Pest Management Grants Final Report

Project Title: Multi disciplinary pest management in a public museum setting

Agreement No. 01-0198C

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Prepared for the California Department of Pesticide Regulation.

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The following are lists of other project collaborators, grouped according to the principle activities in which they participated. Such a diversity of contributors well illustrates how IPM can be also serve as a community-building initiative.

IPM Implementation Project:

Snyder's Pest Control staff and owner Harold Snyder

Dr. Michael Rust, University of California, Riverside – Department of Entomology, as well as University Staff Research Associates Roger Burk, Eileen Paine and Don Reierson

John Burke (object conservator for the Oakland Museum)

Fred Walters (historic structures conservator)

RMM Science Advisory Committee chairman Dr. Rudy Ruibal (University of California, Riverside, Department of Biology – retired)

Demonstration Project:

Dasia Bytnerowicz, Exhibits Designer, Riverside Municipal Museum

Eric Barnett, President, RCB and Sons, Inc., licensed landscape contractors and architects

Kyle Brown, and other faculty and students in the landscape architecture program at California State Polytechnic University – Pomona

Jeff Signor, Nature Tech Landscaping

City of Riverside Department of Public Utilities - David Wright (Deputy Director), Lynn Scott (Program Services) and LeeAnne Uhler (Contracts Officer)

City of Riverside Department of Public Works - Tom Boyd (Deputy Director), Philip Hanawi (Principle Engineer), Abe Massoud (Associate Engineer) and Daniel Ciacchela (Contracts Administrator)

City of Riverside Department of Parks and Recreation - Terry Nielsen (Director), Andy Emery (Senior Park Planner), and Dave Roger (Urban Forester)

Ian Unitt

The Riverside Museum Associates

Riverside-Corona Resource Conservation District

Dissemination Project:

Marjorie Mitchell (Curator of Education), Wendy Sparks (Assoc. Curator of Education-Science) and other education staff of the Riverside Municipal Museum

University of California, Riverside – Department of Entomology: Dr. Timothy Paine, Dr. Tom Perring, and numerous other professors, their graduate students, and University Staff Research Associates

Metropolitan Water District Community Partnering Grants Program, and its member agency the Western Municipal Water District

Smithsonian Institution Traveling Exhibit Service

Parkview Nursery

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EXECUTIVE SUMMARY

Professional standards and public trust obligations require that museums maintain facilities where deterioration of collections objects is kept to a minimum. Practices that limit destructive pests must also ensure the safety of museum staff and visitors. In past decades, chemical pesticides were frequently used at the Riverside Municipal Museum [RMM] downtown Riverside facility. Since 1999, RMM staff members have utilized integrated pest management (IPM) procedures - pheromone trap monitoring, improved housekeeping, harborage reduction and studies of pest species ecology – to meet professional standards. Documentation of these activities and their results has employed computer database software. By providing funds for additional staff time and training, pest monitoring supplies, landscaping supplies and services, documentation and data analysis software/equipment, and dissemination activities, this CADPR grant has helped accomplish the following project goals:

Expanded/upgraded multi-disciplinary IPM activities: RMM employed trained technical staff to assist in carrying out IPM activities, including pest monitoring and data gathering. To date, RMM records account for more than 15,600 specimens caught or observed throughout the building's interior. From this database, it appears the building harbors invertebrate species that thrive in three characteristic environments: those species characteristic of the urban setting; species of pests common to collections in storage; and pests and related species characteristic of moist, dank settings. Limiting urban and dank setting species may only be possible through addressing significant structural problems such as were revealed during the course of the project. In contrast, the numbers of common collections pests at RMM may be close to an acceptable "threshold", beyond which further reductions may not be practically achievable.

Further reduction of pesticide use: During the project, only exterior applications of pesticides were permitted, chemicals approved for use against incursions by the targeted urban pest species. In time, it became apparent that these pest occurrences were becoming less frequent, and that regularly-scheduled pesticide applications could be discontinued.

Improvements to the exterior environment of the museum building: A great deal of energy was devoted to design and installation of an entirely new landscape for the building, one intended to minimize incursions by pests from the surrounding urban environment. Processing such a project through the design approval, legal and purchasing channels of a municipality proved to be very time consuming. However, toward the end of the project period the new design began to be realized, and its benefits should become apparent in the coming year.

Simplified/improved building and landscape maintenance: The IPM project team worked closely with RMM building maintenance staff to prepare policy revisions and work schedules for expanded housekeeping and interior/exterior maintenance. New equipment and supplies were employed which helped reduce target pest occurrences and improve the building environment.

Reduction in pollution of surface water runoff at the museum's urban site: After years of heavily-watered turf maintenance, landscape irrigation was discontinued for the project period, and pending installation of the new "water-wise" landscape plan.

Provide other City departments - and other museums - with a model IPM program: RMM brought staff from City Public Works and other departments into discussions with urban entomologists to plan and implement IPM activities at other downtown Riverside facilities. Papers and documents describing the RMM IPM policy and project were presented and made available to the museum profession at large.

Improved public awareness of IPM: More than 6000 members of the RMM's general audience participated in education programs related to entomology and IPM. The public will continue to benefit from completion and interpretation of the museum landscape plan, and through IPM on-line exhibits offered via the RMM website.

REPORT

Introduction

In January of 2002, the RMM was awarded a $39,059 project grant from CADPR, a major addition to what has come to total over $100,000 in funding, goods and services contributed to the IPM implementation, education and capital improvements initiatives at the museum's downtown Riverside facility. Back in 2001, the City of Riverside Department of Public Utilities committed $30,000 toward creation of a new landscape for the museum site. That same year, the Metropolitan Water District Community Partnering Grants program awarded $7500 to the RMM in support of education programs related to water-conserving and water-quality aspects of the landscape project. And in 2003, the City Department of Public Works contributed the major portion of the funding and staff support needed to replace the concrete sidewalks and public areas at the Mission Inn Avenue and Orange Street approaches to the museum building.

In March 2002 (as part of a federally-funded series of RMM conservation assessments and workshops), Project Director and principle investigator James Bryant (RMM Curator of natural History) held discussions of the museum's IPM plans with consultants John Burke (collections conservator from the Oakland Museum) and Fred Walters (a specialist in the preservation of historic structures). RMM staff and the Assistant City Attorney processed the CADPR agreement and obtained City Council final approval of the project contract. On May 29, project implementation meetings took place in Riverside between IPM project team members and CADPR contract administrator Belinda Messenger. Subsequent implementation meetings included RMM building maintenance workers, University of California - Riverside urban entomologist Dr. Mike Rust, RMM education staff, RMM Science Advisory Committee chairman Rudy Ruibal, the local pest management company Snyder's Pest Control, and RMM collections management staff. These meetings created the action plans needed to carry out the project objectives. These objectives fell into three major categories:

IPM Implementation Project Objectives:

Create, fund and fill the position of Museum IPM Technician
Expand and upgrade trap monitoring at the museum
Continue visual monitoring, with analysis of all monitoring data by computer
Utilize UCR consulting entomologists
Gradually discontinue uses of pesticides around the building's exterior perimeter

Demonstration Project Objectives:

Collaborate with other relevant City services on re-configuring the museum's landscape
Collaborate with a landscape architect on design/implementation
Utilize a landscape design that reduces water use/surface water runoff

Dissemination Project Objectives:

Interpret IPM and conservation aspects of the project for the general public
Promote IPM practices and project activities of the project City-wide through interdepartmental communications
Post news of the project on the RMM website
Produce professional newsletter articles and papers describing the project

The project's scope of work consisted of the following tasks:

TASK 1: *Project management & pest monitoring/management program*

In May 2002, the museum hired UCR undergraduate student Monica Ballon as its first IPM Technician. Ms. Ballon conducted a review of past IPM museum building audits – documenting facilities problems and improvements with photographs – and established an expanded series of trap monitoring sites. (For list of trap and bait types see Appendix 4.) In June, meetings with RMM maintenance/facilities staff prepared RMM IPM Policy revisions and work schedules (see Appendices 1. and 2.) for expanded housekeeping and interior/exterior maintenance. The revised Plan was submitted to staff for review, and was approved by staff that August.

In July 2002, project and maintenance staff conducted the first of a series of exterior "cleanups" of the downtown museum building (see photos, Appendix 3.), providing a valuable baseline for monitoring accumulation of pest harborage and other dirt over the course of regular maintenance activities. The Project Director teamed with building maintenance staff to plan, test and schedule new housekeeping/maintenance methods, and carry out interior pest harborage reduction efforts. Components of this new maintenance program included:

Increased number of trashcans

Trashcans emptied at the end of each day so organic waste would not remain in the building overnight

Purchase of three HEPA filter vacuums to help prevent redistribution of fine organic debris, old pesticide residue and other particulates

Efforts to reduce storage and work area clutter

Maintenance activities were recorded daily on paper forms (see Appendix 2.), for later entry into the IPM database. (Analyses of the dates of these activities relative to monitoring data should help determine the effectiveness of the measures.)

By August, new scheduled maintenance activities began to be routine. Additional project equipment and supplies purchases were received. The project team met with Dr. Rust to discuss identifications of insects detected in RMM traps and review project methodology. RMM provided Dr. Rust's lab with approximately 50 vouchers representing insects and other arthropods obtained from RMM traps.

In February 2003, UCR junior Entomology major Candice Stafford replaced Monica Ballon as RMM IPM Technician. Ms Stafford began preparation of a new IPM audit report for the downtown museum building (to further document changes/improvements in facility maintenance). The trap monitoring program expanded its effort to identify all insects and arthropods (to species level, when possible) recovered from traps – whether they were pest species or not – in order to arrive at the best description of overall building "ecology". Ms. Stafford continued entry of IPM activity records the museum's IPM database.

TASK 2: *Pesticide applications*

At the beginning of the project, the Project Director and IPM Technician assumed from museum maintenance staff responsibility for conducting monthly pest control inspections with service staff from Snyder's Pest Control (RMM's contract pest control service). These inspections included placement and retrieval of trap monitors and exterior applications of pesticides approved for use against incursions by the appropriate pest species (see Appendix 5.). When used, pesticide was applied to exterior foundation masonry and portions of adjacent grounds, usually well inside the roof "dripline". During ant outbreaks around the downtown building perimeter, Snyder's provided additional exterior treatments of pesticide, and ant bait stations were placed at selected interior locations. In August 2002, evidence of termite

infestation was found in an old outdoor storage alcove; wood trim elements at this location were treated by Snyder's staff (see Appendix 6.). By late summer 2003, it was apparent urban pest occurrences were becoming less frequent, and that regularly-scheduled pesticide applications were no longer necessary.

TASK 3: *Landscape project design development and approval*
TASK 4: *Landscape design and implementation services*

The project's landscape concept, design goals and objectives were derived through a series of planning meetings which followed a standard museum program development model. In January of 2002, the project concept created by the project planning team became the basis for a semester-long project by students in landscape design at California Polytechnic University-Pomona. Using the top design concepts selected from the student projects, the museum's landscape architect (Eric Barnett of RCB & Sons, Inc.) prepared a final project design and working drawings. Further meetings took place between the landscape architect and representatives of all Municipal Museum public service areas (Collections, Exhibits, Education and volunteers) as well as programs and services representatives from Riverside Public Utilities and other City departments active in supporting and approving the project (e.g. City Planning, Parks & Recreation). The architect and the IPM Project Director then advised the Museum Director and Deputy Director for Public Utilities with respect to specific program ideas, and they in turn instructed the landscape architect to prepare a set of landscape project designs and working drawings.

In February 2002, the first, complete sets of landscape project working drawings from RCB were delivered to the Riverside City Planning office for initial review by their staff. In March, the IPM Project Director and landscape architect Eric Barnett met with City Planning staff to address various questions/concerns and prepare for review and final approval by Riverside's Cultural Heritage Board. Discussions began with City Public Works Director Tom Boyd regarding his department's contribution to hardscape renovations at the museum site, and with the City Street Trees program supervisor regarding changes to street tree configuration called for in the landscape plan.

In April, City Planning requested more design revisions and further information on various project components. At the end of the month, City Planning and Historic Resources staff met with the project team to discuss the project status and pending Cultural Heritage Board review. A project site visit was scheduled for Planning staff and revised project drawings were required. A final design review meeting was held at Planning in late May, and the design proposal for the RMM re-landscaping project was approved (with minor adjustments requested) by the Cultural Heritage Board on June 19. By August, all outstanding design issues (as noted in those requested adjustments) had been resolved. In September, tree and street tree demolition, replacement and transplant requests were submitted to the City Park & Recreation Department's urban forester for his comments and cost estimates. The Riverside Museum Associates Board committed $5000 to the cost of the project, while the RMM citizen Advisory Board approved expenditure of $14,000 from the Museum Trust fund.

In July 2002, the RMM project team met with Public Works engineers to discuss hardscape components. It was decided that demolition and construction would begin after September 16, and that, in the interim, the landscape architect would submit construction details for the design and Public Works would make arrangements for carrying out the project. Delays in the submission of these details and in release of bid packages to contractors delayed hardscape replacement till October, then November of 2002, and finally until early May, 2003.

