

# AN ODD PROBLEM TO FACE: INTEGRATED PEST MANAGEMENT AND *Thylodrias contractus* Motschulsky, 1839

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In this talk I will take you on a 25 year journey of failures and successes at controlling an odd beetle infestation.

*Thylodrias contractus*, or odd beetle, is an unusual dermestid. The males and females look strikingly different from each other and neither looks like any other dermestid. Like other dermestids, though, they prefer the tasty proteins found in natural history collections. In fact, odd beetles are found almost exclusively in museums.

## ODD BEETLE *Thyodrias Contractus* Motschulsky, 1839

Female



Male



Larva



The odd beetle is native to Central Asia. Odd beetles do not move around easily on their own. They need human help to spread. Once they infest a collection, they can stowaway to other museums through loans. They have adapted to life in museum collections throughout Europe and North America.

The most striking feature of the odd beetle is sexual dimorphism. Adult females are larva-like, pale and teardrop shaped. Adult males are dark with small white wings. Larva have thick rows of short hairs on the head and on each segment and are often found curled in a C shape. Adults are usually 2-3mm long and larvae grow up to 5mm. The females cannot fly and the males are very poor flyers which is why they cannot spread without help.

The odd beetle life cycle lasts about a year. The eggs hatch within a couple weeks. The larva will live anywhere from 10 months to 5 years before pupating. The larva can live for years without eating. Adults live about a month. Long dormant periods make the odd beetle challenging to track. At the Science Museum of Minnesota, for example, we find odd beetles in blunder traps months apart. We monitor them over years rather than months or weeks.

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# MuseumPests.net

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## Odd Beetle *Thyodrias contractus*



### GENERAL INFORMATION

What makes the odd beetle so odd is its sexual dimorphism: the male and female of the species look nothing alike. Though the adult female is larviform in appearance it is characteristically different from the larvae as well. Larvae themselves do not appear sexually dimorphic. Though similar in appearance to other carpet beetle larvae the odd beetle is distinctive in that they lack long hairs at the tip of the abdomen and the upper body is not covered with short hairs. Rows of hairs exist at each segment as noted in the Diagnostic Morphology section. When disturbed the larvae curl into a "C" or crescent shape.

Native to Central Asia they must be introduced in order to disperse. This is largely due to the female's inability to fly. Now widely found throughout cultural institutions and other areas, they are described as a cosmopolitan species. It is likely that the species is dependant upon humans and building environments in North America.

### SIGNS OF INFESTATION

Signs of odd beetle infestation will most likely be in the form of damage to specimens, furs and the cast skins from larval insects. As the males can fly, in some rare instances flying adults may be observed.

### FOOD SOURCES

In the past the odd beetle was often referred to as



Information current as of 16 April, 2007  
For more information visit [www.museumpests.net](http://www.museumpests.net)

### DIAGNOSTIC MORPHOLOGY

#### Adults:

- Adult Male: Resting elytra meet at along top third of length, then diverge to reveal abdomen. Long narrow body with thin appendages
- Adult Female: Wingless and larviform shaped body
- Both: 2.5mm in length - Thinly covered with short, pale hairs - clubbed, 9 segmented antennae uniform in thickness along length - Median ocellus between compound eyes



#### Immature Stage:

- Full size - 3mm
- Single transverse row of hairs across the dorsum at each segment



the "tissue paper beetle" because of early literature describing an outbreak in tissue paper erroneously identifying the paper as the food source. It is now thought that the beetles were feeding on whatever was in the paper. Their primary dietary preference is dried animal matter. This makes natural history collections particularly susceptible to odd beetle infestations. This includes skins, bones, fur, feathers, insect collections, and natural fiber fabrics such as silk and wool. Infestations have been observed in collections of birds nests. Odd beetles have also been observed burrowing into bone where it is thought they are attracted to the moisture of dried tissue.

### LIFE CYCLE

The life cycle of the odd beetle lasts for approximately one year or slightly longer. The eggs are elliptical and a translucent white in color. They are .2mm long. After 23 - 30 days the larvae emerge. They will live the majority of their life as larvae (242-368 days), entering a short pupal stage (7-14 days) just before adulthood. The life expectancy of the adult itself is varied, living as short as one day or surviving as much as fifty days.

### CONTROL & TREATMENT

Due to the fact that females are flightless and must be introduced into a collection, prevention is the first line of defense against the odd beetle. However, once an infestation has been found, thoroughly inspect and identify the scope of the infestation. This includes all storage cabinets, drawers and/or display cases. When treating an infestation be sure to include nearby cracks and fissures where pupae may be deposited.

Undisturbed corners in natural history collection storage areas are ideal breeding locations. Odd beetles are very tiny and they eat rather slowly compared to other museum pests. It can be difficult to see an infestation on specimens. Museum staff can inadvertently spread odd beetles by moving infested specimens or materials to different locations, as you will see later in this talk.

For more information on odd beetles and lots of other IPM related content, please check out MuseumPests.net.

Since odd beetles cannot easily move from place to place, the best control method for them is prevention. Standard IPM procedures of inspection, isolation, preventive treatment, and monitoring should work. What happens, then, when a fairly robust IPM program fails to control odd beetles?

## DON'T MOVE PESTS\*



Old Buildings 1963-1999



Image courtesy of Verne Anderson



Current Building

**\*OR TRY REALLY HARD NOT TO MOVE PESTS EVEN THOUGH YOU ARE USING STRICT IPM MEASURES**



**Science Museum of Minnesota staff first discovered odd beetles in a display in the 1980's. The infestation spread to a biology collections storage room, among other spaces. Regular IPM monitoring began in the early 1990's and has continued to the present. When the museum moved to a new building in 1999, the conservation department used extensive IPM methods to prevent bringing odd beetles and other pests along.**

**During the move, we froze all the specimens stored in areas that our regular IPM monitoring identified as having the worst odd beetle infestations. We were largely successful at preventing the odd beetles from moving into our new collections storage area.**

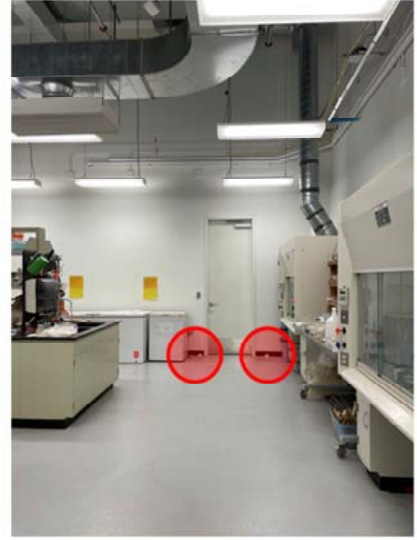
## FIRST MISTAKE = MOVING INFESTED LAB SUPPLIES



