeps pests out; RH and temperature control discourages many pests; reduces migration of pests from one zone to another		Y	
restricted access using swipe cards	X			keeps pests out		Y	
Doors:							
sweeps	X		X	keeps pests out	door sweeps were removed and replaced by automatic door bottoms (ADB). The idea was great but the doors now no longer close properly. This results in some of them being left ajar and creating a greater opening for pests to enter than if the original sweeps had been left on.	N	Although costly, the current sweeps should be replaced. When replacements are needed properly fitted ones should be used. Better communication between museum departments would have corrected this before it became a problem.
double doors	X		X	keeps pests out	door thresholds were removed to allow for smoother transport of carts in and out of collection and lab rooms.		Ensuring all doors are equipped with properly working door sweeps will effectively block any pests.
Ceilings:							
no suspended ceilings	X			aids in visual inspection; no pest harbourage; prevents build up of dead pests and breeding areas; aids in good housekeeping		Y	
Walls:							
painted a light colour	X			aids in visual inspection		Y	

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Floors:							
no carpet	X			less attractive to pests; doesn't trap food sources that support pests		Y	
light colour	X			aids in visual inspection		Y	
no baseboards - floor material curves upward on wall	X			aids in visual inspection; reduces accumulation of food sources for pests; no pest harbourage		Y	
Cabinets:							
movable by forklift	X			aids in treatment if pests found; complete cabinets can be moved directly into walk in freezers		Y	
good seals on cabinet doors	X	X	X	keeps pests out; can also work to keep pests in	Time and budgets permitting, old seals are removed from cabinets and replaced with new ones.	Y	
new cabinets upon move	X	X	X	keeps pests out; can also keep pests in; clean and fitted with good gaskets	Time and budgets permitting, new cabinets have continued to be added to collection pods as needed.	Y	
Shelving:							
open and visible	X	X	X	aids in visual inspection; no pest harbourage or dark pest breeding areas	Time and budgets permitting, open shelving continues to be used and added to collection pods when needed.	Y	
Miscellaneous:							
zap traps installed in office areas		X		attracts wasps and other flying pests; eliminates any that enter	these were deemed necessary to help deal with wasps in office areas.	N	It is crucial that the cleaning of these traps be added to existing housekeeping procedures to avoid the dead insects attracting additional pests.

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Policy and procedures							
no food or drink in collection pods	X			good housekeeping; eliminates food sources for pests		N	a very small number of staff refuse to follow all of the IPM procedures. An increase in staff awareness of IPM (required yearly IPM re-orientation) may help. Realistically we may have to wait patiently for their retirement. An increase in the value of IPM is needed to ensure that directors enforce the procedures
no live plants allowed in building	X			good housekeeping; eliminates food sources for pests		Y	
IPM training for all new staff, students and volunteers		X		shares knowledge of IPM and reasons for our procedures and policies; once trained all staff have potential to aid in IPM efforts	sharing knowledge and advice on IPM has shown to be our best defence against pests. IPM policy and procedures only work if people are aware of them and understand the reasons behind them.	Y	
storage containers for food given to all staff		X		keeps pests out; eliminates food sources for pests	we began doing this as a way to encourage staff to follow appropriate IPM procedures regarding food in the workplace. The conservation section hands out assorted reusable containers with a note about IPM and the importance of keeping your food sealed.	N	this works well except there is a large amount of students, interns and volunteers. It is difficult to keep up with the need for the containers and who will cover the costs.
pest report forms available		X		facilitates communication between staff/visitors and IPM specialist	This is a standard form that lets staff and visitors alert conservation as to any pest sightings. The forms are easily accessible to all and located on several bulletin boards.	Y	

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conservation IPM specialist on staff		X		individual(s) responsible for IPM program; provides knowledge and training for institution; designated individual(s) ensures IPM program is accountable	Within our organization the conservation section is responsible for running the IPM monitoring program and handling all areas of IPM. We work closely with Facilities to ensure IPM practices are successful.	Y	
live animal care policy	X			adds to staff knowledge		Y	
pest management procedures in place		X		ensures accountability; adds to staff knowledge	compiled after our move to the NHB	Y	
housekeeping procedures		X	X	keeps pests out; essential to an IPM program; eliminates food sources for pests; ensures accountability	compiled after our move to the NHB; continues to change as we become more aware of areas to focus on as a result of our IPM monitoring	Y	
IPM monitoring program in place	X		X	keeps pests out; ensures accountability; essential	compiled after our move to the NHB; continues to change as we become more aware of areas to focus on as a result of our IPM monitoring	Y	
use of lockers procedures		X		keeps pests out; adds to staff knowledge	compiled after our move to the NHB; the result of our IPM program and the need to ensure lockers were being cleaned out on a regular basis.	Y	