

Municipal Rodent IPM Working Group Meeting Report

November 19, 2021





Table of Contents

01	<i>Summary</i>	p 03
02	<i>Municipal IPM Objectives and Goals</i>	p 04
03	<i>Defining and Measuring "Success"</i>	p 04
04	<i>Metrics and Indicators to Measure Success</i>	p 05
05	<i>Tools to Measure Success</i>	p 06
06	<i>Opportunities in Municipal Rodent Management</i>	p 07
07	<i>Challenges in Municipal Rodent Management</i>	p 12
08	<i>Research Needs</i>	p 15
09	<i>Future Directions</i>	p 17
10	<i>Acknowledgements</i>	p 18

Summary

The second meeting of the Municipal Rodent IPM Working Group invited participants to discuss various components of rodent management programs. Topics included:

- measures and definitions of success
- identification of critical research needs
- challenges and opportunities, and
- planning for the future.

This report collates feedback from meeting attendees by topic.

While the group was able to identify numerous opportunities, challenges and research needs, the discussion on measuring and defining success was limited. This highlights an obstacle for municipal programs that solicit operational funds from local government to support their efforts. The lack of relevant and meaningful measures of program success is an area requiring further exploration and development.

Several research topics were discussed in detail, representing important needs for municipal rodent IPM. One of those topics represents a critical requirement for municipal rodent management: **development of effective surveillance tools to provide information about rat populations**. Without the ability to track and/or estimate rat populations, it is unknown if municipal or private efforts affect rat populations. Research to address this question involves the development of additional opportunities, such as *tools to monitor and manage rats in difficult areas, techniques to track individual rats in urban landscapes, and techniques to determine the efficacy of control tactics on open populations*.

In addition to research needs, several topics were flagged as items that could be addressed by the Working Group. These are highlighted in blue throughout the document, and include *development of minimum standards for what to include in a municipal rodent management program, specifications for landscaping and foundation plantings to minimize attractiveness to burrowing rodents, guidelines for cross-departmental collaboration (i.e., who is responsible for what actions in a municipality), and creation of an evidence-based position statement regarding the detrimental use of feral cats for rodent management*.

Working group members found meetings to be worth their time, learned something new as a result of their participation, and made new connections. All attendees that responded to poll questions voted for the Working Group to continue, suggesting future meeting topics, opportunities to meet in person, and potential development of a professional society dedicated to addressing urban rodent issues.



Municipal IPM Objectives & Goals

Service

- "to provide effective rodent control and Integrated Pest Management (IPM) for city/county-controlled properties, including local government run housing programs."
- Respond to resident complaints.
- Reduce rat numbers in the municipality (important to not use the term 'eradication,' which is not possible. Instead, municipalities should define the level of reduction that is desired and sustainable).

Education & Outreach

- Make the public aware of municipal programs and their efforts to reduce rat problems (and other pests/vectors).
- Teach pest management professionals (PMPs), state sanitarians, residents, and other relevant groups the most effective methodologies to improve rodent IPM programs. Basic education can be effective if it is tailored to each group.
- Educate constituents (private organizations and the public) about their role in contributing to rodent problems and what they can do to improve management efforts and outcomes.

Ways to define "success" in Municipal Rodent Management?

- Resident satisfaction based on testimonials and reviews.
- Responding to complaints in a designated amount of time.
- Documented reduction in rat numbers (relies on a feasible way to measure rat abundance, which is not currently available).
- Fewer complaints by residents about rat sightings.



What Metrics/Indicators are used to Measure Municipal Rodent IPM Success?

Indicators are measurable, practical, and reliable pieces of information that are relevant to the activities performed by a municipality, useful to decision makers, direct and precise.