Doors to corridor



Bench with specimens



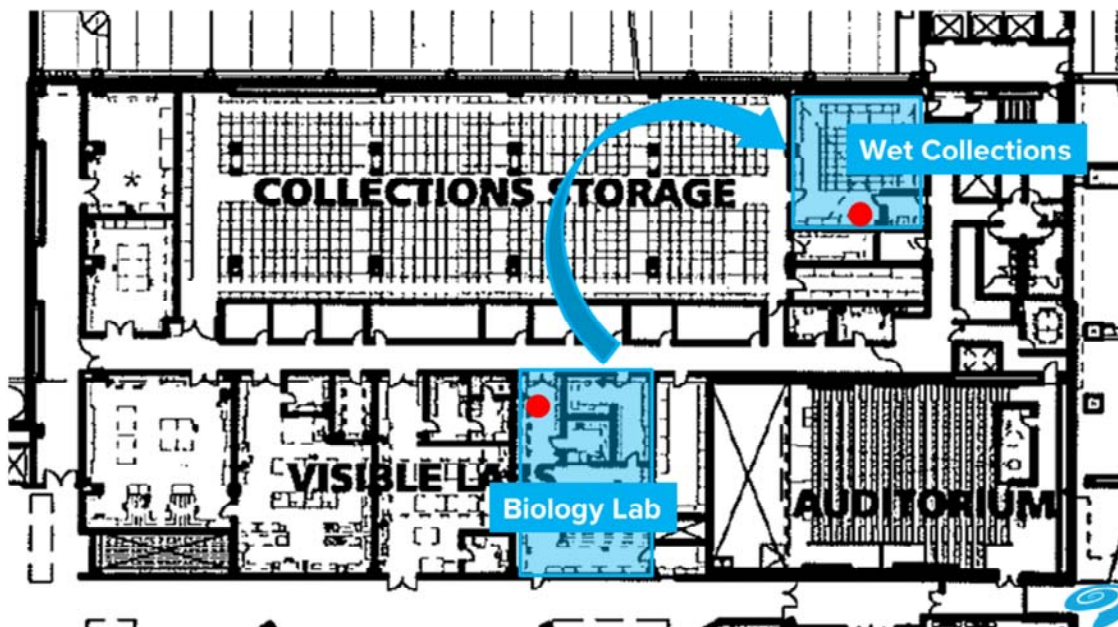
Egress door to exhibits



Unfortunately we neglected to freeze or isolate the biology lab equipment and supplies. Mistake number 1. We discovered our first odd beetle hitchhikers in the new biology lab within a month of the move. This slide shows the locations of some of the blunder traps in the new biology lab. We typically only catch one or two beetles at a time.

In the new building, we check about 200 insect blunder traps twice monthly. We have traps throughout the 9 story building, located by doorways, equipment rooms, vulnerable exhibits, offices, and areas where food is prepared, served and stored. Because we have this extensive trap network, we have been able to track the odd beetle spread through the building over the years.

### LEVEL 3



Within a few months of moving in, we were catching odd beetles in wet collections storage. It turns out I had inadvertently moved the odd beetles harboring inside boxes of empty jars into the room. Mistake number 2. From that point on we consistently caught odd beetles in wet collections and the biology lab.

We implemented a policy of low temperature treatment for everything leaving the biology lab to augment the existing procedure of freezing or isolating objects coming into collections storage. We now limit what equipment and materials can move into collections storage as well.



## SECOND MISTAKE = MOVING SUPPLIES FROM LAB TO STORAGE



Wet collections



Boxes of jars



Only access to the floor through grate

**IPM in wet collections storage is hampered by the dropped floor and immovable grates we were required to install by the fire inspector. There is only one area where you can place a blunder trap on actual floor. Cleaning the floor is a tedious exercise in using a custom wand-like vacuum attachment that can reach through the grate and cover a 15cm square at a time. Due to the difficulty of cleaning floor, the odd beetles can exist largely undisturbed. We were more likely to catch multiple odd beetles at a time in traps in wet collections. Contact me if you want to hear the saga of this floor system!**



August 2002 Odd Beetle

Key  
♦ Male adult  
▲ Female adult  
● Larva



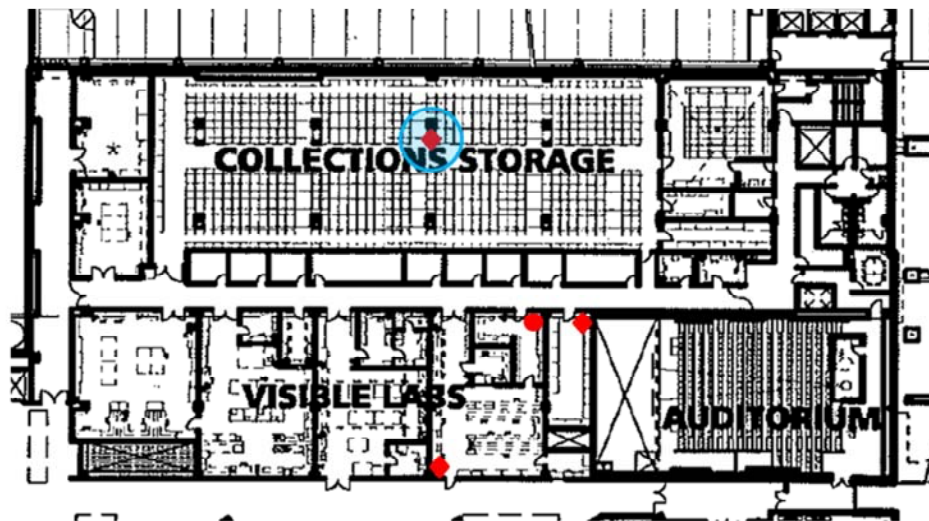
First male odd beetle caught after returned loan placed on this shelf



In another incident in 2002, we placed a box with a returned taxidermy loan on a shelf in the middle of the main collections storage. We neglected to freeze or isolate the specimens.

March 2003 Odd Beetle

Key  
♦ Male adult  
▲ Female adult  
● Larva



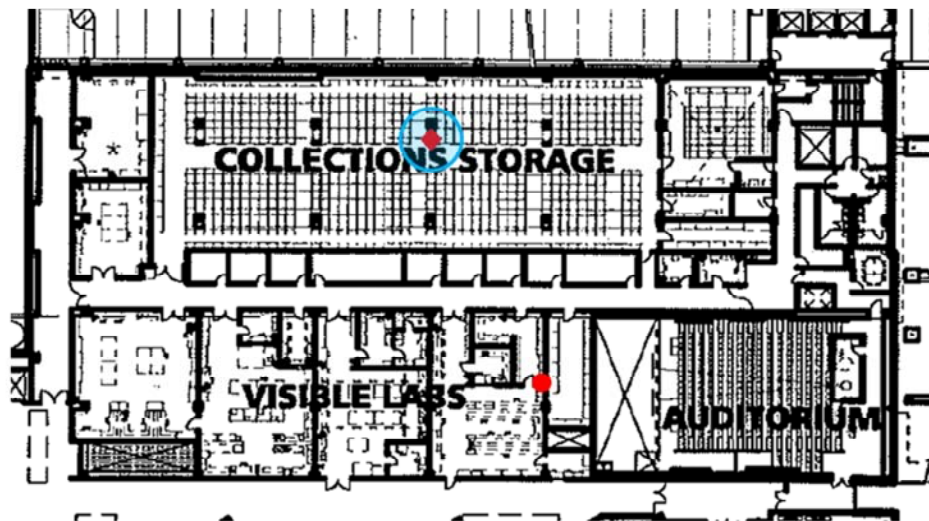
Second male odd beetle caught in this location, 7 months later



We caught single odd beetles in the nearby blunder trap about once per year.