On January 11, 2003, the Park & Recreation Department's contract arborists removed all existing trees around the museum building (see photos, Appendix 7.), with the exception of one

fan palm which was relocated per the project design. In March, Parks & Recreation staff assisted the RMM in an informal bidding process to obtain a landscape contractor for installation of irrigation and electrical infrastructure (steps to occur midway through hardscape concrete work). The contract was awarded to Nature Tech Landscaping.

By late July 2003, both the Public Works hardscape replacement project and Nature Tech's phase of landscape work were nearing completion. In September, RMM and Parks & Recreation staff worked with RMM staff to finalize details for the scope of work to be employed in the final phase of landscape work. Invitations to an informal pre-bid meeting were mailed to six Riverside landscaping firms. Bids received for the project were opened on November 12, with RCB and Sons submitting the winning proposal. Current plans are to finalize a contract for this phase of work by early December 2003, with installation to take place during that month. In preparation for this phase, Riverside resident Ian Unitt completed his Eagle community service requirement by organizing members of his Boy Scout troop and conducting an overall cleanup of the museum site.

TASK 5: *Public education and project results dissemination*
(see Appendices 8. and 9.)

From April to September, 2002, a temporary exhibit was installed at the museum to illustrate problems and challenges in the storage and conservation of natural history collections, including information on common museum pest species. (In conjunction with opening of the exhibit, a day-long public conservation workshop was conducted by a visiting conservator, a program which focused on conservation and storage methods for natural history specimens.) The April 2003 installment of the RMM "First Sundays" family programs series focused on plants, landscaping, and the museum's re-landscaping and IPM projects. An outdoor display used plants provided by Parkview Nursery of Riverside, and included species selected for the museum's landscape project. The Natural History curator was on hand during the event to discuss the water conservation and pest management benefits of this style of landscaping. Literature was available describing water-wise gardening and the Riverside Public Utilities "Tree Power" energy conservation program.

During June 2003, the IPM project team (including Assoc. Curator of Education-Science Wendy Sparks) developed an IPM-related public programs schedule for the coming 12 months. In July, discussions with UCR Entomology Chair Dr. Timothy Paine covered details of collaboration with entomology faculty, staff and students. In early September, the museum confirmed arrangements for hosting the Smithsonian Institution's traveling exhibit "Insect Safari" that October 26 and 27. Plans were laid to incorporate IPM-related information into the RMM website. Proposals were submitted for IPM presentations at upcoming professional meetings. Also that summer, the project team met with Dr. Rust to discuss other possible collaborations with the RMM and other City departments on outdoor bait survey of stored products pests and a roach control project for downtown Riverside manholes.

Results

TASK 1 Of a total of 2540 RMM database records of trapped and monitored invertebrate species, 2228 of these records were created during the duration of this project. To date, RMM records account for more than 15,600 specimens caught or observed throughout the museum building's interior, 14,562 of these between 1/1/2002 and the present. This cumulative record of insects and other arthropods represents both a greater diversity and a more significant sample than that from IPM activities in prior years (see Figure 14.). With the exceptions of rodents and cigarette beetles, all pest species targeted by the RMM IPM plan (see Appendix 1.) have been detected during the project period.

American cockroaches (*Periplaneta americana*) Of those species that pose a threat to RMM property and collections, this is by far the most conspicuous insect found in the museum building. American cockroaches are, by nature, an outdoor species, though (according to observations by City Public Works personnel) they inhabit the City sewers in large numbers. An abandoned, underground rainwater drainage system (see description below) that passes through the museum building basement makes entry into the structure easy. From the large numbers of nymphs (see Figures 3., 4., 5a. & 5b.) and oothecae collected, it appears female roaches are depositing oothecae inside the building, and thus there may be an indoor population of this urban pest already established in the museum. Furthermore, trap and visual monitoring revealed that the building's attic provides excellent harborage for these pests: that space is largely inaccessible, and thus one of the only places in the museum that is not cleaned on a regular basis. Yet monitoring indicates most roaches occur in the building basement (see Figure 3.). Other levels of the structure are accessible through stairwells and building infrastructure (e.g. plumbing chases, drains and gaps through ceilings and walls that run from the basement to the bathrooms, kitchen, Nature Lab and attic). The number of adult cockroach records has peaked in late July, while the number of nymph roach records show steady, high totals from August to October. Should RMM data reflect continued invasion in the lower parts of the building, results of the sewer manhole treatments (described below) may help reduce the levels of cockroach occurrences.

House crickets (*Acheta domestica*) As the live animal program in the museum's second floor natural history classroom (aka "Nature Lab") has expanded, the number of crickets trapped on the building's second floor has increased significantly (see Figure 5b.). Crickets are used as a live food item for several species in the living collection, and random "escapes" are always a possibility. However, the management of the facility and the structure of the room's walls and door thresholds prevent crickets escaping from this perimeter room to other interior spaces (for 2nd floor overall totals see Figure 5a.). Elsewhere, crickets are somewhat more common in the building's basement, where they pose a serious potential threat to cellulosic collections in the RMM Library, Anthropology storage and RMM Herbarium (see Figure 3.). Crickets are most prevalent in the museum around May, and only occur in very low numbers in winter.

Species of silverfish/firebrats, while not nearly so numerous as other insects, are nevertheless widespread (see Figures 7., 8., 9a. and 9b.), and once were quite prevalent in the building's second floor exhibit gallery. In the year prior to this project, this gallery was gutted and converted to a multi-purpose programs room; continued monitoring has shown that firebrats are nearly always present at low numbers, and have peek numbers around September and are very sparse in the winter months. Furthermore identification of several samples of the firebrat/silverfish have shown all of them to be of the species *Thermobia domestica*, known as the common firebrat, which is the most prevalent species of firebrat in many structures.

Foraging Argentine ants (Linepithema humile) have been a sporadic yet, at times large-scale problem. Ranging over broad sections of Riverside's downtown, these ants are most abundant in the basement and the first floor of the building (see Figures 3. & 4.). Effective control of ants has been accomplished by trying to "stop the problem before it starts" through landscape work, aggressive removal of harborage and food debris, and (if there should be an incidental outbreak in the museum) exterior applications of pesticide and interior placement of food bait stations. There has been a significant decrease in the number of ant sightings since the cleanup of the outside of the museum building. Indeed, despite the significant increase in monitoring data gathering during the project, analysis of the data still shows a decrease in the total number of ant specimens found throughout the museum.

Dermestid beetles (Dermestidae) – This category is meant to include all species of hide, furniture, carpet and odd beetles that have been detected in the museum building (see

Figures 7., 8., 9a. and 9b.) Specifically, those prevalent in the basement include *Anthrenus verbasci, Thylodrias contractus,* and (in somewhat smaller numbers) *Trogoderma versicolor.* Most dermestids found in traps occur as larvae, which suggests they are attracted by the carcasses of other trap "victims". A few, recent outbreaks of these beetles have been discovered in museum exhibits, most notably in freeze-dried specimens. The infested specimens have been treated using conventional cabinet freezers. The adults have more frequently been found in the yellow flying insect traps (a finding consistent with dermestid life history, as the adults spend a good deal of their travel time flying as opposed to walking). Adults have also been rather abundant in simple black light traps. The large increase in the amount of adult dermestids found in the months of June and July is - at least in part - a reflection of the placement of these new light traps in two locations in the museum basement.

Cigarette Beetle (*Lasioderma serricorne*) - This species was one of the original targets species. However, upon identification of several specimens it was discovered that there were no actual records of cigarette beetle inside the museum, and that these were, in fact, Drugstore Beetle (*Stegobium paniceum*). In addition, these beetles appear to be present in very low numbers, and were only found in traps or spotted by employees 32 times during the project period. The largest occurrences of drugstore beetle were in Nature Lab, insects that may have emerged from stored animal cage substrate. As a further effort to tackle the alleged problem of cigarette beetle, pheromone-baited dome traps were set. The results continued to be negative.

Casemaking clothes moth (*Tinea pellionella*) and Webbing clothes moth (*Tineola bisselliella*) – During the entire project period, 28 records were made of clothes moths (a total of 37 specimens). All but four of these records occurred in the basement, mostly adults trapped in a variety of traps (e.g. covered sticky traps, black-light traps, moth pheromone traps). In the early stages of the project, it was suspected that the Casemaking clothes moth were present. However, there has yet to be a positive identification of these moths from trapped specimens, and it may turn out that the museum has no infestations of Casemaking clothes moth, but rather of some look-alike micro-lepidoptera that has come in from elsewhere.

TASK 2 Collaboration of museum IPM staff with Snyder's on regular trap monitoring activities has significantly increased the quantity and quality of IPM data. During the drought year of 2002, other businesses and City departments served by Snyder's experienced persistent problems with ant incursions. As mentioned previously, it appears strategies for harborage reduction, and the use of bait stations and exterior pesticide applications have been particularly effective at controlling ants at the museum.

TASKS 3 & 4 Control of plant debris at the museum site has been a persistent problem, as leaves and other material tended to gather around the building foundation, often blown by the wind from adjacent sites. At the onset of the project, all plantings adjacent to museum building foundation areas were removed and irrigation of the existing turf areas ceased. As the project proceeded, all trees and shrubs were removed from the rest of the site, and a succession of herbicide applications eliminated all annual and perennial weeds and grasses. Through a series of site cleanups and subsequent inspections, it was learned that other types of dirt and debris accumulate quickly: within a month, many of the areas vacuumed free of dust, bird droppings, human waste and other materials were once again thoroughly soiled. While preliminary harborage reduction and water conservation measures seem to have helped reduce pest incursions, it is anticipated that configuration of the new landscape installation will help address these other problems as well. (For a plan view of the approved design, see Appendix 7.)

TASK 5 (See Appendices 8. and 9. - programs list, publicity flyers and photos)
The wide variety of audiences served by IPM-related museum programs has included home-schooling families, youth group participants, and adults. Examples of the curriculum employed include:

- an elementary school program which includes the story "What about the Ladybugs?",

a tale which the children are able to act out (a story about how a farmer uses pesticides to kill aphids, and ends up killing everything else)

- an outdoor "beneficial insect tent" devised for after-school science programs and special events, where a mesh-covered tent houses ladybugs and butterflies, and contains a small trail where visitors use trail markers to match pests with beneficial insects (the Vedalia beetle being one of the beneficial species discussed)
- Several installments of the museum's "First Sundays" family programs series have focused on plants, landscaping, and the museum's re-landscaping and IPM projects. The program "Bug Daze" focused on identification of common pests; "It's a jungle out there" emphasized beneficial insects and reducing irrigation as a method of pest control.
- Four recent segments of the museum's "After-school Science Adventures" series emphasized IPM: "Squish! Living with Pests" included a slide show discussing pest identification and control, plus a game focusing on when an insect is or isn't a pest; "Caring For Our Community" and "Snails: Slow and Slimy" covered alternatives to pesticides; "There's a BUG in my garden!" emphasized biological control and reducing water use. The museum has also developed an Eco Explorer Girl Scout merit badge program emphasizing beneficial insects.

The Smithsonian Institution's traveling exhibit "Insect Safari" (which visited the RMM on October 26 and 27, 2003) was, in many ways, the climax of this slate of education services. A large number of personnel from UCR Entomology helped to stage this event, including faculty members and researchers Dr. Les Greenberg, Rick Vetter, Dr. Kirk Visscher, Dr. Tim Paine, Dr. Bill Walton, Karl Haagsma, Dr. Matthew Blua and David Hawks. More than sixteen students assisted with demonstrations using preserved and live insects and other arthropods. Both days featured the mobile exhibit, numerous displays of preserved and living insects and other arthropods, and brief lectures by UCR entomologists, with altogether almost 5000 people in attendance.

In April 2003, the RMM was notified that it had been nominated for a CADPR IPM Innovator Award. This nomination was specifically intended to bring attention to the museum's efforts in bringing IPM education programs to the public. In September, DPR notified the museum that it would be receiving one of eight awards being handed out statewide, the first museum-based project in California to be so recognized.

In May 2003, 100 copies of a brief RMM project report (entitled "IPM: Inside and Out"; see Appendix) were distributed to attendees at the American Association of Museums (AAM) annual meeting in Portland, Oregon. From June 15-20, the Project Director/Natural History Curator attended the annual meeting of the Society for Preservation of Natural History Collections in Lubbock, Texas (at Texas Tech University). At that meeting, a full paper and PowerPoint presentation describing the Municipal Museum IPM project (see Appendix) was delivered and a further 100 copies of the brief report distributed. CADPR grant funds supplemented other RMM funds in covering the expense of the publications and attendance at both conferences.

In August 2003, the Project Director submitted a proposal to the administrators of downtown Riverside's public parking garages, a description of a project to be carried out by Dr. Michael Rust and his staff/students to place insect food baits in downtown elevated garages as a means of surveying the populations of stored product insect pest species which inhabit the downtown area (the study to be based on the methodology described in Strong, 1970). In addition, meetings were held between Museum staff, Dr. Rust and City Public Works personnel to plan implementation of a cockroach baiting program for the sewers of the downtown historic district. Based on Dr. Rust's earlier work in Santa Monica, California (CADPR project report on file), this project began in September with the application of paste-like baits in manholes located along the streets adjacent to the museum's site. Both the roach baiting and food packet projects will continue into 2004.