Several types of evaluation are possible to gauge the success of municipal rodent IPM programs:

- Formative: aim to improve program performance.
 - Process: aim to improve program delivery (delivered as intended? Does it reach the target audience?)
 - Summative: focus on program outcomes (were goals achieved? Did it work? Worth continuing?)
 - Outcome: focus on short-term outcomes (was there a change in conditions?)
 - Impact: focus on long-term outcomes (was there a change in behavior? Are there societal changes?)
 - At a minimum, programs can list the various activities they undertake and identify expected outcomes. This can be used to evaluate if goals were achieved (similar to what is done in a logic model).
-
- Complaint-based systems like 311 can be used to interpret program success based on trends in complaint numbers over time. However, it is well known that several factors affect reporting to these systems, and results should be interpreted loosely.
 - Numbers of violations and/or citations issued that are associated with presence of rats. This may include health, sanitation, and code violations.
 - Compliance/'closed complaints' in which violators sufficiently resolve the issue.
 - Updated maps of rodent activity, including active rodent signs.
 - Cambridge, MA has freely available system to map complaints and rat hot spots <https://data.cambridgema.gov/Public-Works/Commonwealth-Connect-Service-Requests-Rodent-Sight/gzbv-wgij>
 - Number of residents assisted.
 - Number of burrows present in an area.
 - Number of burrows treated in an area.
 - Resident satisfaction with how the municipality responds to complaints (number of days between complaint and action, type of action taken, communication, etc.). Do municipalities currently evaluate this?
 - Number of fleas per animal or fleas per burrow (relevant to Typhus risk assessments).
 - Recommendation to move away from metrics that use amount of bait consumed because rates of consumption differ by species, consumption rates can differ based on the type of rodenticide (first generation, second generation and non-anticoagulants), bait resistance alters feeding amount, percent active ingredient in the bait changes anticipated/required amount of feeding, etc.

What Tools are or Should be Available to Measure Municipal Rodent IPM Success?

Currently Available

- Remote monitoring tools are available, but adoption/use is currently low. This technology can help identify problem areas and detect activity in out-of-sight or difficult to access locations.
- Passive surveillance by residents: 311 and 'report-a-rat'. These systems are useful to identify new introductions, which are easier to manage than established infestations.
- Mapping tools that help identify hot spots and classify these as management zones. For example: <https://data.cambridgema.gov/Public-Works/Commonwealth-Connect-Service-Requests-Rodent-Sight/gzbv-wgij> and http://gis.nyc.gov/doitt/nycitymap/template?applicationName=DOH_RIP

Not Yet Available

- Scorecard, standards, or rubric that identifies what represents, and/or is included in a well-rounded municipal rat control program.
 - Potential WG goal to develop minimum standards of what to include in a management program based on efficacy. Examples may be available from what mosquito control programs do in response to West Nile virus or Zika outbreaks.
- Decision-support systems that help guide municipalities and cooperating pest professionals about how to improve programs based on acquired data.
- Surveillance systems like those used for mosquito control are needed, but challenging to develop for cryptic pests that are not easily monitored. A summary of the components in effective mosquito control programs can be found here: <https://entomologytoday.org/2021/12/08/integrated-mosquito-management-protects-people-animals/>

Opportunities in Municipal Rodent Management

Education

- Offer free continuing education units (CEUs) to audiences (PMPs, sanitarians, etc.) to motivate meeting attendance. It is important to think about the target audience and what would motivate them to attend meetings and learn before planning events. This can improve communication between the municipality and groups with overlapping interests. An example was given about a requirement for pest management companies to attend educational meetings with a client as a prerequisite before they can submit a proposal to provide service.
- Educate residents of the municipality that they play a vital role in rat problems by feeding pigeons, garbage practices, etc.
 - Resident behaviors contribute to problems, but are rarely targeted through educational efforts.
 - Additionally, adoption rates of new practices can be influenced by life circumstances and the resources people have to implement change.
 - Messages must be relatable to public audiences.
 - One way to help residents understand rat behaviors/routes is to refer to the Hotel, the Highway, and the Restaurant (harborage, pathways, and food sources).
- Science-based education to improve overall approach to rodent management. Emphasis on inspection (what to look for) and pest biology to inform management. Homeowners/residents, technicians from private industry and municipalities, state sanitarians, state-level agriculture inspectors, regulators could all use this information.
 - WG develop a video series? Grant funded with excellent videography showing techniques and practices for effective management.
 - "good science presented to the public in easy-to-understand terms could help with buy-in for sanitation, more tools, and keeping old tools."
 - Content discussed in Working Group meetings is not the same information shared at industry training events. How can the science trickle down to industry?
 - Teach better methods to the professional pest management industry.
- Methods to motivate public and stakeholders to effect behavior change regarding practices that facilitate rodent populations? Targeted messaging? Social marketing?
- What can private sector do better to contribute to more effective rodent/pest management? What can be learned from a scientific approach?
- Educate public/customer to want the proactive, long-term solution of exclusion (even if it costs more), compared to short-term reductions in pest numbers that will rebound.
- Opportunities to have pest exclusion materials listed on project Dodge Reports? These documents specify all the products that will be used for a project.
- View rats in a OneHealth model: your health isn't just about you, but about the health risks and animals in the environment. How rats interact with the city and how people interact with city influences the health of residents.