April 2004 Odd Beetle

Key  
♦ Male adult  
▲ Female adult  
● Larva



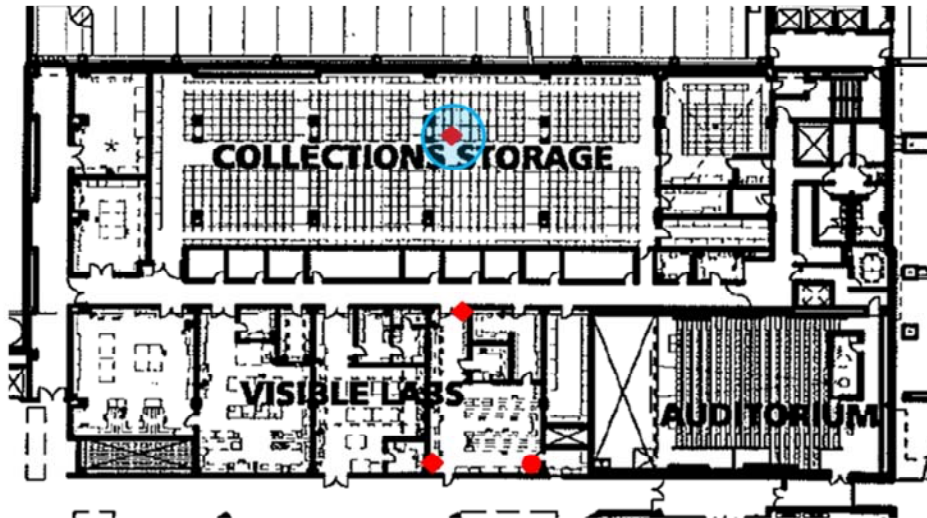
Third male odd beetle caught in this location, 13 months after the second one



After a couple years we knew we had a problem rather than a coincidence. We traced the insects to the returned loan, which we luckily hadn't returned to cabinets. We froze it immediately and cleaned the area.

January 2006 Odd Beetle

Key  
♦ Male adult  
▲ Female adult  
● Larva



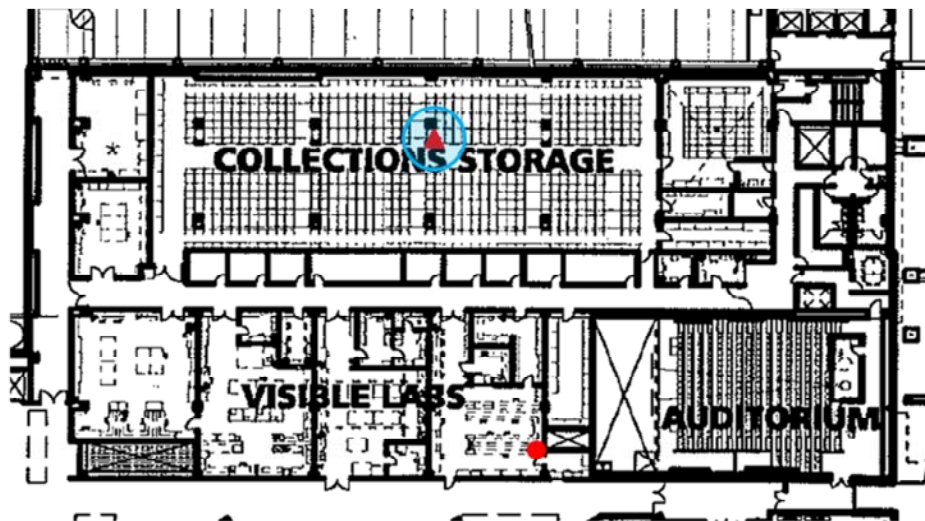
Fourth male odd caught, 21 months after the third one



We had a couple odd beetles in the years after we treated the returned loan

December 2006 Odd Beetle

Key  
♦ Male adult  
▲ Female adult  
● Larva



Last odd beetle, a female, caught in this location, 11 months after the fourth one



After a few years, we no longer caught odd beetles in that spot. The incidents remind us to be extra vigilant when moving specimens or supplies into collections.