Finally, the Internet has been used to provide the public greater access to information on IPM projects. Scheduling and descriptive information on RMM education programs – such as First Sundays - is disseminated via the Municipal Museum's City-sponsored website (see http://www.ci.riverside.ca.us/museum/education/fs1202.htm). A new web page focusing on IPM methods at the Museum is in development and will be released in conjunction with the Museum's upcoming website upgrade. The RMM Integrated Pest Management Policy (see Appendix 1.) will soon be available over the Internet from the American Association of Museums (AAM) on-line Information Center, a source of technical information and sample policies and forms made available to the AAM's member museums.

Discussion

TASK 1 As mentioned above, early in the project period discussions were held with historic structures conservator Fred Walters. In conducting his conservation assessment of the RMM's downtown museum building, he discovered a significant source of structural deterioration: an internal rainwater gutter and downspout system, original to the 1914 building but subsequently abandoned and allowed to fall into disrepair. "Hidden" metal rain gutters were part of the building's original design, recessed into the margins of the clay tile roof and feeding into four cast iron drain pipes built into the masonry walls, pipes current RMM staff had mistaken for old sanitary sewer lines (see photo, Appendix 7.). Decades ago, the decision apparently was made to roof over the gutters rather than maintain them. This seems, however, to have failed to exclude all water from the internal system, as rain continues to collect in and overflow the old gutters (causing damage to the building walls and trim). It seems sufficient water enters the drains to keep them moist, not flushing them free of debris.

These abandoned drain pipes may be significant sources of the building's interior insect population. Traps located near the drain system's basement junctions carry the largest load of insects, especially species associated with mold and moisture (see Figure 10.). These drains may also allow large numbers of cockroaches to enter the building from the City storm sewer system. While a major structural defect of this kind may prevent the project from clearly demonstrating how a landscape plan can prevent pest incursions, Dr. Rust may be able to help the RMM and the City address the issue of storm sewer infestation (as mentioned above), and thus arrive at an additional strategy for mitigating urban pest problems in the museum building.

TASK 2 The Snyder's Pest Control firm was originally contracted to provide regular pesticide applications and other licensed services at the RMM facility. Over time, the activities of Snyder's became more oriented toward trap monitoring. Through effective monitoring, in late summer 2003 it was determined that the overall level of pest species activity was sufficiently low to allow cessation of regular exterior pesticide applications.

TASKS 3 & 4 The City of Riverside design review and approval process took longer than anticipated; issues involving historic structures required a great deal of discussion and community review before design compromises were formulated that satisfied the RMM, City Planning staff and the Cultural Heritage Board. The affects of these delays are mitigated somewhat, when local drought conditions are considered: it would have been much more difficult to establish the design's plant selections, and thus heavier irrigation would have been necessary. The museum had to endure rather bleak surroundings during the summer of 2002, but this may have helped reduce pest incursions, and new plantings may have been postponed to a more successful, ultimate outcome.

TASK 5 (See Appendices 8. and 9. - programs list, publicity flyers and photos) As a public museum and educational institution, the RMM is well-placed to provide the general public with a demonstration of IPM techniques, and has a shared interest with the City of Riverside Department of Public Utilities in the water quality/water conservation aspects of this effort. Workers in diverse areas of City operations have been receptive to suggestions that their staff and facilities could play roles in these IPM efforts. In addition to the broad base of City employees and others directly involved in the project, over 6000 of the museum's general audience have thus far participated in Municipal Museum public education activities related to IPM.

Summary and Conclusions

TASK 1 One of the goals of any museum IPM program is that, through understanding of the diversity of pest species and their life histories, the list of particular pests identified from traps will lead to conclusions about the environmental conditions present in the museum building. The types of pests present are good indicators of resources available to them. In this context, knowing the life histories of pest species can be helpful in determining if attaining a manageable level of pest activity – an acceptable "threshold" of pest occurrences - is achievable.

Based on the RMM project's monitoring database, it appears the Municipal Museum building harbors invertebrate species that thrive in three characteristic environments:

The Urban Setting

American cockroaches (*Periplaneta americana*)
Argentine ants (*Linepithema humile*)
House crickets (*Acheta domestica*)
Earwigs (Dermaptera)

These species typify those that wander into the museum building from outside, insects that live on a variety of organic matter, but may also inflict damage on collections. The project is designed to demonstrate how limiting landscape irrigation can help manage numbers of American cockroaches and House crickets, and preliminary data suggests that reduction in water use has already generated this benefit. Cockroaches are very prevalent in Riverside sewer systems, which may suggest a possible point of entry into the building: an abandoned, underground rainwater drainage system that passes through basement work and storage areas.

Due to the fact that the first floor is where most of human visitors enter and exit, it is not surprising that the largest percentage of pests on this floor thrive in the urban environment and may have "wandered in" as well. Argentine ants accounted for the largest number of pests on the first floor (see Figure 4.) probably largely due to the ample gaps in the building's fabric and around all entrance doors. Urban pests also thrive in the basement, no doubt due to the abundance of possible entrances that the basement has to offer, including numerous ground level windows, open pipes, and a door, all poorly sealed. The basements largest urban pest population consists of American cockroaches, closely followed by Argentine ants (see Figure 3.). The second floor's largest pest population consists of House crickets, obviously due to the presence of the Nature Lab (Figures 5a. and 5b.).

Collections and other Stored and Preserved Materials Settings

Confused flower beetle (*Tribolium confusum*)
Varied carpet beetle (*Anthrenus verbasci*)
Common firebrat (*Thermobia domestica*)

Spider beetle (Ptinidae)
Odd beetle (*Thylodrias contractus*)
Casemaking clothes moth (*Tinea pellionella*)
Webbing clothes moth (*Tineola bisselliella*)
Spider Misc.
Wasp of the Bethylidae (*Laelius utilis*)

Among these are the major pests of the materials housed in museums, the species most frequently targeted in pest management efforts; yet this community of animals can survive solely on dead insects and spiders scattered on the floors of work and storage areas. For this reason alone, regular, thorough cleaning is a key ingredient to a successful IPM program.

The common collections pests are the least abundant target pest species throughout the entire facility (see Figure 1.). As with most of the other pest species here, these insects are most abundant in the basement. However, they do not make up the largest percentage of pests on any of the floors of the building. It is important to keep in mind that these are the pests that may be, for the most, part hidden inside of the objects they infest. For this reason, more active trapping techniques such as pheromone, food, and light traps were used to try and catch them. Yet even with these increased efforts, the numbers of collections pests for RMM still appear to be at low levels.

Interesting ecological discoveries have come of the monitoring of pests in this category: three examples of natural biological control were discovered to be occurring at the RMM. Continuous trapping has shown fair levels of the Bethylid wasp *Laelius utilis*, which is known to parasitize *Trogoderma versicolor*, a species of dermestid beetle detected occasionally in the museum. Monitoring traps have also collected several window flies (Family: Scenopinidae - species identification pending); the larvae of some species are said to feed on carpet beetles. The third, more obvious example is that of the common spiders which inhabit the museum and catch pests in their webs, continually working to clean the building of their prey.

Moist, Dank, Enclosed Settings

Fungus gnats (Mycetophilidae and Sciaridae)
Fungus beetle (Cryptophagidae)
Humpback flies (Phoridae)
Booklice (*Liposcelis* sp.)
Springtails (Collembola)
Moth flies (*Psychoda* sp.)
Misc. Mites

These species all thrive in warm, moist conditions, the same conditions that encourage mold, mildew, and fungus. They live in decaying matter, and feed on fungi. The presence of these species is a good indicator of fungus problems in a building, and thus may be a reflection of past over-irrigation and poor drainage around the perimeter of the Municipal Museum building.

The largest percentage of pest species found in the basement - indeed the largest percentage of pests found throughout the entire building - are dank setting pests. These are, for the most part the smallest pests found in the museum and are usually present in large numbers. Of these, moth flies and Collembola dominate the numbers (see Figure 11.) obvious signs of a wet atmosphere or clogged pipes. The second floor also produced substantial numbers of dank pests, although, as with crickets, these originate in Nature Lab, including the largest number of fungus gnats found in the building (Figures 13a. & 13b.). A large quantity of potted plants in the Lab is also responsible for the prodigous numbers of thrips and true bugs (white flies, etc.) detected by traps (see Figure 14.). The presence of all these pests illustrates the importance of having a fairly dry atmosphere in an indoor environment.

TASKS 2, 3 & 4 It is often thought that Integrated Pest Management means ceasing use of all pesticides and "letting nature run it's course", yet IPM more accurately entails using all of the resources at one's disposal to effectively manage a pest problem. Such resources should include: chemical control, educational control, mechanical control and biological control.

Chemical control means using pesticides responsibly. The RMM has a policy of no pesticide use inside of the museum, yet this policy also allows application of repellant insecticides – when needed - to exterior portions of the building. This approach allows the museum to take advantage of pesticides that act as a deterrent. **Educational control** can be achieved by educating the museum staff and the public on the importance of responsible pest management, and how to spot pest problems, so that they can be dealt with before they become less manageable. **Mechanical control** has been a major part of the Municipal Museum IPM program. The museum staff has worked diligently to clear the inside and outside of the building from of pest harborage. Cleaning of the building has been documented on a daily basis, including the use of new HEPA filter vacuums. Recognizing water as a limiting factor for all life forms, the new design for the museum building's landscape is intended to curtail water use relative to more traditional methods and planting schemes. **Biological control** is carried out entirely by the insects that inhabit the museum, and is yet another positive outcome of limiting uses of pesticides. In a traditional museum setting there is often a "zero level" of tolerance toward sharing the premises with insects and other invertebrate species. Today, a better understanding of "indoor ecology" has shown that "zero tolerance" is an unrealistic goal. There will always be some way for these insects to thrive. Instead, IPM programs like the one at the Municipal Museum show that it is possible to pursue documentation of an acceptable, "threshold" level of invertebrate populations – one that maintains itself to a significant degree – and at the same time satisfy the professional requirement to protect museum objects from deterioration.

TASK 5 The Municipal Museum is confident that this project has been successful in demonstrating methods for monitoring and assessing occurrences of pests and associated species in a medium-sized museum facility. Across the state and the nation, most local museums and historical societies are housed in rehabilitated historic structures, such as old railway stations, post offices, libraries and school buildings. Recipients of project printed reports and attendees at presentations by project staff have been eager to learn of the project's design and results. By sharing these project results with the profession, these methods and results will give the staff working in such facilities a clear picture of how they can employ IPM techniques at their locations.

Above and beyond the museum management-oriented outcomes, this project has created a significant opportunity to improve public awareness of IPM, and provide the museum's audience with a better understanding of the roles played by insects and arthropods of all kinds in healthy living and working environments. The Municipal Museum's success in this realm is due in large part to the Education staff preparing activities that appeal to many age groups and learning styles.

At the same time, more formal exhibits and programs based in IPM have demonstrated an appeal for adults and serious students. Evaluations from these and other programs indicate that visitors will enjoy seeing live insects, value interacting with UCR scientists and students, and look forward to learning the "fun facts" about insects (e.g. beetles that eat chocolate; insects that actually eat Pyrethrum, etc.). Children enjoy learning more creative and environment-friendly ways to interact with insects and other pests in their homes and gardens. There is a substantial future for museums who offer such IPM-related programming: on average, RMM programs that feature insects as the subject matter have attracted 18% greater attendance than programs that do not.

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APPENDIX 1.

INTEGRATED PEST MANAGEMENT POLICY
RIVERSIDE MUNICIPAL MUSEUM
Adopted 10/28/99

Current professional museum standards require that collections-holding institutions maintain facilities in which the deterioration of objects which are stored or exhibited be kept to a minimum permissible under contemporary conservation practices. Among these practices are measures known to limit the occurrence of animal pests that are destructive to collections, while at the same time ensuring the safety of museum staff and visitors. Thus it falls to the Municipal Museum to become familiar with and employ such practices.

For decades, chemical pesticides were used to control many collections pests. Today, the uses of pesticides are not only restricted by occupational safety regulations, but by the understanding that poor landscaping, building structural problems and poor housekeeping methods are typically associated with museum pest problems. And while no pest species can be totally eliminated, it is only by knowing the precise identity of pest species and each species' life cycle and ecology that the numbers of specific pests can be kept to a workable minimum.

Because integrated pest management (IPM) is an interdisciplinary approach involving a broad spectrum of methods, no one person on a museum staff can be responsible for carrying out all these methods. It is incumbent upon all museum staff to assist in carrying out the IPM procedures described in the RMM's most current IPM plan.

All RMM staff members will work to remove pest harborage and habitat from the vicinities of RMM facilities: building foundations will be raked free of debris; grounds will be policed for garbage and conspicuous trash will be picked up as necessary. Each staff member will take a measure of responsibility for seeing that their respective work areas are cleaned on a regular basis.

All RMM staff members will work to prevent conditions in work and storage areas that provide access, food or harborage for pests: commercial corrugated cardboard will not be used for long-term storage; all items and objects stored on building floors will be elevated; consumption of food and beverages in work spaces is discouraged; consumption of food and beverages in public spaces is prohibited (except during special events); food waste and related waste materials used in Museum work and public spaces must be disposed of according to the provisions of the current IPM plan.