Advocacy

- Tools needed to educate funders on the importance of municipal rodent programs.
- Different educational tools for different stakeholders: mayor, government, public, etc.
- Municipal programs need to develop a better understanding of what legislators and funding agencies want or need to see to make decisions about funding easier.
- Government employees, pest management professionals and the public may not understand what is needed for effective municipal rodent management – like public health concerns, proactive prevention is essential (i.e., refuse management), but rat management is almost always reactive.
- **WG develop evidence-based position statement on the use of feral cats for rat control.**
 - Cause of flea-borne typhus in CA; pathogens, birds, animal welfare, etc.

Guidance

- Focus on developing programs that are proactive, rather than relying on reactive approaches. What are the elements of proactive programs that municipalities can use?
- Develop policies/procedures for rodent management around homeless encampments:
 - Some cities use only carbon monoxide/dioxide to avoid tampering with bait.
 - Filling in rodent burrows with concrete to avoid the need for treating burrows with rodenticide. This also improves safety by preventing cave-ins and falls.
- Determine best practices for how to divide labor in a rodent management program: indoor v. outdoor; residential v. commercial; public v. private, etc.
 - Guidelines for collaboration between pest professional and municipality: how to translate work in one apartment/building/block to entire municipality? What is the scale of work?
 - Example in Philadelphia of private pest professional managing rats in building, municipality treating rat problem on exterior (baiting sewers, parks, etc. nearby).
- **Update of procedures and policies for demolition and construction – what should be done during the construction or demolition phase in a city?**
 - Need for surveillance and implementation of inspection-based rodent control program: development of best practices.
 - Capital projects provide an opportunity to inspect and remediate issues with underground infrastructure: review plans, cut and cap all lines that are no longer in use. Install backwater flow preventers (can become a burden if not maintained).
 - Include cut and cap old sewer lines as feature of municipal plumbing code.
 - Assess other areas to add new standards that would benefit rat management. For example, electrical and plumbing codes requiring a seal around utility openings.
 - This can also be addressed through programs like Community Development Block Grants Program or Healthy Homes, where tax dollars are used to improve and develop structures, including residences. During the environmental impact assessment phase, a condition could be added to the statutory checklist that would evaluate decommissioned plumbing fixtures and other important exclusion needs before approval is granted.
 - A project in Somerville, MA is investigating whether or not there are any changes in rat activity before, during and after demolition projects.

Guidance (continued)