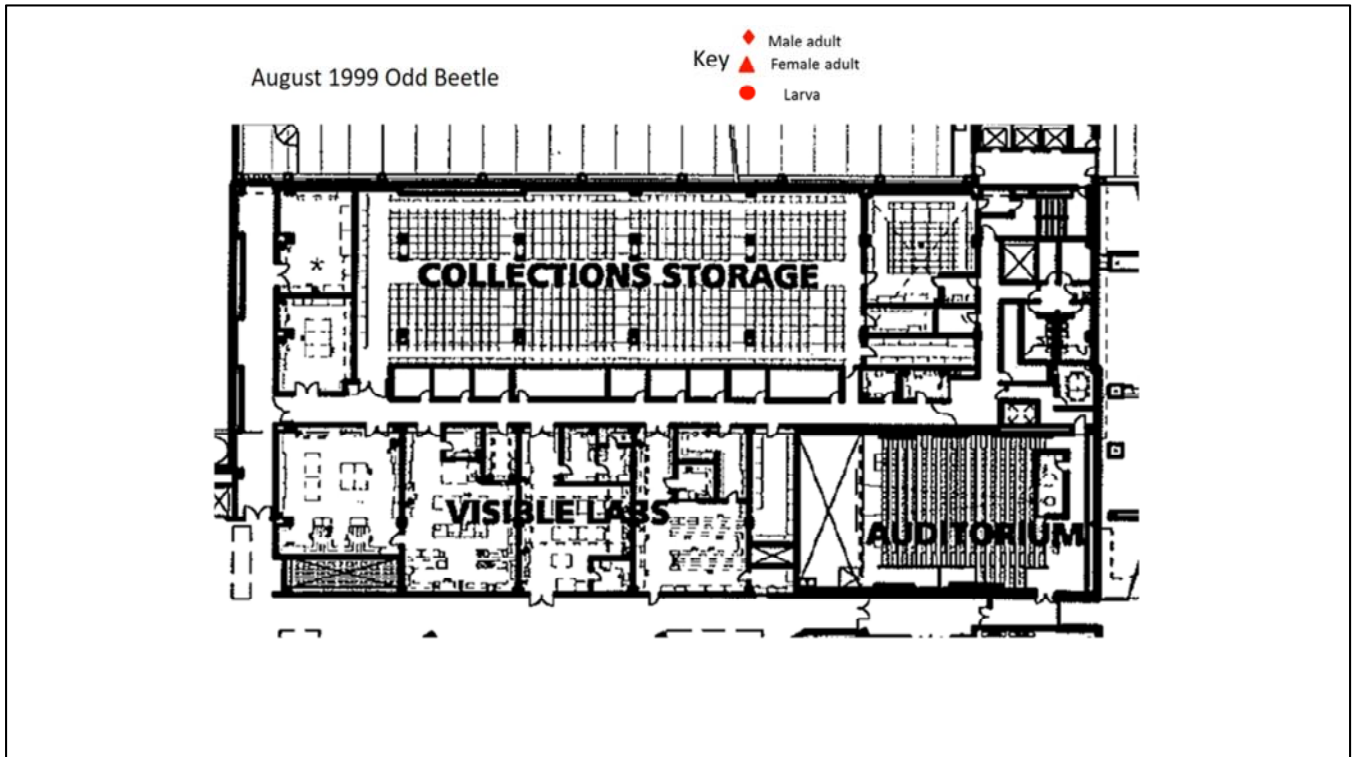


Image courtesy of Verne Anderson



**The long life cycle of odd beetles makes it hard to track an outbreak. Catching a single specimen in the same area months or years apart can seem like a coincidence. It took 15 years for odd beetles to spread throughout our new building. We have accidentally moved infested materials and caused some of the spread between the labs and storage. The spread through the rest of the building is harder to explain. I was baffled by this and at the 2014 SPNHC meeting I asked Tom Strang for some advice on handling such a wide ranging infestation. After expressing his sympathy, he suggested mapping the incidences to look for patterns.**

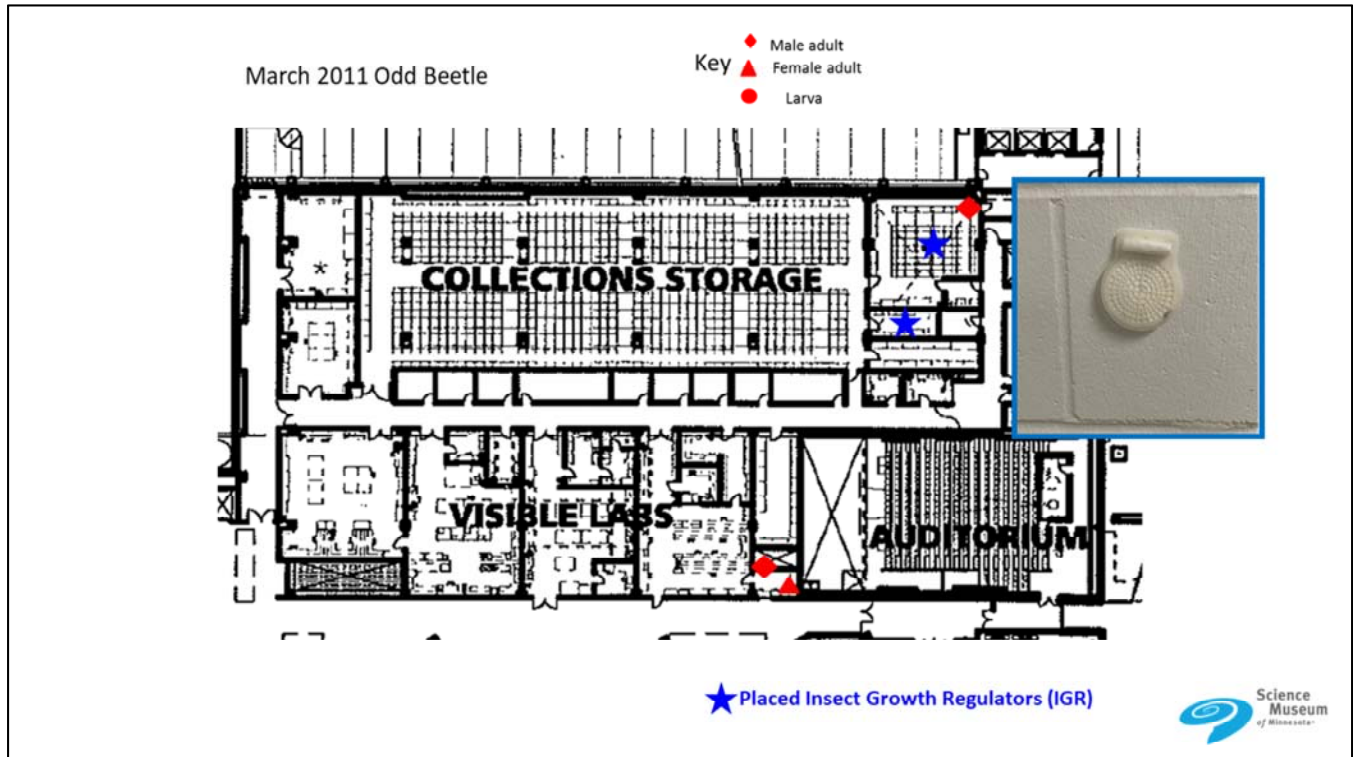




I decided to use PowerPoint as a simple way to map odd beetles. I copy a floorplan into a slide for every month. Then I place markers to indicate where we catch odd beetles. I differentiate between females, males and larvae, just in case it might show patterns.

When you rapidly scroll through the slides, the odd beetle catches appear animated and give a visual understanding of the spread. Mapping them this way helps me make sense of where the beetles spread and the intervals between their occurrences.

Watch this animation of odd beetles on level 3, where the labs and collections storage are located. Don't worry about reading individual slides, just watch the patterns. I will single out incidents later.



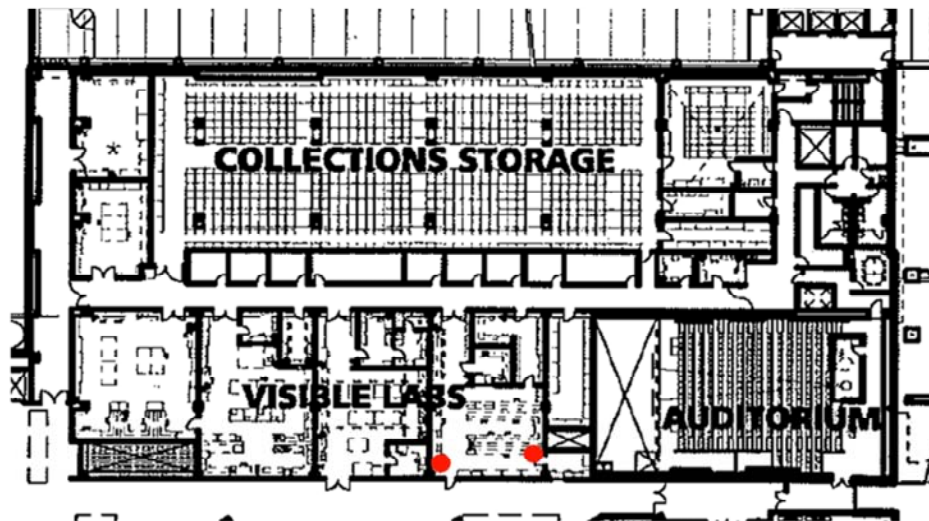
Since we were starting to catch more odd beetles in wet collections by 2011, we decided to experiment with using Insect Growth Regulators in wet collections and the adjacent entomology storage. IGR's are not targeted at odd beetles and they only work for about 90 days. It was a gamble. We changed the Gentrol disks every few months.