All RMM staff will participate in monitoring the results of IPM practices, with careful reporting and documentation of pest activities. With the exception of termite control, use of chemicals will be restricted to exterior applications of commercial pesticides, substances which are licensed to control specific museum pests.

INTEGRATED PEST MANAGEMENT PLAN FOR THE RMM
Adopted 6/29/2000; Revised 7/26/2002; Adopted 8/15/2002

Sites: main Museum building Annex Heritage House

Target pests: gray house crickets American cockroaches rodents ants silverfish & firebrats cigarette beetles hide & carpet beetles clothes moths

Rationale: In recent years, rodents, crickets, roaches, ants, silverfish and firebrats have been the most conspicuous pest species to routinely (and often seasonally) invade RMM premises, especially the downtown Museum and Annex. Evidence strongly suggests that the sources of these pests lie outside these structures. More chronic problems have involved traditional collections pests, such as various beetles and clothes moths, most notably in those collections (life sciences and History textiles/costume) which have historically been the most susceptible.

While in the near term funds are lacking to address landscaping and major structural problems (poorly fitting doors, gaps in masonry walls and mortar, faulty trim and moldings, etc.) associated with these pest problems, small repairs are possible. More importantly, establishment and enforcement of new pest management policies and procedures can remove pest harborage and habitat and reduce pest incursions. These procedures, combined with exterior applications of commercial pesticides, may significantly reduce the threat from these pests. Continuing and expanding implementation of these procedures, and monitoring the results with careful reporting and documentation, should prove the appropriateness of this approach.

Insect pest ecology:

American cockroach

Prefers starchy and sugary materials, fermented food waste, leather, parchment; nocturnal; attracted to moisture; damage caused by feeding; evidence includes chewing marks, oblong black droppings, brown egg cases. SITE FOCUS: downtown Museum and Annex

Grey house cricket

Eats both animal and vegetable matter, including all textiles (esp. silk and wool), wood, paper, and especially items stained with food matter; may also damage many non-food items, such as plastic; invade buildings during cool weather, mostly nocturnal, concentrating around warm equipment (hot water pipes, etc.). SITE FOCUS: downtown Museum and Annex

Ants

Depending on the species, colonies may be in the soil outside a building or in walls; foraging adults attracted to water sources, sweets and sometimes meat. SITE FOCUS: downtown Museum and Annex

Silverfish

Prevalent in warm, dry spaces; attracted to materials high in cellulose, especially linen textiles and sized textiles and paper products (all high in starch); also adhesives and book binding materials and the dust and lint that accumulates in corners of rooms; thrive in areas of long-term storage, where materials are seldom disturbed; damage caused by chewing surfaces and holes. SITE FOCUS: downtown Museum and Annex

Cigarette beetles
A serious pest of books, as well as dried plant materials, silk, and plant fibers used to stuff upholstered furniture. "The chief pest of herbaria." SITE FOCUS: downtown Museum and Annex

Hide & carpet beetles
Attracted to feed on all manner of protein-based materials, including skin and sinew, wool and fur, plant flowers and adhesives; larvae will burrow into wood and structural crevices, or hide in bird nests; will also feed on cellulose materials bearing food stains.
SITE FOCUS: downtown Museum and Heritage House

Clothes moths
Some larvae produce tubes of silk and debris that cover them as they feed; larvae move from food to attach to walls and ceilings in order to pupate; feed on furs, skins, milk-based materials, and many textiles including wool (incl. carpets, upholstery and felts), wool blends, as well as silk and vegetable fibers when they are sized or stained.
SITE FOCUS: downtown Museum, Annex and Heritage House

Exterior procedures:
Biocide application -
Snyder's Termite & Pest Control will administer monthly applications of pesticides to the outside of Annex and Museum building foundations, chemicals approved for use against the above listed pests. Irrigation of adjacent grounds should be avoided for a few days period after application, as the pesticide is soluble. Inhalation of the pesticide should be avoided, as should contact with skin or eyes.

Harborage reduction – main Museum building
Measures will be taken to reduce human and plant derived litter around the structure.

* Exterior of the foundations will be swept/raked free of debris once per month; basement windows and hardscape crevices will be vacuum cleaned once every three months. Pressure washing of soiled areas will be conducted as needed.
* Grounds will be policed for garbage at least once each day.
* All staff will pick up conspicuous trash as necessary.
* Efforts will be made to avoid excess use of water in outdoor maintenance and program activities.

Specialized equipment:

- gasoline-powered landscape vacuum
- gasoline-powered pressure washer

Interior procedures:
Prevention -

* All forms of corrugated cardboard must eventually be eliminated from long-term storage (e.g. Heritage House basement stores, Museum back stock of supplies, inventory for Shop and Press, old packing materials, custodial and collections). Inventory in such boxes should be unpacked and shelved (with appropriate dust covers). All items and objects stored on building floors should be elevated in proper cabinets or shelving. (All of the above are important measures to meet fire inspection requirements, reduce other hazards and optimize work space.)

* Gift shop inventory shipments should be unpacked immediately and packing materials removed from the building. If for any reason packed shipments must be kept for a prolonged period, they can be treated for pests in the Museum/Heritage House freezers. Gift shop inventory must be stored in the shop or a designated isolation storage area.
* Consumption of food in Heritage House is prohibited; consumption of food in the Museum and Annex work spaces is discouraged, and prohibited in collections storage spaces; consumption of food and beverages in public spaces (including Heritage House grounds, Museum reception and sales areas) is prohibited, except during scheduled special events.
* Food and beverage waste and related waste materials used in Museum work spaces must be disposed of immediately by removing it from the building, or placing it in trash cans in the kitchen, Nature Lab or on the front portico prior to 4:15 pm each day. All kitchen and Nature Lab food waste and other food waste must be removed from the building before closing the building (trash cans are to be emptied by 4:30pm each day). Items brought to the Museum or Heritage House by visitors must be disposed of immediately outside the building or held at the Museum reception area for recovery upon exit. Wastes from Nature Lab live animal maintenance must be disposed of in the covered trash can in that room or in the kitchen. Wastes from food services at Museum special events must be accumulated in the kitchen immediately following the event and removed from the building. All food waste at the Annex should be removed from the building immediately after consumption. Handling of food waste at Heritage House involves immediate removal of waste to the dumpster at the rear of the property.
* Essential cardboard packing and shipping materials (no re-used boxes) must be stored off-site or packed into closed cabinets or covered, moisture proof containers (such as Rubber Maid storage tubs).
* Basement window screens and upstairs window/porch screens at Heritage House should be of a gauge small enough to exclude insect pests.
* All public spaces must be vacuumed daily, or more often as needed. Bare floors should be dry mopped, and wet-mopped only when deemed necessary, with chlorine bleach added to the mopping solution. Care should be taken to leave as little excess water as possible on wet-mopped floors. All work spaces and collections storage areas must be vacuumed at least once a week or more often as needed.
* Incoming materials, especially objects being considered for accession, should be kept in isolation from stored collections, and preferably cycled through freezers to kill any pests which may be present. Objects on exhibit or being removed from exhibition (especially objects containing animal or plant material, freeze dried or taxidermy preparations) should be treated in freezers on a regular basis to remove pests.

Monitoring -

* All activities and data related to the RMM IPM project must be fully documented and entered into ARGUS. Checklists will be developed to assist staff in performing respective housekeeping, maintenance and monitoring projects.
***** Snyder's Pest Control and IPM staff will inspect and install sticky traps at sites around the main Museum building perimeter following on a monthly basis. Used traps will be retained for examination by Museum staff. In addition, RMM staff will install specialized traps for other types of crawling and flying pests (some employing pheromone baits) in public, collections and work areas. Locations of all traps will be plotted on building floor plans; these traps will be regularly and lures/baits replaced as needed. All removed traps will be given to the Natural History curator for identifications and documentation.

* Pest incident report forms (on which to document pest occurrences) and other monitoring reports and records will be maintained in ARGUS.

Specialized equipment:

- HEPA floor and canister vacuum units
- insect monitoring traps and kits

REFERENCES:

Edwards et.al. (1980) *Pest Control in Museums*.
Keith Story (1985) *Approaches to Pest Management in Museums*.
Rose et.al. (1995) *Storage of Natural History Collections: a Preventive Conservation Approach.*
Metsger & Byers (1999) *Managing the Modern Herbarium: an interdisciplinary approach.*

MUSEUM MAINTENANCE RECORD

MONTH: August **YEAR:** 2002

Daily interior trash pickup (check one box per day)

✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Special events trash pickup (write date and location)

FOSSIL EXHIBIT 8-10					

Exterior trash & debris pickup/ once per month (write date)

Additional exterior trash & debris pickup (write date & location)

AROUND Bldg	ALL AROUND THE BUILDING	8-12 8-13 8-14 8-15	8-23 8-26	8-31	
8-1 8-2 8-5 8-6	8-7 8-8 8-10 8-11	8-16 8-17 8-23 8-24	8-28 OUTSIDE BUILDING	AROUND THE BUILDING	

Exterior pressure washing as needed (write date & location)

8-5 FRONT STEPS	8-26				
	FRONT AND SIDE STEPS				

Interior public spaces vacuumed/dry mopped (check one box per day)

✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Interior public spaces wet moppedas needed (write date and location)

RESTROOM 8-2	8-9 - 8-10								
8-5 - 8-6 8-7 8-8	8-11 - 8-12 8-14 8-16								

Work spaces vacuumed/dry mopped once per week (check one box per week)

✓	✓	✓	✓	

APPENDIX 3. RMM Building Maintenance: exterior/interior cleanup

On July 3, 2002, RMM maintenance workers, the IPM Technician and the Natural History curator raked, swept, vacuumed and washed all hardscape surfaces as well as the building foundation perimeter

A new pressure washing unit and a rehabilitated landscape vacuum (both obtained for this project) were utilized.

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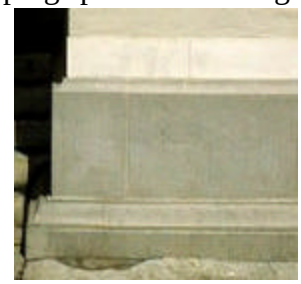
Area soiled by bird droppings prior to cleaning…

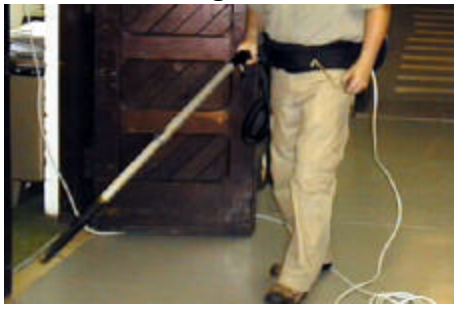


…and after cleaning.

Area of debris trapped in grate before cleaning…

…and after cleaning

New HEPA vacuum cleaning equipment is being used for interior crevice cleaning and general cleaning of collections storage and work areas.



APPENDIX 4. RMM pest monitoring: list of trap types

Catchmaster Insect Trap and Monitor EPA Est. #48377-NY-1 Model #100-I

AgriSense Lo-Line
Cockroach Trap with
pheromone lure
EPA Est. #224-EN-001

FMC Corporation FluorGuard ant control bait (N-Ethyl perfluorooctanesulfonamide) EPA Est. #1812-GA-1 EPA Reg. #1812-348-279

Whitmire Advance Dual Choice ant bait station (N-Ethyl perfluorooctanesulfonamide) EPA Est. #56207-WI-002 EPA Reg. #499-459

Insects Limited No Survivor moth trap with pheromone bullet lure EPA Est. #63866-IN-001

ECKO/Woodstream Victor roach pheromone trap EPA Est. #47629-PA-01 Model #M330

Bell Laboratories Trapper monitor and insect trap EPA Est. #12455-WI-1

Bell Laboratories Trapper glue trap EPA Est. #12455-WI-1

TRECE
Pherocon AM yellow sticky
flying insect trap

TRECE Storgard DOME trap with cigarette beetle lure/bait

APPENDIX 5. **RMM Pest Control services: pesticide information**

Specimen label – Pesticide used for RMM building exterior treatments.

Syngenta

DEMAND® CS

Insecticide

For Use by Individuals/Firms Licensed or Registered by the State to Apply Pesticide Products. States May Have More Restrictive Requirements Regarding Qualifications of Persons Using This Product. Consult the Pest Control Regulatory Agency of Your State Prior to Use of This Product.

Active Ingredient:
Lambda-cyhalothrin[1]:
[1α(S*),3α(Z)]-(±)-cyano-(3-phenoxyphenyl) methyl-3-(2-chloro-3,3,3-trifluoro-1-propenyl) -2,2-dimethylcyclopropanecarboxylate 9.7%
Other Ingredients: 90.3%
Total: 100.0%

[1]Synthetic pyrethroid

EPA Reg. # 100-1066
EPA Est. 61282-WI-1
SCP 1066A-L1B 0602
SCP 130-1066A-L1B

Specimen label – Pesticide used for RMM building exterior treatments.

Bayer

Tempo® SC Ultra

Insecticide

For Pest Management Professionals and Commercial Use Only.