- Guidance from other municipalities:
 - Boston requires an assessment by an environmental health inspector to determine compliance. Bait stations are installed on property based on assessed activity levels. During construction, laterals and sewers are capped if not in use. Commissioners Bulletin in Boston has regulations and ordinances related to construction. Entities performing construction are responsible for rat issues up to 150 feet from construction site, and fined if demonstrated that the site is responsible for rodent populations. Sewer baiting program may be performed in grid around construction sites if issues arise.
 - Washington, DC requires a rodent control plan from the beginning to the end of a project. Typically no rodent problems for vacant buildings – only when people arrive. Applicants pay a fee, which covers inspector time to visit sites and ensure implementation of the rodent management program.
- A useful tool would be the development of standardized surveillance programs or practices, which would allow for comparison of data between municipalities.
- Strategic plans for rodent management in municipalities are needed. Whereas other municipal projects have strategic plans (transportation, sanitation, etc.), rodent management programs are often overlooked.
- Develop guidelines for conducting research related to rodent-borne disease programs.
- **WG propose template legislation with recommendations to help address municipal rats.**
- There are differences between municipalities, but also similarities. A template program could be developed that covers rat management in common problem areas such as parks, sewers, dumpsters in alleys, etc. Each city would then be responsible to develop their own supplemental document that address the unique aspects of their city.
- Develop guidelines for how pest control company (or agencies) should respond when client (i.e., restaurant) does not comply with addressing exclusion and sanitation issues.
- **WG create specifications for foundation plantings that would reduce attractiveness to rodents (burrowing and food sources - see [Pest Prevention by Design - Landscapes](#)).**

Research

- Study vacuum trash systems that do not require curbside pickup, but chute system. Evaluate how refuse is handled and how it impacts rat populations (ex. Roosevelt Island, NYC. Note: systems require major infrastructure changes and are expensive).
- Education about, and research on building materials. For example, spray-foam insulation works well for weatherizing a building, but can facilitate wood-destroying insect pests and is not effective for rodent exclusion.
 - Opportunities for materials/engineering partnerships at university level to evaluate/study rodent-proofing materials.
 - Example given about academics and pest professionals working together with insulation industry. Academic paper to be published soon.

Resources/Tools

- Method to upload data to centralized system in municipality to share information. For example, pest professional upload trapping and population data from building, which is collated by municipality with information about rat populations on the block.

Pest Prevention

- Most cities (and states) have codes that require exclusion, sanitation, and pest free environments. However, this is not enforced and should be by the municipality.
- Due to concerns with COVID and animal reservoirs, the timing might be right to get additional funding for rodent management work, including pest prevention. There is a need to prevent rodents as commensal animals from bringing pathogens into environments where people live, work, learn, play, and worship.
- Municipalities and private entities should implement rodent exclusion to keep rats out of buildings and prevent them from burrowing in sensitive areas.
- Opportunities with new infrastructure bills to discuss rat issues and pest prevention by design for new builds? **How can WG promote this message?**
- Certification programs for good building practices that keep pests out.
- Environmental impact checklists that highlight cost and energy savings of exclusion and weatherization.
- Importance of rodent exclusion on airplanes where fiber-optics and other sensitive equipment cannot be damaged without severe negative outcomes.

Engaging Qualified Professionals

- Municipalities would benefit by having a list of pest professionals that do rodent work to serve as a resource for property management, municipality, etc.
 - Essential that this is an unbiased list. One way to make the list unbiased, but also ensure providers are qualified, is to set criteria for companies to meet. Not a certification, but quality control criteria that establishes them as a preferred vendor. For example, "demonstrated ability to implement a rat IPM program that utilizes monitoring and assessment." Look to QualityPro Public Health Certification: www.npmaqualitypro.org/media/1515/qualitypropublichealth-rodent.pdf
- Add monitoring and assessment subject matter to the various rat academies held across the country to see how it is received and if companies implement protocols.
- Improve bid specifications for contractors that better articulate the needs and goals of a rodent management program. Based on experience, unless the municipality has a dedicated team, the contractors might not know what they're doing on a large scale.
 - Important to have contingency agreements and a group to provide oversight.
 - Municipalities might need to develop different frameworks for different circumstances. A standard framework for how to perform rodent management in the municipality can be modified in the event of rodent-borne disease outbreaks or natural disasters to provide guidance for service providers. This is especially true if municipalities don't have an in-house rodent control program. Providers would need to know what to do operationally to reduce risks to people (education/communication), and in terms of trapping/increased surveillance.

Coordination & Collaboration

Large municipalities have interest, knowledge, and presumably funds to address rat problems, but require collaboration.