We did not use IGR's in the biology lab because our dermestid colony is located in an adjacent room seen here with the triangle and diamond marks.

Before you ask, the room has a very tight door sweep and gasketing on the jamb. We have also covered all of the vents with fine mesh to prevent the dermestids from getting into the dedicated HVAC system. There is a chest freezer in the room to treat specimens after they come out of the tank. In 21 years we have only had a couple *Dermestes maculatus* escape. Since odd beetles are much smaller, they do manage to get into the room. Feel free to contact me to hear about how we've successfully contained dermestids in their room over the years. We even have a window between the room and the galleries that visitors can look through to see the action in the tank.

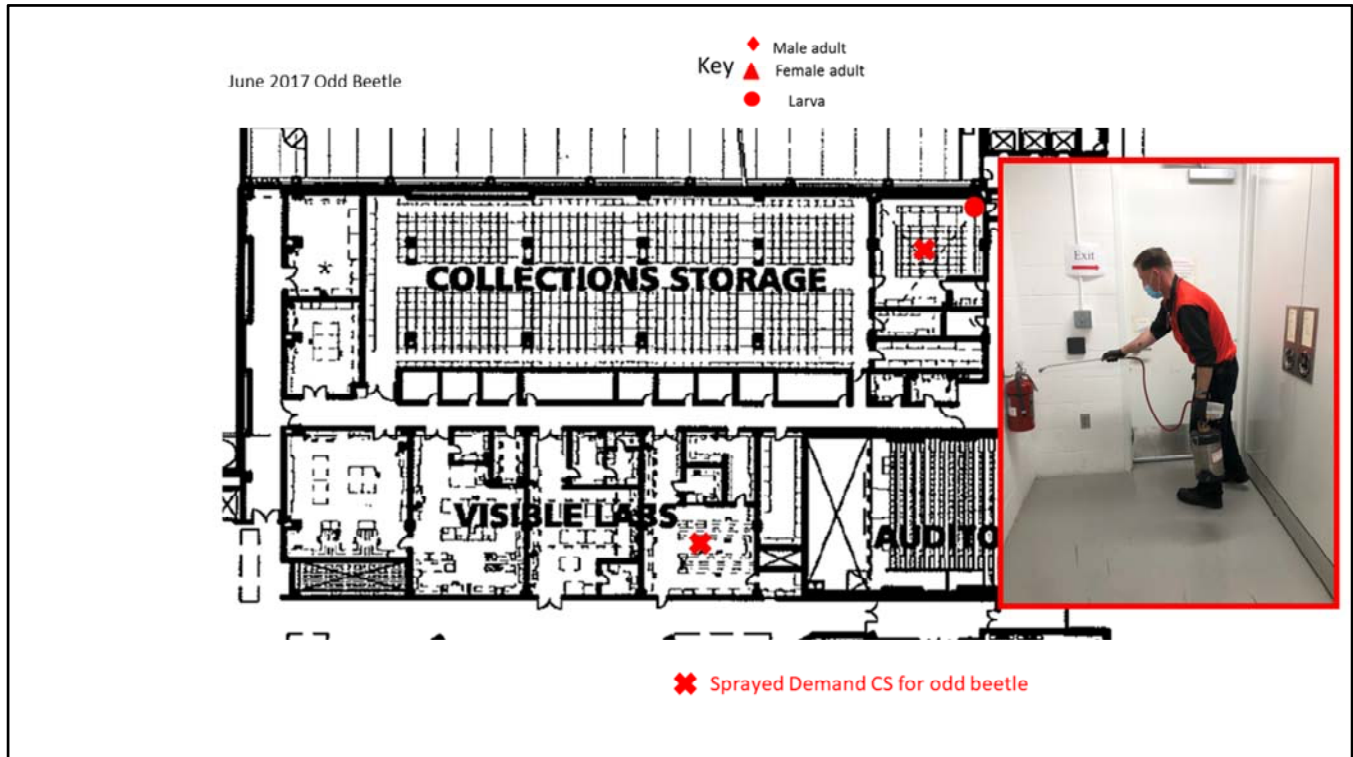
April 2011 Odd Beetle

Key  
♦ Male adult  
▲ Female adult  
● Larva



As you will see in the next animation, the IGR's had little effect on controlling odd beetles.

In fact, we were catching more in the space over the years. We knew the IGR's weren't working. In 2016 a Pestlist discussion between Alan Van Dyke, Joel Voron, Tom Parker and Louis Sorkin brought up the idea that using IGR's prolongs the larval stage of an insect which is potentially more damaging since dermestids typically only eat as larvae. That convinced me to remove the IGR's by the end of 2016.



In early 2017, Josh Walden, our pest control contractor, proposed targeted interior base board spraying with Demand CS. Demand CS is a water based synthetic pyrethrin effective on a wide range of insects. It lasts up to 90 days. It can only be applied by a licensed exterminator.

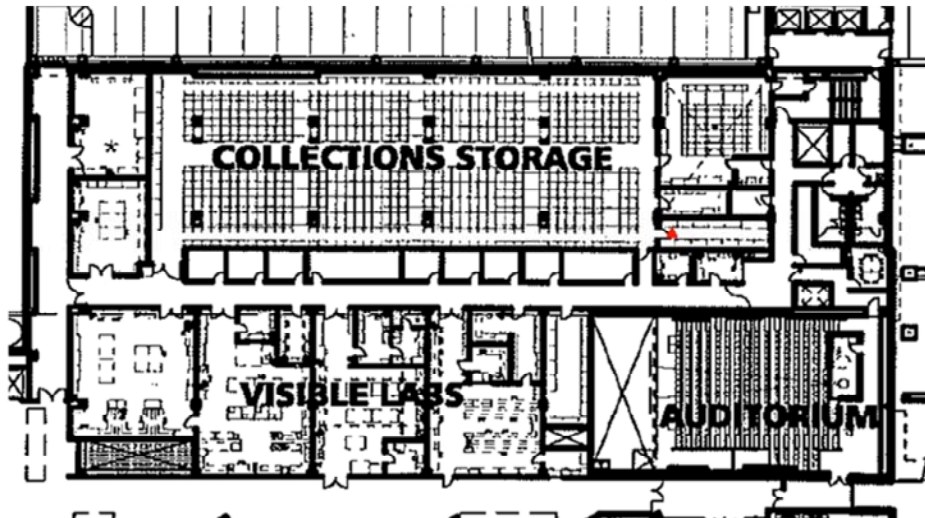
I had been hesitant to use pesticide sprays inside collections storage and the labs up to this point. I was nervous the spray could accidentally land on objects. I also wanted to avoid pesticide overuse.