ACTIVE INGREDIENT:
β- Cyfluthrin
Cyano(4-fluoro-3-phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,2-dimethyl-cyclopropanecarboxylate 11.8%
OTHER INGREDIENTS: 88.2%
100.0%

Contains 1 lb cyano(4-fluoro-3-phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate per gallon.

EPA Reg. No. 3125-498

Specimen label – Pesticide used for RMM exterior termite treatments.

PRESCRIPTION TREATMENT® brand

CY-KICK®

Crack & Crevice® Pressurized Residual

For Pest Control Operators and Commercial Use Only

KILLS: [illegible]

FOR USE IN AND AROUND: [illegible]

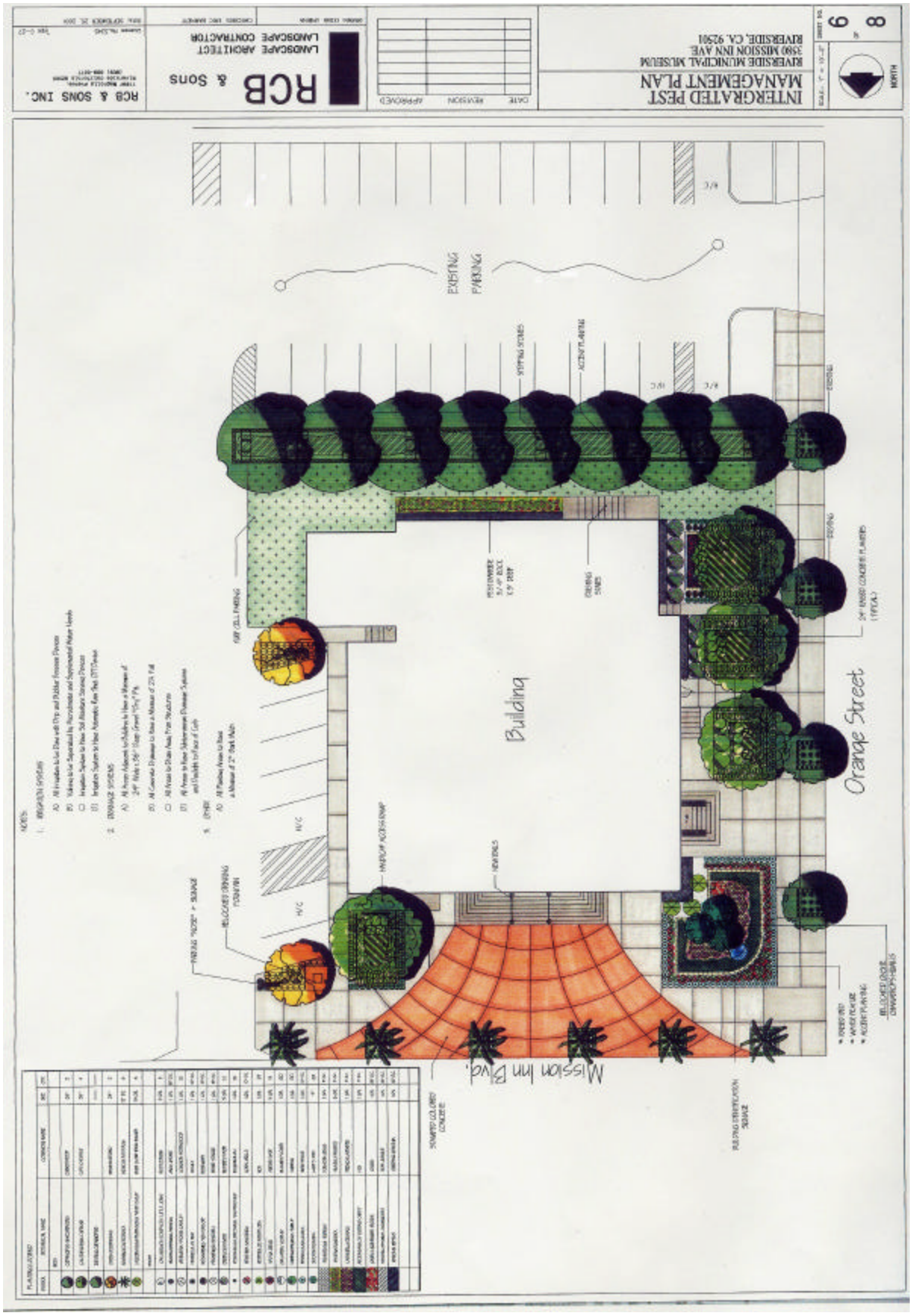
ACTIVE INGREDIENTS:
[illegible]
OTHER INGREDIENTS: [illegible]

EPA Reg. No. 499-470 EPA Est. No. 499-MO-1

APPENDIX 6.

RMM Termite Control services: treatment site

APPENDIX 7. RMM Landscape project: plan view



APPENDIX 7. (cont.) **RMM Landscape project: photos**

Municipal Museum ca. 1996

Tree removal

Hardscape demolition

New irrigation and drain lines

New pavement areas

Old rainwater downspout outlet

New raised planters

Boy Scout cleanup project

APPENDIX 8. RMM Public Programs

Program: Smithsonian Institution traveling exhibit – The O. Orkin "Insect Safari"

Date: Saturday and Sunday, October 26 and 27, 2002
Category: Large scale family program. Projected attendance: 500
Description: **"**Leave the bug spray at home and head to the Museum for a fun filled day of insect fun! Tour the Smithsonian Orkin Insect Safari!" Housed in a multicolored 53-foot mobile unit, the Insect Safari is filled with interactive displays, scientific facts and a stimulating range of imaginative, colorful illustrations. UCR entomologists will be on hand!

IPM Components:

1. ***Insect safari***
   Orkin Insect Safari will set up on Mission Inn Avenue in front of Museum.

2. ***When is a pest, a pest?***
   Activities that will focus on "When is a pest, a pest?"

3. UCR Entomology faculty, staff and students will present a series of table top displays on their research, featuring live insects.

4. Display of live insects in the RMM Nature Lab

Program: Bug Daze First Sunday

Date: December 1, 2002
Category: Large scale family program. Projected attendance: 200
Description: "Get ready for a day with the bugs! We'll get the buzz on bugs as we explore the fascinating world of our six and eight legged friends. Take a spider safari and go on a beneficial bug hunt. Explore the role different creepy crawlies play in our lives, and find out why it might be a good thing to have a spider or two hanging out in your house."

IPM Components:

1. ***Spider safari:***
   Visitors will learn how to identify common spiders and compare their appearance to that of the "mysterious" brown recluse.

2. ***Beneficial bug hunt:***
   When is a pest a pest? When is it not? Visitors will explore this idea through this activity.

3. ***Insects and people:***
   "The Queen's Own Grove" essay on the origins of biocontrol in the Riverside citrus industry; reenactment or retelling.

4. ***Bug buffet:***
   Demonstration of Native American cuisine. When and why did native American eat bugs?
   Sample modern insect cuisine.

5. ***Meet live insects:***
   UCR outreach.

6. ***Insect origami:***
   Make beneficial insects using origami.

Program: "It's a Jungle Out There!" First Sunday

Date: April 6, 2002
Category: Large scale family program. Projected attendance: 200
Description: "Explore life in a garden, a front yard or an empty lot as we spend a day discovering how plants grow and survive. Get up close and personal with a waterwise garden as we look for the mystery plant and search for garden insects. Find out how you can help conserve water and resources through waterwise gardening and recycling."

IPM Components:

1. ***Garden insect search***
   We'll create an artificial garden. Bugs will be released into the garden, and visitors will search for different beneficial and pest insects.

2. ***Beneficial bug and pesky pests***
   UCR outreach

Program: Insects in the Classroom

Date: March 29, 2003

Category: Teachers and educators

Description: During this evening workshop, teachers will learn how to identify common insects and discover how they can be used as effective teaching tools in their classroom. The principles of integrated pest management will be discussed as an additional educational tool for meeting state standards through interdisciplinary studies.

IPM Components:

1. Teaching about bugs = teaching about IPM
2. What is IPM
3. How IPM curriculum can enhance curriculum
4. IPM in your classroom
   a. pyramid of tactics
5. IPM curriculum activities
   a. IPM across the curriculum
6. IPM and inquiry
7. Bugs in your classroom- how to set up and maintain a small collection for classroom use

Curriculum to use:

1. Modern children's literature such as "What about the Ladybugs?" by Celia Godkin.
2. Activities adapted from the Pennsylvania IPM program. (For more information, visit: http://paipm.cas.psu.edu/schools/coursematr.html)
3. Activities adapted from *Insects in the Classroom* series at Texas A&M University.

Program: Integrated Pest Management in Museums

Date: May 31

Category: Adult/professional

Description: The Museum will host colleagues from other museums and botanical gardens for an IPM symposium. The symposium will introduce IPM concepts for application within a museum or similar setting.

IPM Components: To be determined

Program: After School Science Adventures

Dates: December 19 and May 28

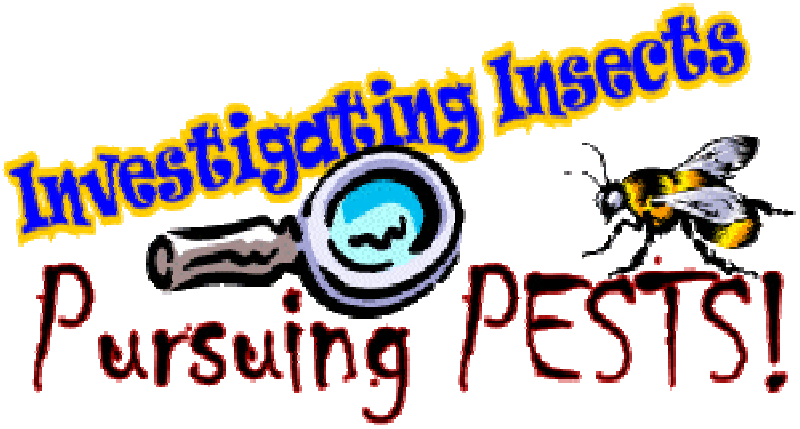
Category: Youth program. Projected attendance: 75 participants per program, 4 programs total.

Description: 2/19 Squish! Living with pests
You may not mind a bird living in your back yard, but what about spiders, ants and other "pests"? Meet some creepy crawly critters up close and find how they make life easier for everyone. Learn how to identify poisonous critters and find out what to do if you see one. Take home a creepy crawly checklist, too!
5/28 There's a BUG in my garden!
We'll identify a few common insects that live outside and in our homes and find out how to live with (or without) them. Meet some beneficial insects up close!

Components:

1. Insect identification slide show
2. IPM introductory activity
3. Examine beneficial insects

APPENDIX 9. RMM Public Programs: program flyers & photos



Investigating Insects, Pursuing Pests is the Riverside Municipal Museum's IPM education website. With content developed for individuals new to IPM principles, the website will:

- Provide an introduction to IPM
- Include links to other IPM informative websites
- Contain downloadable IPM activities for kids
- Advertise upcoming IPM activities at the Museum
- Link to the Museum's IPM policy as well as other information related to our IPM initiative.

The Museum's main website will also contain information specific to IPM in Museums, providing a comprehensive resource for museum professionals or facilities managers.

Smithsonian Traveling Exhibit Service "Insect Safari" October 26 & 27, 2002

APPENDIX 9. (cont.) **RMM Public Programs: program flyers & photos**

Spiders exhibit at Insect Safari

UCR Entomology activity tent at Insect Safari

Exhibition "Natural History Collections - Preparation & Conservation" April to September, 2002