- Cities should have a coordinated group of critical agencies that work together to address rodent issues. This would include the health department, housing, sanitation, parks, sewers/streets, etc. A task force with consistent leadership from a mayor or the mayor's office can have lasting impacts on the effort to manage rats.
 - Each department would have different assignments, and progress would be monitored in one- to two-year cycles for accountability.
 - If one agency asks for help from others, it might not happen. If mandated or overseen with structure from above, it is more likely to happen.
- **WG could develop guidelines for cross-departmental collaboration and communication: indicate who (department) is responsible for what (action)?**
 - Could be similar to what Orange County Vector Control uses for Typhus response. Could include empty templates for municipalities to fill in with their respective departments.
 - Needs to address situations where different agencies use different contractors, but no communication (mentioned in challenges above).
 - Example that one department knows where rat problems are, but has no authority to manage them on public property (can be similar to union issues).
- Opportunity, system or mechanism for neighborhoods to intervene when there is a rat problem. How to get buy-in from businesses that are causing the problems but taking no corrective action, meanwhile residents suffer the consequences of rat populations.
 - Community Hygiene program in Washington, DC: addresses rat issues in commercial areas one block at a time.
- Importance of developing and maintaining a relationship with the media. They can provide a platform to get messages out to constituents. However, it's important to set expectations for collaboration to avoid inaccuracies.
 - Think of ways to frame what municipal programs are doing that would be interesting to media.
 - Or, make own media to promote and/or demonstrate what programs are doing to address rat issues (documentary-style short film?).
- Develop relationship with legislators (might be easier in smaller cities or in situations where there are no competing financial interests).
 - Invite legislators to participate in, and attend rat academies.
 - Create a legislative position that supports rat management programs (some municipalities have no support at the state or local level).
- Improve collaboration with agencies that regulate pesticide use in state/municipality.
- Communicate message to "League of Urban Municipalities" and other groups that share interests of preventing pests where people live, work, learn, play or worship.
 - LEED would be interested in approaches that reduce pesticide/rodenticide use.
 - It might be possible to certify good building practices through partnerships with LEED, GreenShield, or other certifying groups.
- Partner with neighborhood associations that are invested in keeping parks and other areas free from rodents.

Legislation & Municipal Codes

- Consider using/promoting a "Pest Free Days" concept for food service establishments, especially with the use of remote monitoring. This metric could incentivize effective pest management and cooperation between the site and pest professional. Another option could be "inspections without pest evidence" based on health department data.
- Need to standardize how long a food establishment is closed after a failed food inspection. For example, in Orange County, CA a restaurant can reopen in less than 24 hours, whereas a restaurant in Los Angeles County must wait 48 hours.
 - WG could provide recommendations for codes/violations that should be included in sanitary inspections, with recommendations for how long before re-opening?
- What data do PMPs, code enforcement, sanitarians, agriculture inspectors, etc. have available to start communication (being investigated regionally by NOLA/CDC grant).
- Municipal codes are needed to require rodent-proof trash cans with known efficacy.
- WG could create a "database" or "repository" of rodent ordinances/codes in local/state jurisdictions shared by group members.
- WG could list recommended codes for municipalities to adopt for rodent management.
- How to enforce accountability for individuals/businesses that don't care?
 - Can potentially deal with landlord if renting, housing authority, etc.
 - Petition system used by DC is legislation that allows reporting of problem sites.
 - States with enacted landlord tenant laws have reduced the number of bed bug infestations - <https://doi.org/10.1073/pnas.1814647116> and <https://doi.org/10.1101/2020.06.30.20143669>

Challenges in Municipal Rodent Management

Urban Rodents are a Wicked Problem

- Rodent problems, especially rats, are interconnected with a variety of municipal issues, representing a Wicked Problem (wikipedia.org/wiki/Wicked_problem). Effective rat management in cities relies on 10% good IPM practices, and 90% good public policy.
- Different municipalities have unique challenges based on their age, geographic location, proximity to waterways/coastal areas, human population density, types of housing, types and ages of sewer systems and other subsurface utility systems, specific city budgets, participating government agencies, expertise designated for rodent management programs, etc.
- Solutions for making a large, sustained impact on rat populations often require big systematic changes (e.g., trash reform) that rely on political buy-in and funding. What solutions are possible that will have an impact and are feasible for local governments?