But we previously had success using Demand CS baseboard spraying in an office area with a webbing clothes moth infestation brought in by an employee from home. During those applications I could see that the spray is pretty wet and lands right where you spray it. It doesn't produce a mist that could blow onto something nearby.

The challenge, then, was to identify when and where to spray for the most effective pesticide application.

July 2017 Odd Beetle

Key  
♦ Male adult  
▲ Female adult  
● Larva



By looking at the data through mapping, I made an educated guess that we have several breeding populations on different schedules on level 3. Regular baseboard spraying makes sense in the area. In fact, we have seen a dramatic reduction in catches since we started spraying every 6-12 months.

The results of the spraying made me hopeful that we can bring down the numbers in other parts of the museum as well.



## ODD BEETLE SPREAD TO OTHER LEVELS

Level 2



Staff Offices

Level 4



Call Center/  
Lost and Found

Level 4



Event Space

Level 4M



Staff Break Area

Level 6



Utility Room

**After several years in the building, we were catching odd beetles on other floors. The interval between finding odd beetles in the same trap location could be up to 3 years. At first I figured they were coincidences and I didn't put much thought into them. In the meantime, the odd beetles kept spreading throughout the building. We have caught them on all 9 floors in offices, event spaces, break areas, and utility closets, for example.**



## ODD BEETLES 1999



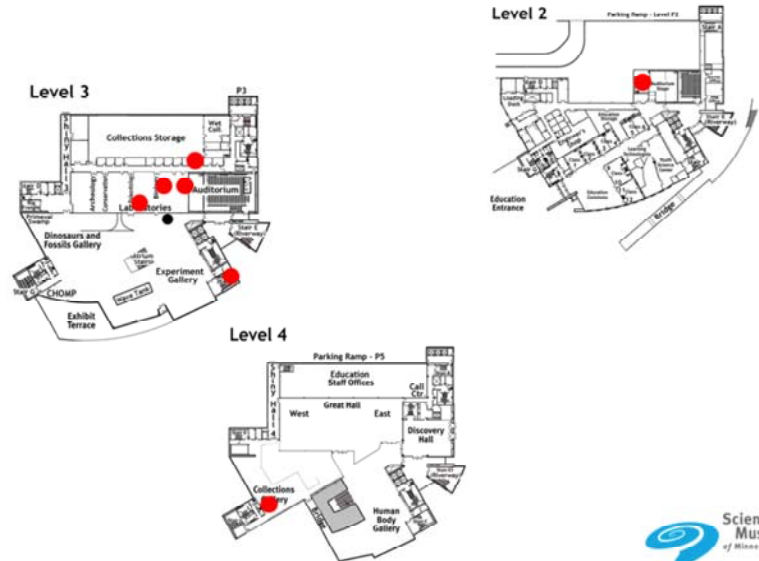
While the spread on level 3 is easy to understand, the spread to other floors is not as easily explained.

## ODD BEETLES 2000



By 2000, they showed up on level 2 in the storage area for our theater programs. These could have been hitchhikers from the move since the theater storage was located close to the biology lab in the old building. This population died out over a few years without any treatment

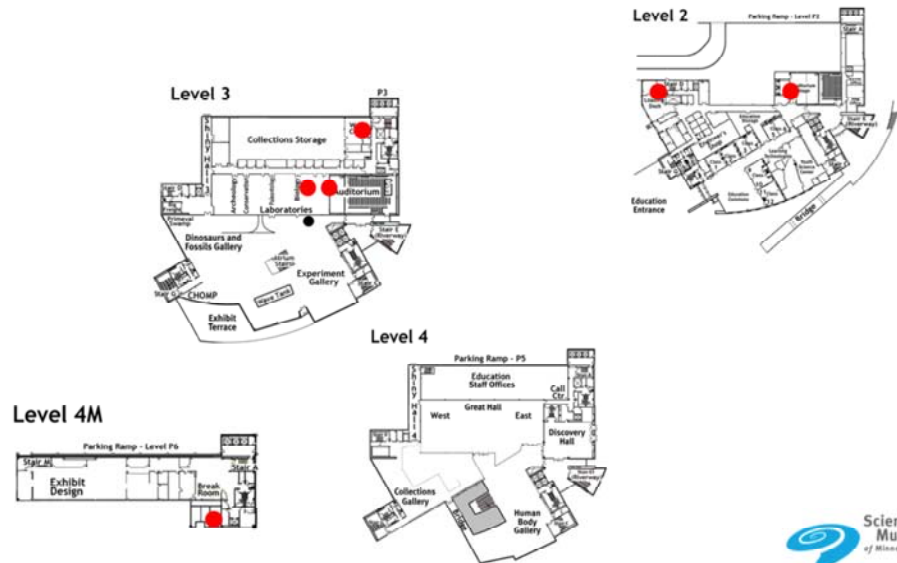
## ODD BEETLES 2002



In 2002, odd beetles showed up in Collectors' Corner, which is a trading post for visitors to bring in selected natural items in exchange for points. They can use the points to "buy" other natural items. For example, a visitor could bring in cool rocks they find over a period of time. They can save up the points from each rock to exchange for a cooler rock. Organic items brought in for trade are frozen immediately and monitored for pests once they are brought back for trade. As you can imagine, we have many blunder traps in this area. At that time, the Collectors' Corner was also used to receive and return items brought in by guests to be identified by museum scientists. Once again, organic items were frozen before the scientists could ID them. ID's took place on level 3 so an odd beetle could have been carried on an item being returned to Collectors' Corner for the owner to pick up.

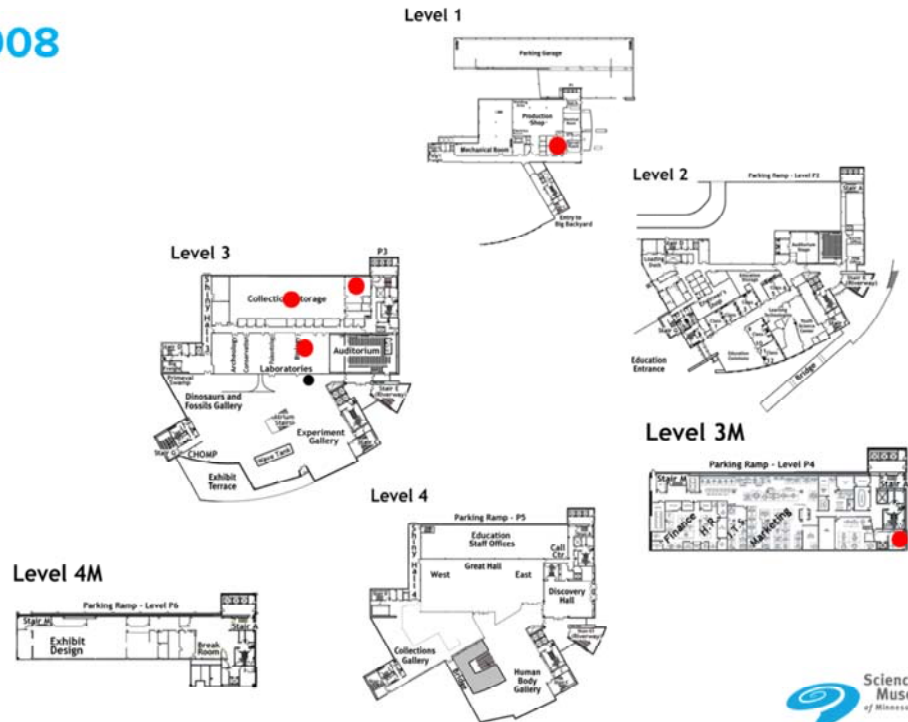
This was a single, isolated odd beetle catch in the area. Odd beetle do not reoccur on level 4 until 2011.