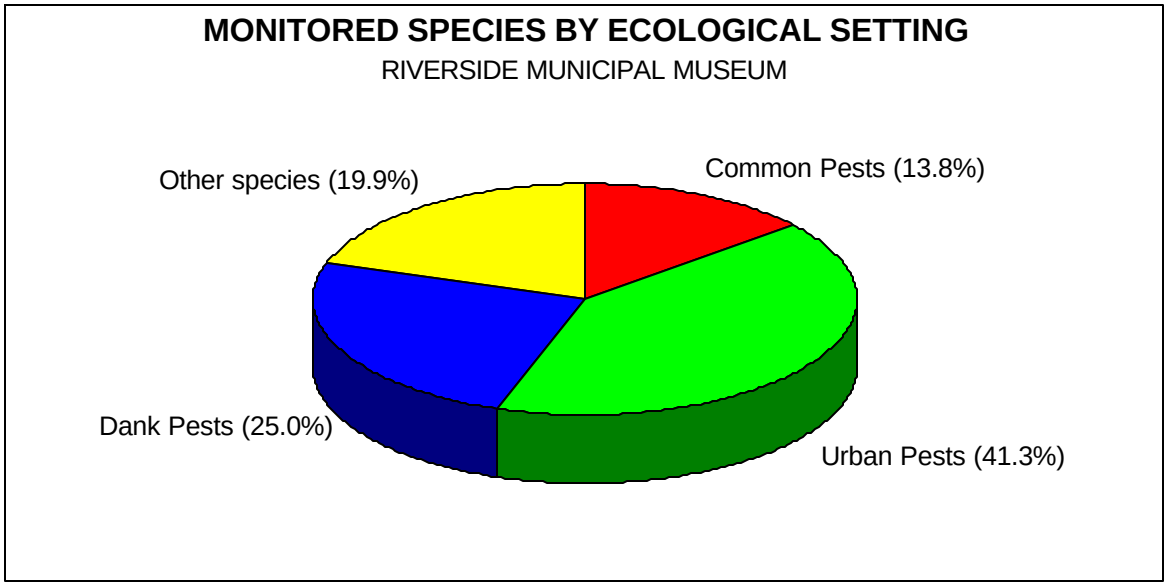


Figure 1. Diversity of pests collected based on ecological associations

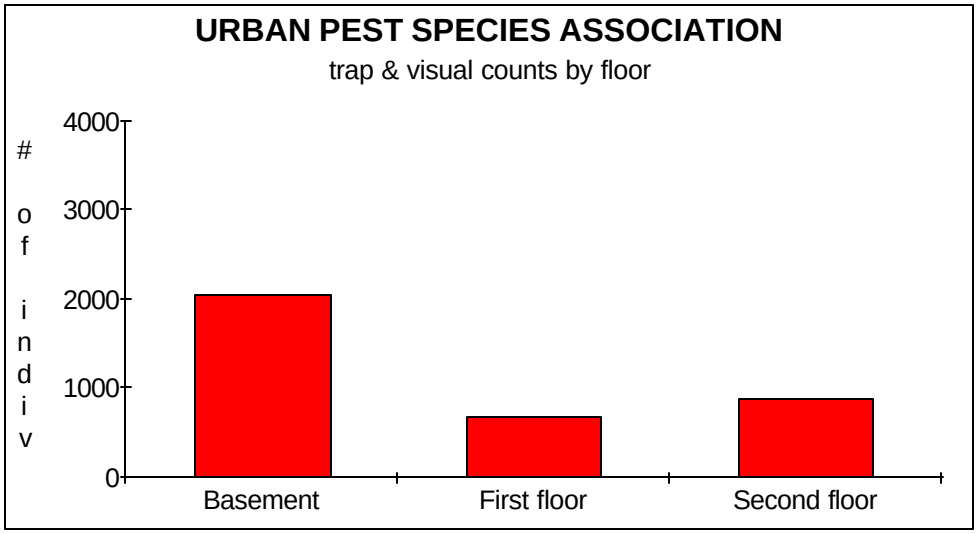


Figure 2.

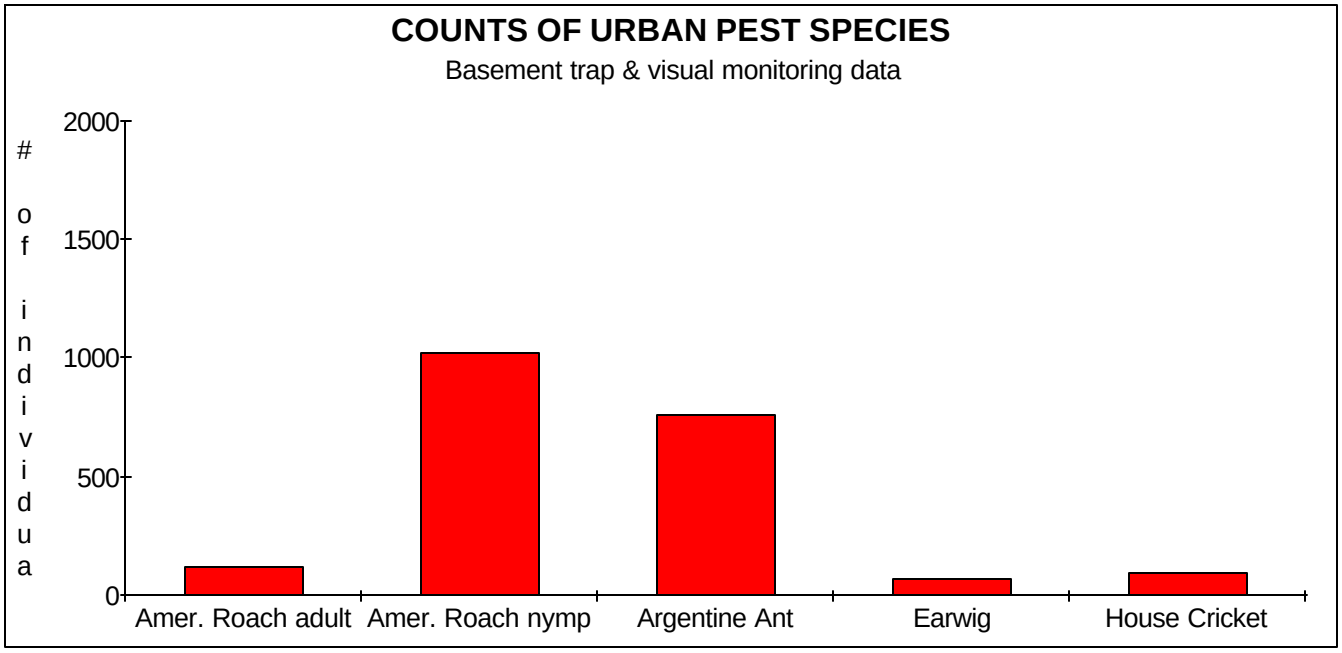


Figure 3.

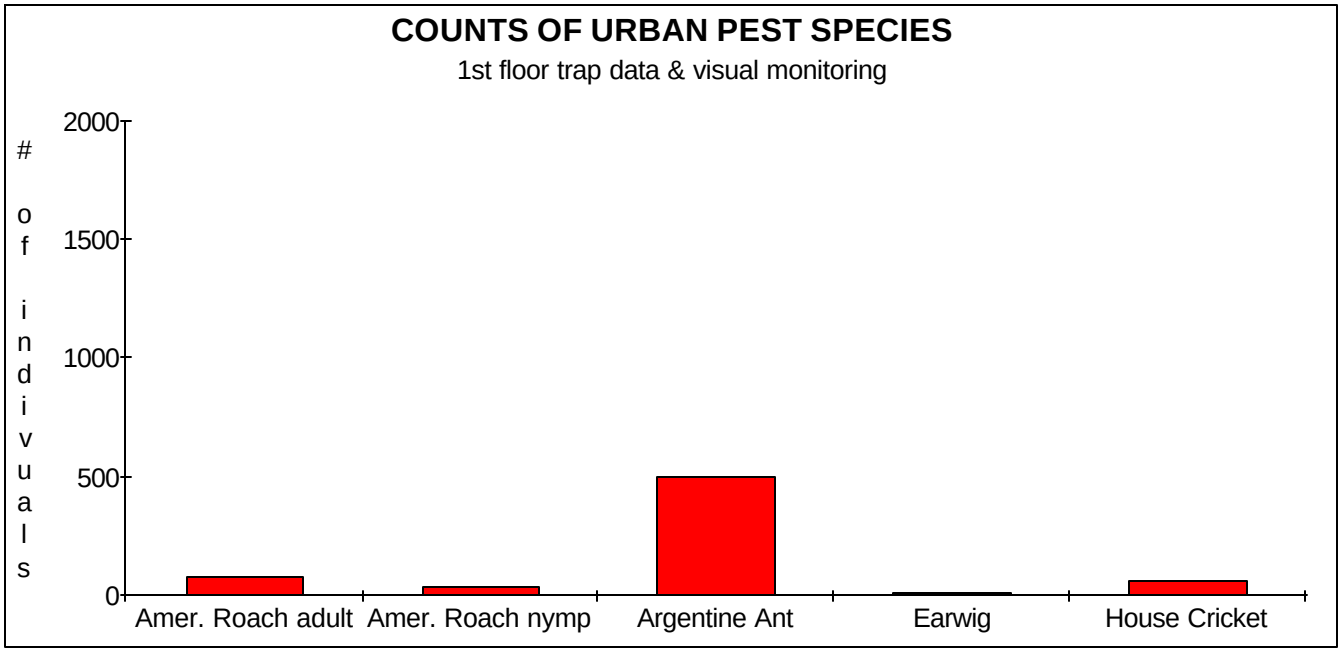


Figure 4.

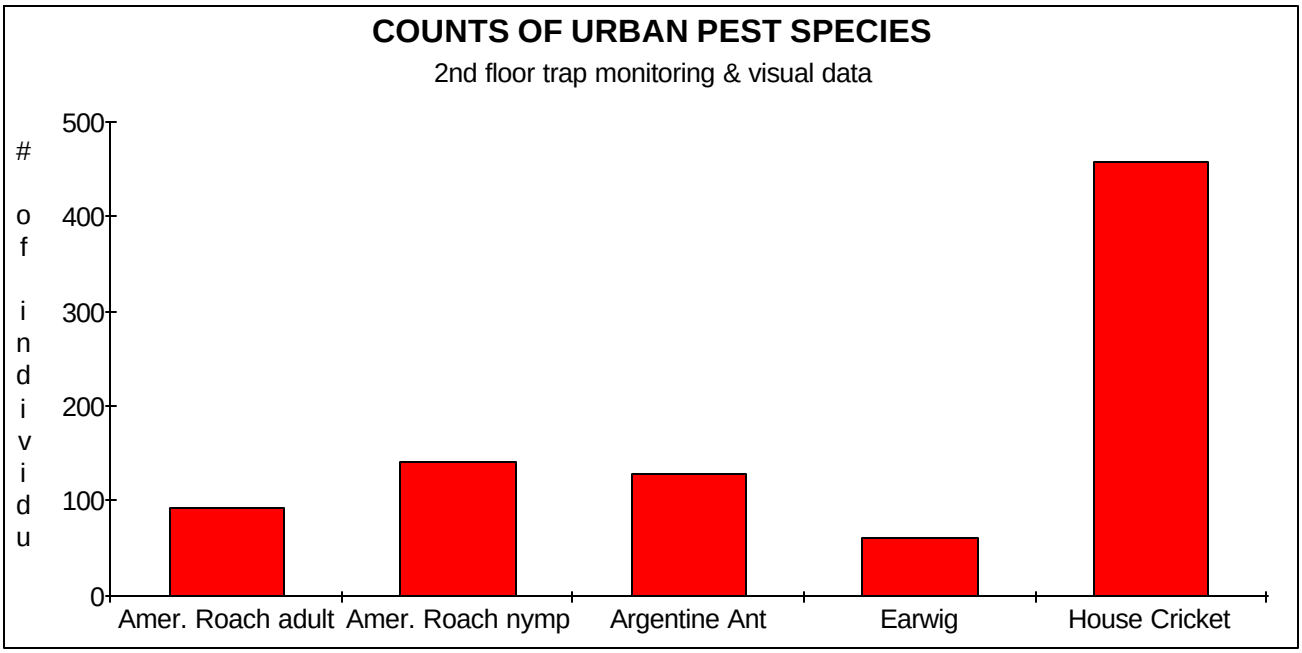


Figure 5a.

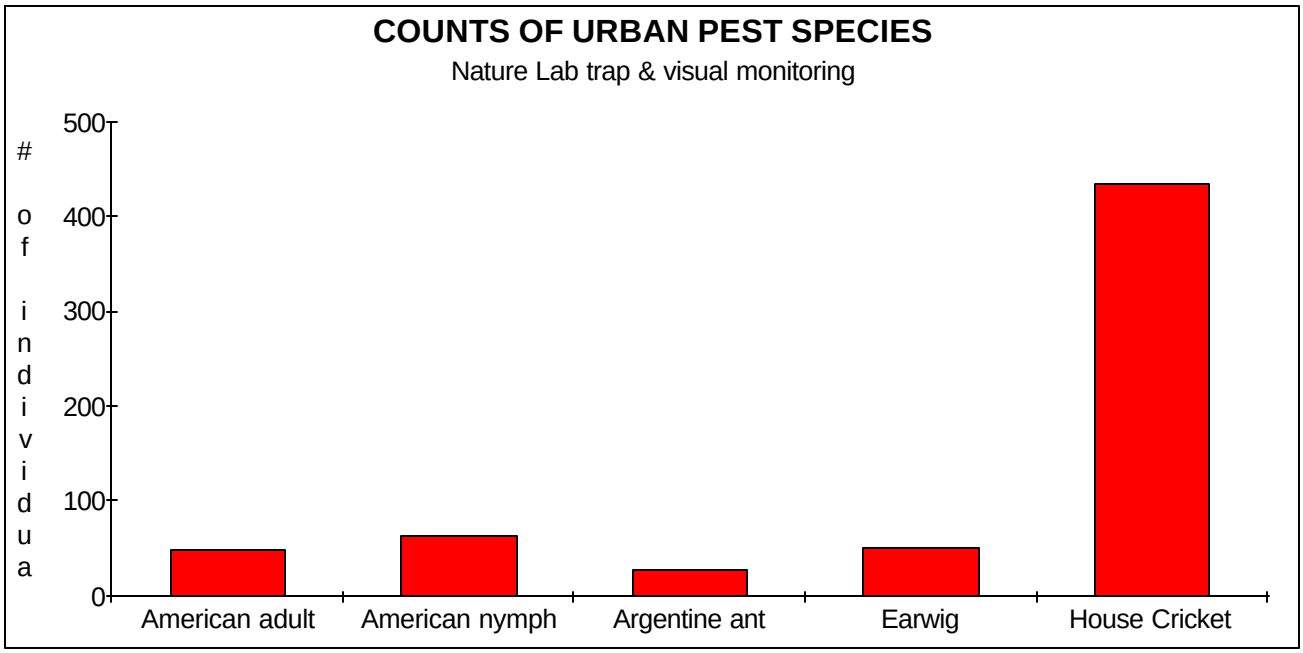


Figure 5b. (Compare to 2nd floor totals, Fig. 5a.)