Education

- Audiences may experience barriers to attending trainings: time/availability, financial constraints or limitations, lack of appropriate technology, relevance/justification.
 - Trainings for pest management professionals do not offer insights for municipal rodent management, and municipality-specific trainings are limited/nonexistent.
- Zero-waste initiatives can lead to rat problems if not properly organized.
 - Called "curbside organics pickup" in NYC instead of "composting organics" because materials are not composted on site.
- Importance of educating organizers about rat issues related zero-waste initiatives:
 - Frequency of removal is important (daily for schools in NYC, weekly in other cities).
 - Sturdy liners inside bin are essential, as is regular cleaning to remove spills.
 - Lid function might be more important than construction type: if not use lid or lid does not close/lock easily, it will not be used and does not provide protection.
 - NYCDOHMH provides training during Master Composter courses (New York Botanical Garden) to inform learners about rat issues related to compost.
- Rodent issues extend over a wide range of specialty areas. For example, building architects and landscape architects are different disciplines, but both need education about rodent prevention and exclusion.
- WG could develop Best Management Practices for landscaping (similar note above).

Coordination & Collaboration

- Disconnect between municipal departments: who is responsible and what role do they play in mitigating rodent problems?
- Laws/regulations made/enacted by one department can impact rat populations. Highlights need for better communication between departments.
 - ex. reductions in sanitation pickup can provide more food for rats.
 - ex. changes in mowing/landscape maintenance can provide harborage for rats.
- Different agencies in municipality use different contractors to address a problem, but there is no communication between the agencies or contractors.
- During construction, there is a challenge in making sure that all sewers, laterals, and other plumbing pipes are addressed/sealed to prevent issues.

Compliance

- PMPs know what is needed for effective rodent management. However, if clients (food handling establishments, housing sites, etc.) do not cooperate by implementing sanitation and/or exclusion recommendations, PMPs have financial incentive to continue working with them, and are not likely to terminate relationship. Therefore, cannot rely on pest control company to get clients to change behavior.
- It takes just one person/business to contribute to and sustain a rodent problem.
 - How can municipality ensure that everyone is complying with sanitation recommendations?

Program Evaluation

- Lack of consistent and robust evaluation of programs/activities. This requires a good definition of success, which is not currently available for municipal programs.

Quality of Pest Management

- How does Quality Assurance (QA) work and how effective is it? A number of bait stations found during inspections are empty and serve as additional harborage for rodents. Pest professionals that work for municipality must provide quality services.
- Skilled labor force may be lacking for public and private rodent IPM programs. Practitioners may not be invested enough to solve problems, but simply perform rote tasks like checking bait and trap stations.
- Implementing recommendations for effective rodent management might represent a conflict of interest with pest management companies in terms of eliminating a problem and reducing recurring payments. However, this argument is not justified. Companies have demonstrated that exclusion programs alone can generate annual revenue.

Public Health & Safety

- Because they are easy to use, rodenticides are often employed by municipalities to manage rodent problems. A major challenge for municipal rodent management is the environmental drift of rodenticides, and subsequent non-target effects, including secondary poisonings of wildlife. This is a public issue in municipalities and has, and is likely to lead to more regulatory loss of active ingredients and products.
- An unintended consequence of the regulations in California (2020) and British Columbia (2021) that restrict the use of second-generation anticoagulants is that the majority of rodenticides currently available/used do not have known antidotes.

Resources/Tools

- Complaint-based systems are inherently biased – some people will not use the system to complain about rats. Are there ways to overcome this bias by targeted messaging or relying on other indices?