## ODD BEETLES 2005



By 2005, we had odd beetles in a staff break area on 4M, a mezzanine between levels 4 and 5. I have no idea how they traveled there.

## ODD BEETLES 2008

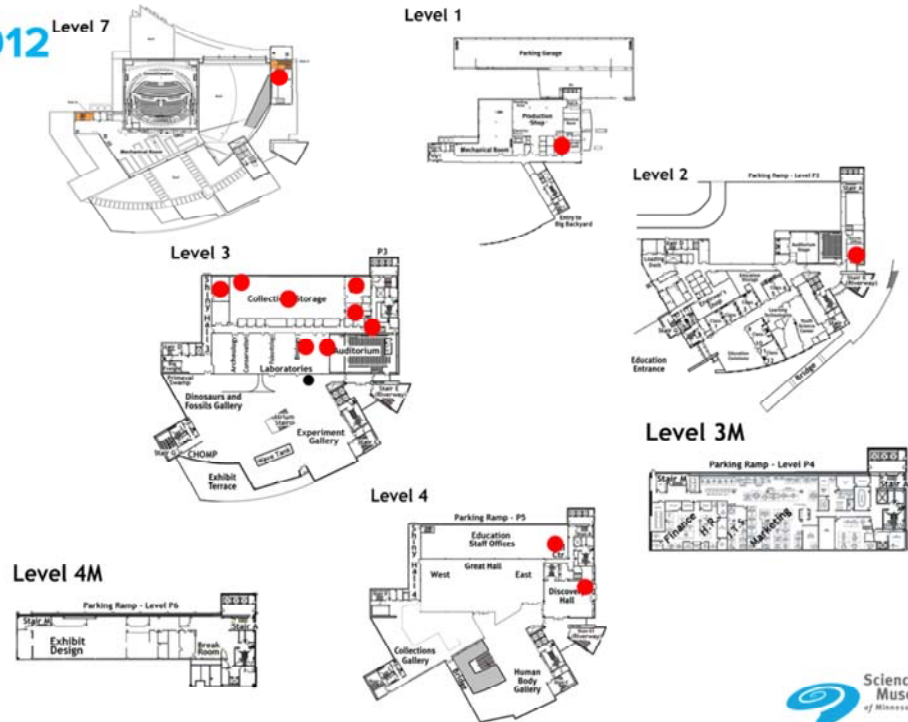


By 2008, we were finding odd beetles on level 3M, a mezzanine between levels 3 and 4. In this case we know that we spread them to level 3M, seen in the lower right corner, when we moved archival material from the paleontology department on level 3 to archives storage. The archives were soon moved back to level 3 when the administration decided to turn the archives storage room into a conference room. The carpet and baseboards were completely replaced and we haven't caught odd beetles in the area since.

We also started catching them on level 1, in the graphics production shop. Again, I have no idea how they traveled there.

It was curious that the spread to other floors was contained mostly on the east side of the building.

## ODD BEETLES 2012



In 2012, we were very surprised to find odd beetles on level 7, in an air handling equipment room. Building engineers are the only staff who regularly enter the space. A door to the roof may provide enough dead insects to feed odd beetles, but it's hard to think of another food source in the space. Once again, this find was on the east side of the building.

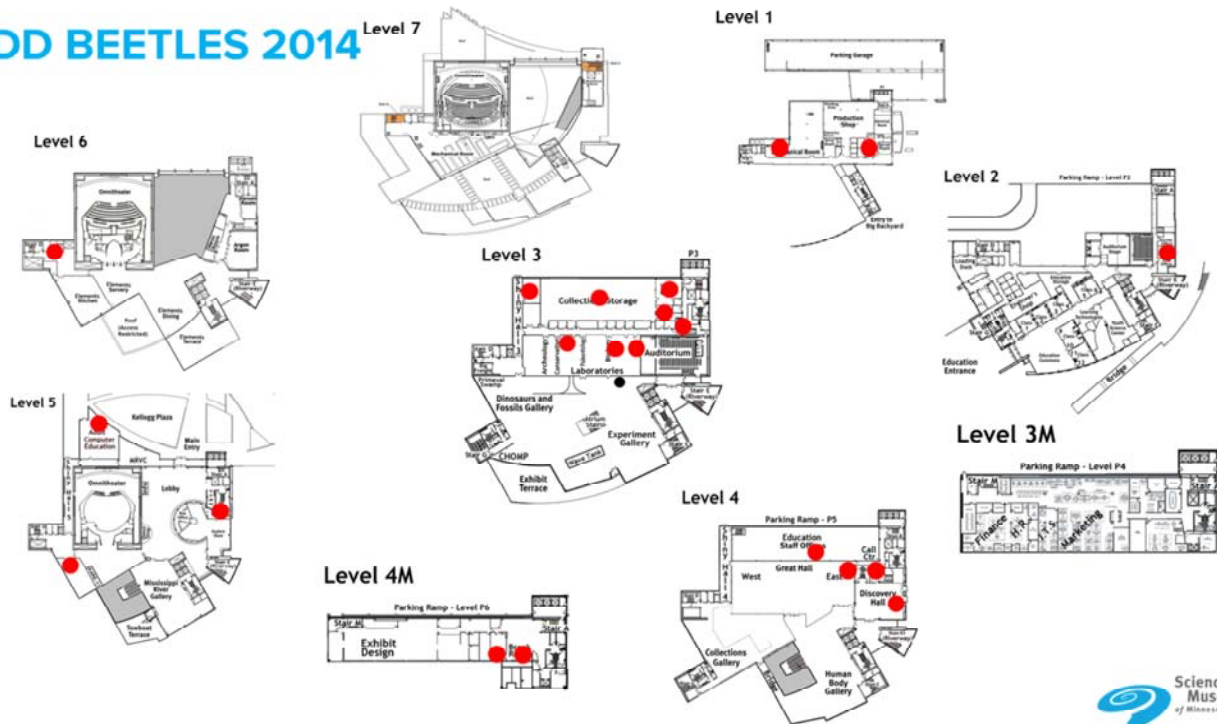
We started catching odd beetles on level 4 in the Call Center and in an event space. We also caught them in office spaces on level 2. Both areas are on the east side of the building.