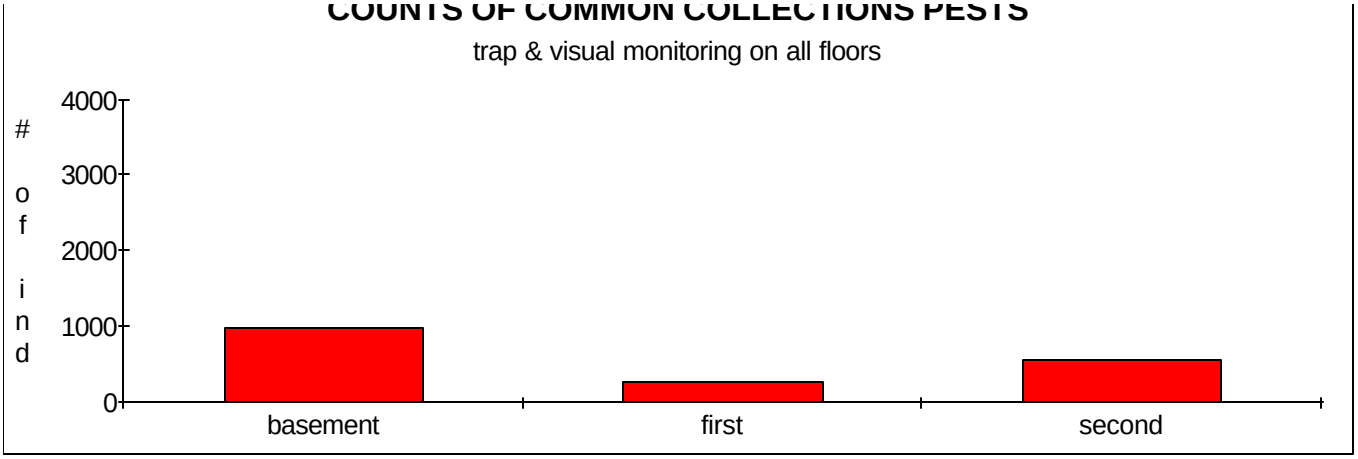


Figure 6.

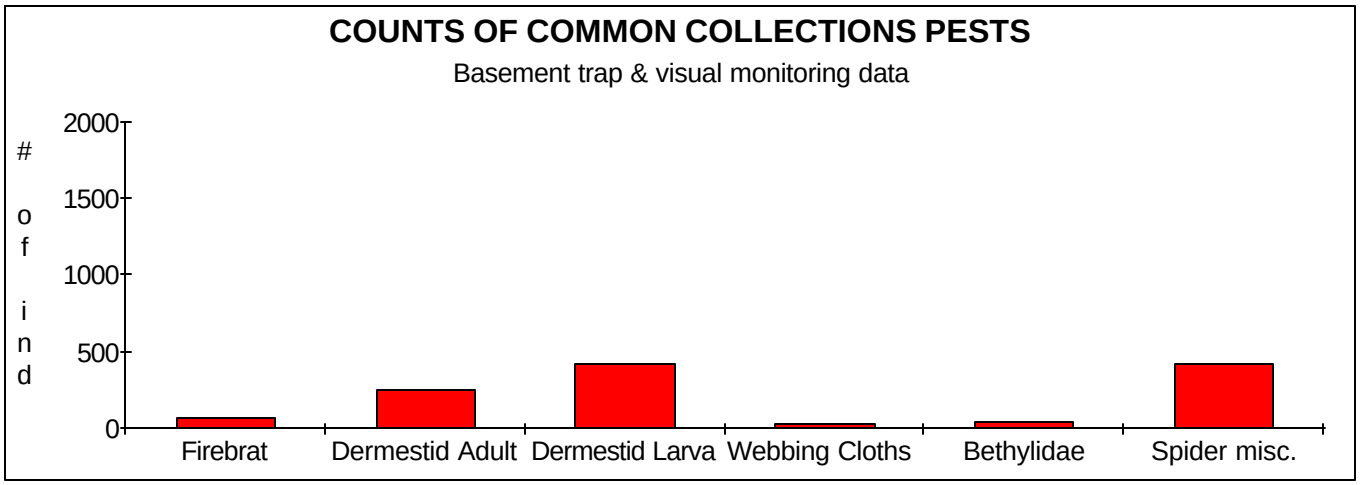


Figure 7.

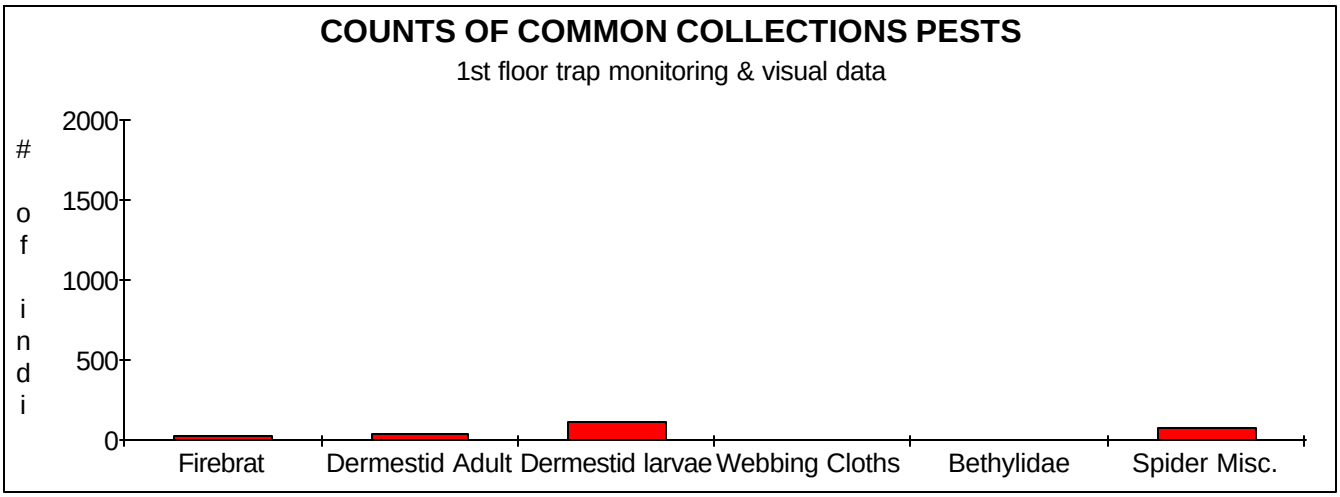


Figure 8.

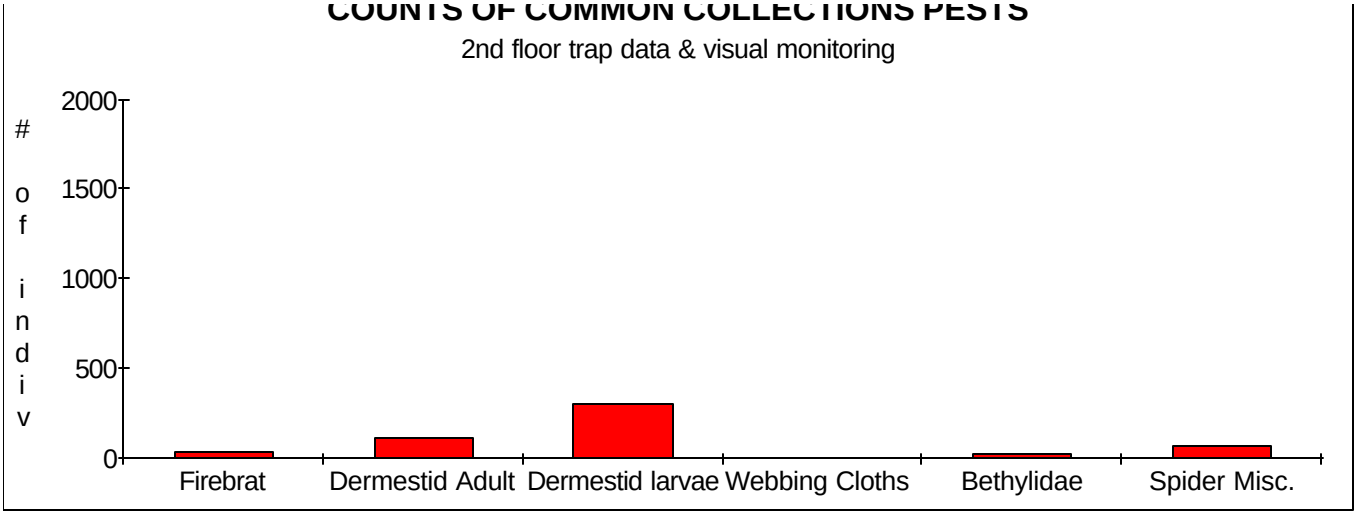


Figure 9a.

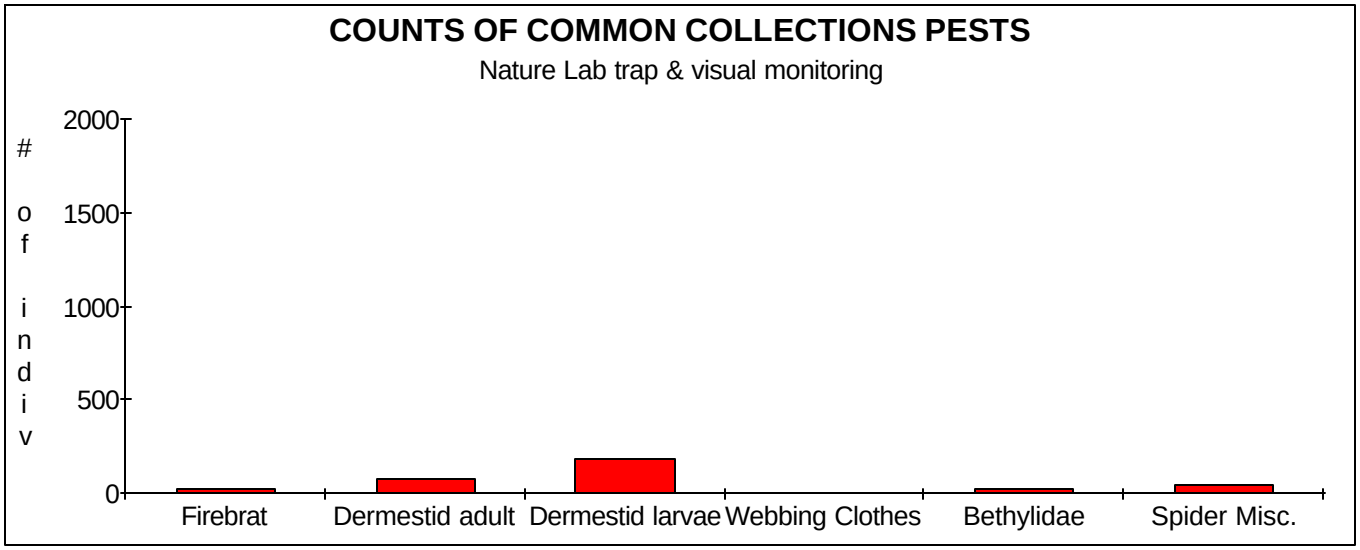


Figure 9b. (Compare to 2nd floor totals, Fig. 9a.)

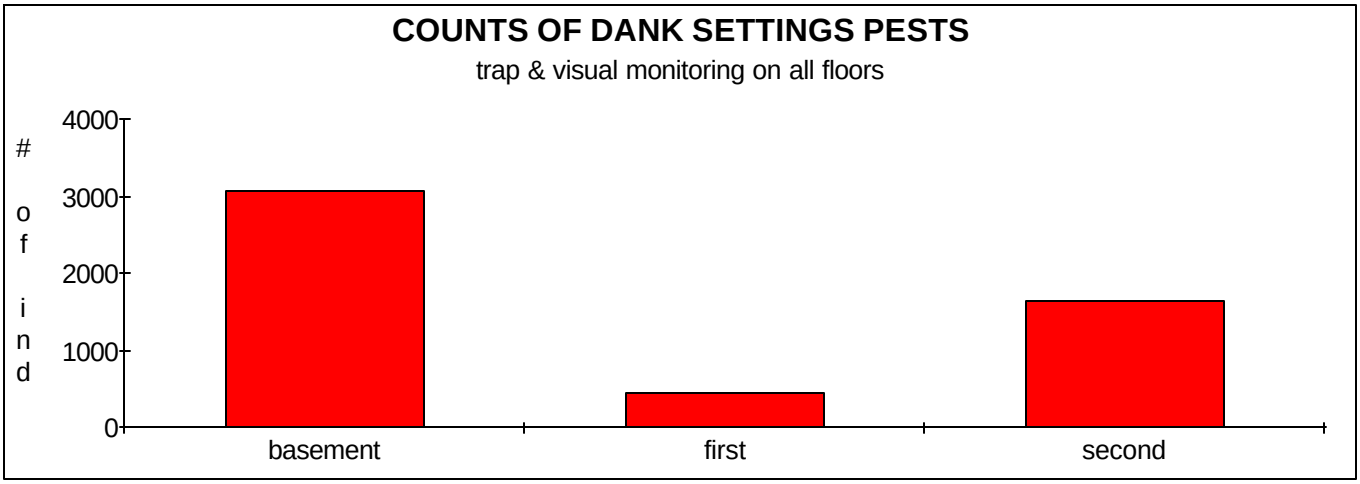


Figure 10.