Research Needs

Urban Rodent Behavior

- Where do earthen burrow rats go during winter? Possible to study with radio collars?
 - Observations from NYC that burrows closed in winter stay closed until warm days in March/April of the following year suggest a vertical migration.
- More studies to evaluate methods of tracking rodent movements with GPS, microchipping, implantable biomarkers, etc. [current projects in NOLA, UCANR; previous studies in Vancouver: <https://doi.org/10.1093/jue/jux010>]
 - How scalable is this to address the needs of a municipality? Is it possible to chip enough rats and get enough resolution at different scales to answer questions about rats at the population level?
 - What is the practicality of movement data for municipality? Would they be able to act on information obtained if rats had to be removed from an entire city block, for example? It might be possible to obtain information with genetic studies of trapped rats, although studies may be too expensive for cities to undertake.

Urban Rodent Management

- Long-term studies are needed to document the impact of various intervention strategies on rodent populations at different spatial scales.
- Develop a method to rank/prioritize management areas based on the vulnerability of the *human* population. It is not possible to rely on passive surveillance and citizen reports (i.e., 311 systems) because these do not always reflect the distribution of pests and factors that contribute to their presence.
- Comparative studies across municipalities/regions are needed to test the efficacy of products in different locations and environmental conditions.
- What are action thresholds for rodenticide baiting? In other words, what level of activity should be documented before a rodenticide baiting program is implemented?
- How to manage rats in inaccessible areas: abandoned infrastructure, laterals, sewers, etc. To date, research has focused on what can be seen, and not below-ground areas.
 - How can municipalities and pest professionals map and know these locations?
- A cost/benefit analysis is needed to evaluate proactive and reactive programs.
- Evaluate efficacy of removing trash more often on rodent populations and sightings.
- Evaluate population-level impacts of various rodent management programs or interventions in open systems (requires development of a surveillance/indexing method to effectively document population changes).
 - Trials would need to implement interventions at different spatial scales since management often occurs at finite scales, but could be scaled up.
- What is the unit of control to effectively eliminate a *population*? Is it specific to the site? How can municipalities and pest professionals know this without genetic studies?

Post-Management Monitoring

- What is the replenishment dynamic of rats in cities?
 - How fast and from where do populations rebound?
- What are the movement dynamics of rats in cities when populations are eliminated – naturally by cold/winter or by poisoning?
 - Genetics can help to answer some of these questions: [work in Salvador, Brazil by Richardson](#) and others showed that residual rats not removed from a management campaign were liberated from competition and could replenish population.
- More work needed to understand how management efforts affect pathogen transmission. Research from the [Vancouver Rat Project](#) demonstrated that failure to eliminate all rats in a population led to an increase in the risk of pathogen transmission among rats: https://wwwnc.cdc.gov/eid/article/24/2/17-1371_article

Population Index & Surveillance

- **There needs to be a feasible way to measure rat abundance that doesn't rely on biased public complaints. Any indexing/surveillance tool should be easy to use, implement, and cheap so that pest professionals and municipalities can use it.**
 - The actual number of rodents in municipalities is not known.
 - Activity measures can be a proxy to rodent density measures.
 - Tracking tunnels, burrow counts, rate that new burrows appear have been used.
 - In order to verify efficacy of surveillance techniques, including burrow counts, need for capture, mark, recapture of animals.
 - Data from remote sensors/monitors placed in the right locations could provide insights, such as low, medium, and high levels of rat activity.
 - Cost is not high relative to current reactive responses (baiting), repairing sidewalks and other infrastructure damaged by rats, and would be included as part of city maintenance plans.
 - Need to develop templates for different urban environments (parks, alleyways, business areas, downtown areas) and different rodent pests.
 - In the future, different device designs might be better for monitoring roof rats compared to the current technology.
 - Different templates for different settings: burrow counts in parks, remote monitoring in buildings.
 - Different templates for different rodent species.
 - Look to other systems in urban areas for models: Gypsy moth; murder hornets.
- Wang et al. 2019 work on spatial distribution of cockroaches in multifamily housing <https://doi.org/10.1093/jee/toz128>
- Decision support tools to help pest professionals and municipalities make data-based decisions on where, when and how to intervene to manage rodent populations.
- Need to explore and expand upon methods for ectoparasite and pathogen surveillance. What sample size is needed over what distance to understand risks?