Were they moving through the air handling system?

The system is incredibly complex, with numerous separate HVAC's so monitoring within the ducts is impractical.



## ODD BEETLES 2014



2014 marked 15 years in the building. By this time we were finding odd beetles on both the east and the west sides of the building. I have struggled to find an explanation for the spread of odd beetles all over the building. Once again, the incidents are usually one insect in a trap with months or years between catches. I began mapping odd beetle catches shortly after this.

Unlike level 3, odd beetles in the other parts of the museum tend to be in isolated breeding populations. Regular spraying may not catch the insects at the most effective moment

Mapping helps me visualize the intervals between catches so we can predict the most effective times to spray.

May 2011 Odd Beetle

Key  
◆ Male adult  
▲ Female adult  
● Larva

## Level 4



Based on the success of the Demand CS sprays on level 3, we expanded the practice to other hot spots. To reduce the amount of pesticide, we try to target the spray for times when odd beetles will be active. Using the maps, we predict roughly when we will catch odd beetles and spray at that time.

On level 4, we have odd beetle populations in the Call Center and in Discovery Hall, an event space. You can see through this animation that the odd beetles show up in yearly intervals. We mark when we spray with a red X. We try and spray when we predict odd beetles will show up in traps.

We recently completed the most extensive base board spraying yet. We will have to wait at least a year to gauge the effectiveness.

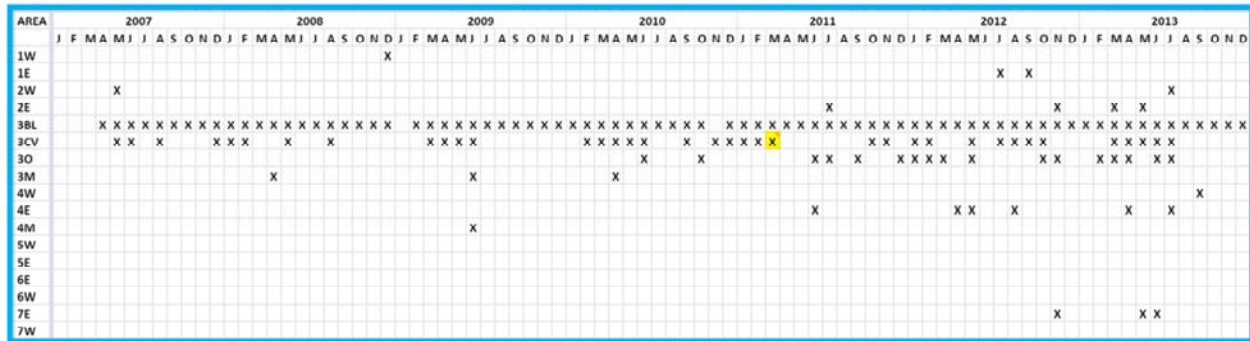
## EXCEL AS A VISUALIZATION TOOL

AREA	1999				2000				2001				2002				2003				2004				2005				2006											
	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
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In order to make better sense of the odd beetle spread I also use Excel to see patterns. In this spreadsheet I place a X in the box for each month we catch odd beetles in different locations. I divided up the areas by floor and by location on the floors. Typically, I track the east and west sides of the floors separately. I have also divided level 3 into biology lab, collections vault, and all the other spaces.

This shows the gradual spread in the early years.

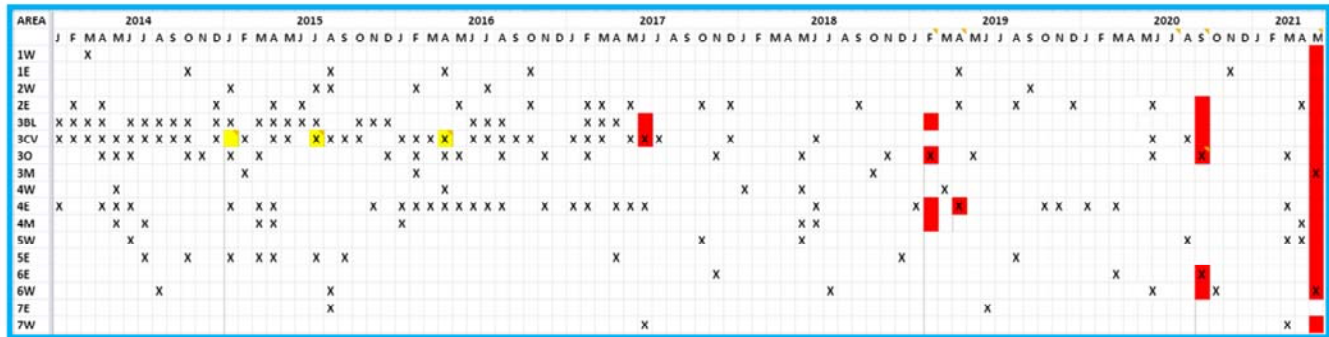
## EXCEL AS A VISUALIZATION TOOL



This shows me that the odd beetles started to appear more frequently in various locations in 2013.

The yellow square indicates the first time we used the Gentrol IGR disks in wet collections.

## EXCEL AS A VISUALIZATION TOOL



The upward trend continued through 2017, when we started to spray baseboards with Demand CS.

Red squares indicate when and where we have sprayed.

The reduction in catches is really exciting.

My attitude toward the odd beetle infestation has shifted from bewilderment over how they spread to excitement over predicting when they might show up again so we can treat the areas and hopefully eliminate them altogether.

## STAY TUNED

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- Continue strict IPM protocols in Biology Lab and Collections Storage.
- Schedule regular spraying in all affected areas, using mapping to predict the most effective times.
- Regular monitoring will show effectiveness of treatment
- Here's hoping that we'll be odd beetle free in a few years!

[rnewberry@smm.org](mailto:rnewberry@smm.org)



Image courtesy of Verne Anderson

**It looks like we have taken a major turn in our 25 year effort to eradicate odd beetles. We will continue strict IPM hygiene procedures in the labs and storage. We will also schedule regular pesticide applications based on the predictions from the maps. Continued IPM monitoring will gauge our success. This is still a work in progress but hopefully we'll see very few odd beetle in the years to come.**



## THANK YOU!

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- Gretchen Anderson *for establishing SMM's IPM program*
- Tom Strang *for his advice*
- Josh Walden and Adam's Pest Control *for problem solving.*
- SMM staff *for supporting the IPM program*
- Verne Anderson *for his cartoons and artwork. We miss you every day.*



PHOEBE THE FLYCATCHER SAYS,  
"ONLY YOU CAN PREVENT  
INSECT INFESTATION."

Image courtesy of Verne Anderson