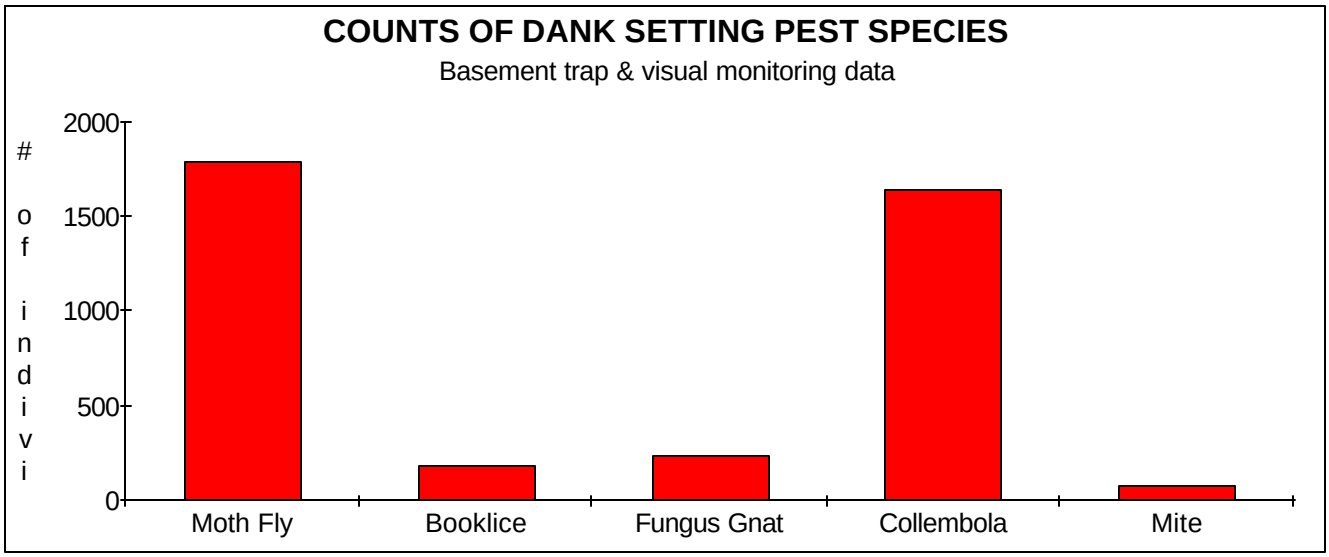


Figure 11.

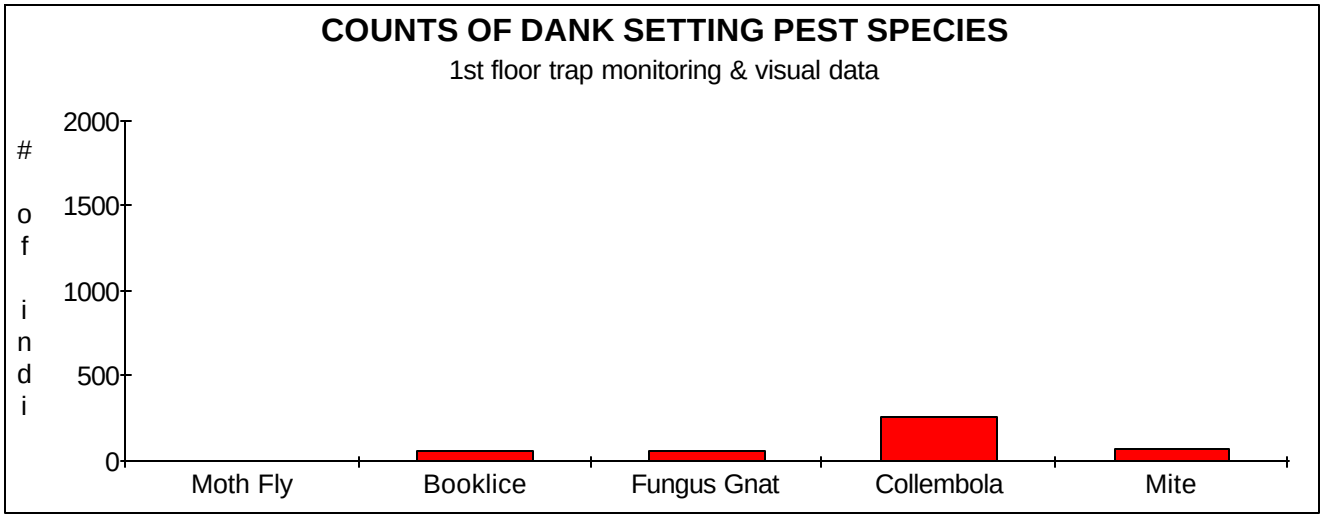


Figure 12.

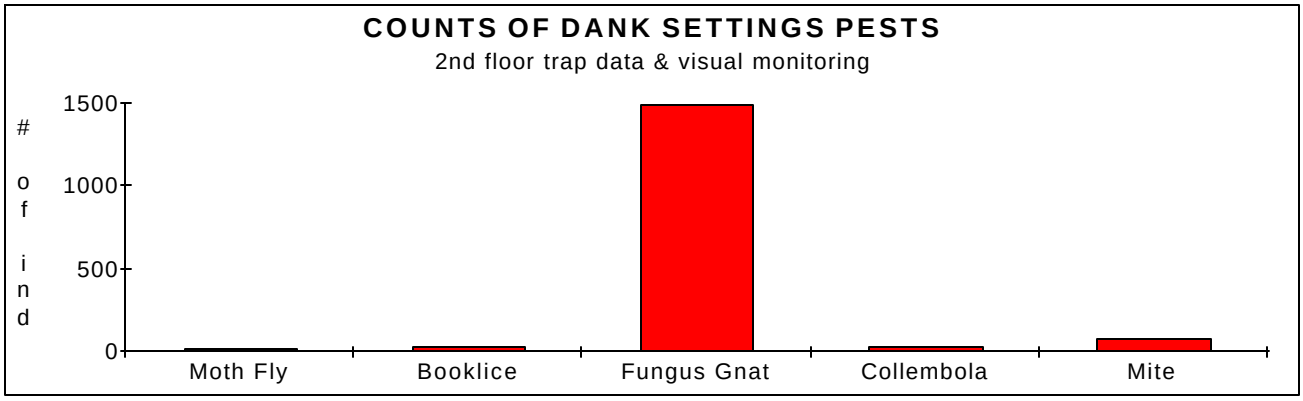


Figure 13a.

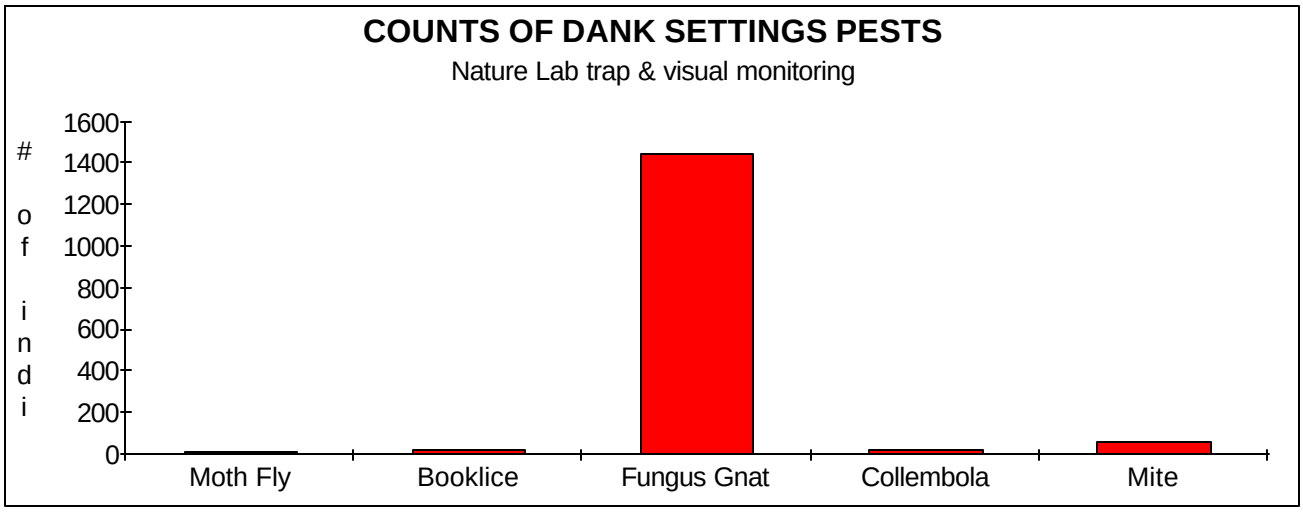
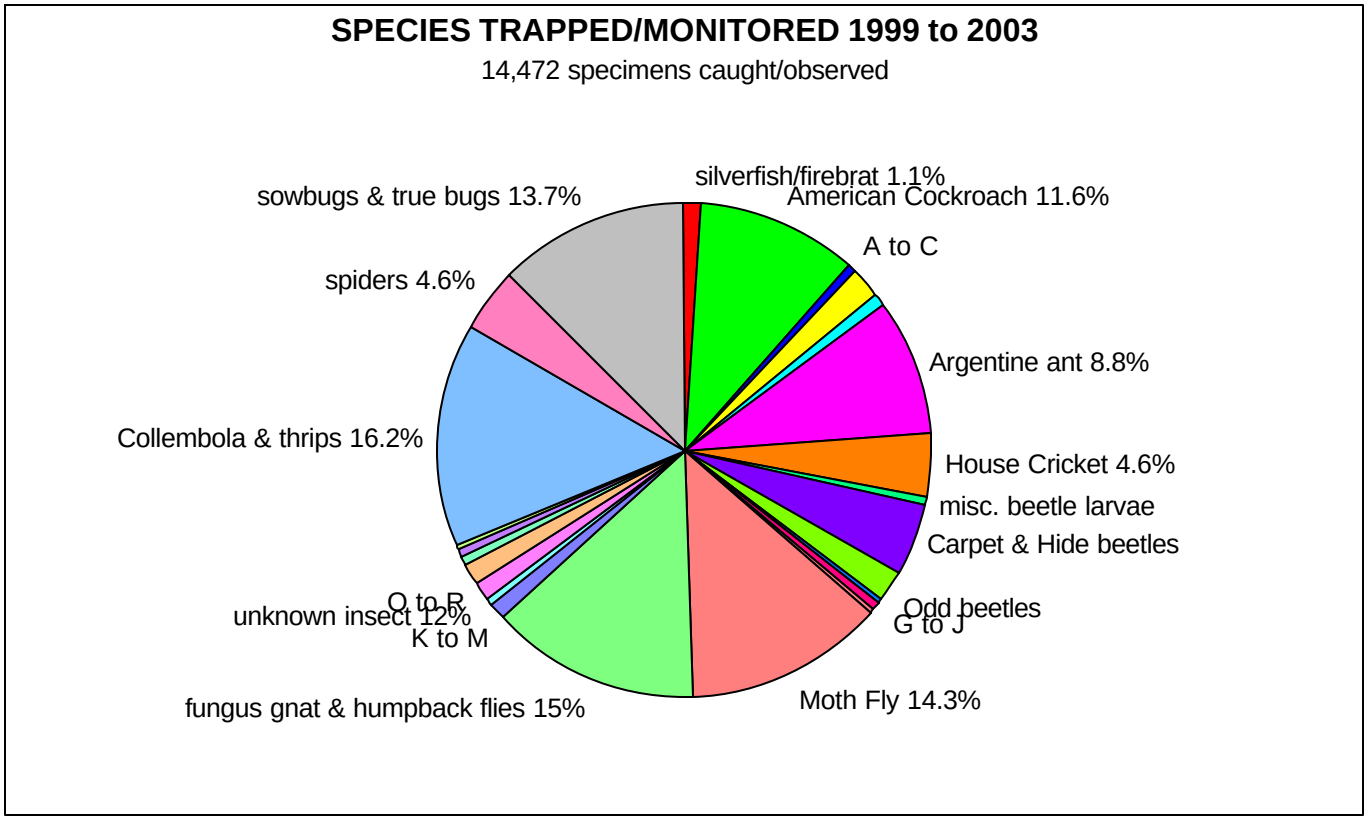


Figure 13b. (Compare to 2nd floor totals, Fig. 13a.)

Figure 14. Cumulative record of invertebrate species – Riverside Municipal Museum



A Misc. Cockroach B booklouse C earwigs E dermestid beetles
F Odd Beetle G ground beetle H drugstore beetle I click beetle
J unknown beetle K misc. flies L mosquito M midges & lacewings
O misc. mites P misc. wasps & bees Q misc. moth
R Webbing Clothes Moth