Products & Tools

- Development of new products and rodenticides.
 - Especially effective alternatives to rodenticides like carbon dioxide applications.
 - Ideally, develop methods that are easy to use, and uses not restricted by registration, certification and product labeling.
 - Research on how new products work in municipalities/the field.
- Do weather patterns and ground moisture affect the efficacy of carbon dioxide for rodent control (dry ice or injection)?
- Evaluate efficacy of rodent-proof trash cans, including how their use impacts the consumption of rodenticide bait and the rodent population in an area.

Rodent-Borne Disease

- What is the incidence of rat-borne disease in people in urban areas?

Rodenticide Concerns

- What are the exposure pathways for secondary rodenticide poisoning?

Future Directions

Professional Society

- Create a professional association for the advancement of rodent management in cities.
- Create the equivalent to the American Mosquito Control Association for rodents.

Outreach

- Create promotional materials to highlight the work done by municipal rodent management programs. Materials would demonstrate how they benefit different sectors of society, and how they can be involved to keep sites pest free.

Education

- Special topic presentation by Dr. Maureen Murray (at forefront of environmental drift work relative to rodenticide exposures)
 - Consider other special topic presentations that relate to Working Group members?
- Field trips: have the Working Group convene in different cities with different groups/communities to view and/or demonstrate rodent management practices in use. Also to solicit advice on what is not working.
- Opportunities for industry to sponsor meetings and other activities/events. Industry may have access to meeting spaces and offices across the country.

Form New Collaborations

- Invite/solicit feedback from municipal leaders, the building industry (especially related to exclusion and construction sites with refuse), local/national restaurant groups, local refuse leaders for improved container management and cleaner disposal of solid waste and storage, regional planning commissions, WELL Building Institute, state sanitarians, regulators (EPA, state regulatory agencies, PSEP Programs), and others.
 - Develop/collate list of target audiences: state sanitarians, PMPs (including wildlife professionals, which have separate associations), etc.
- Involve college and graduate students so they can learn about real-world issues and how they are addressed at different levels (contractor, municipality, etc.).
 - Suggestion to include pest exclusion education in academia as part of public health courses: 3-4 credit course (investigate at one institution, with no buy-in).
- Involve school students: Pest Patrol for middle schools.

Meeting Attendees/Participants

Bobby Corrigan, Brie Gray, Brittany Campbell, Carmen Reichard, Caroline Bragdon, Chris Morales, Claudia Riegel, Courtney Ray, Dave Power, David Colbert, Dion Lerman, Doug Smith, Ed Dolshun, Elton Rogozi, Georgianna Silveira, Gerard Brown, Jeff Lyons, Jessi Allen, Jill Woodworth, Jody Gangloff-Kaufmann, John Phil, John Ulrich, Jonathan Richardson, Kaylee Byers, Kelley Altland, Laura Krueger, Leah Helms, Marieke Rosenbaum, Martha Vernazza, Martin Overline, Matt Frye, Matthew Combs, Maureen Murray, Michael Goldstein, Niamh Quinn, Ray Delaney, Richard Pollack, Ron Torres, Ryan Younge, Sarah Badenhop, Scott Johnson, Scott Mullaney, Shannon Sked, Stephen Kells, Steven Krause, Susannah Reese, Terry Wolak, Timothy Madere, Trisha Shellenberger, Waheed Bajwa
See Working Group website for [affiliations](#).

Acknowledgements

The Municipal Rodent IPM Working Group is funded by the Northeastern IPM Center through Grant #2018-70006-28882, Accession Number: 1017389 from the USDA National Institute of Food and Agriculture, Crop Protection and Pest Management, Regional Coordination Program.

Municipal Rodent IPM Working Group website:
www.northeastipm.org/working-groups/municipal-rodents/

Contact information:
Matt Frye
mjf267@cornell.edu

 National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

 New York State
Integrated Pest Management
Program



Cornell University
Cooperative Extension

Northeastern
IPM
Center