MEMORANADUM

Date: December 13, 2017

To: The Legislative Matters Committee, through Chairwoman Rossetti

From: Cortni Kerr Desir, SomerStat Analyst

Re: Rodent management research and data analysis findings and takeaways

---

As the SomerStat Analyst to the Inspectional Services Department, my assistance was requested to provide background research and data analysis on the relationship between building construction and rodent sightings. Through this memorandum I present key research takeaways, followed by a more detailed review of literature review findings, as well as results from a preliminary analysis of Somerville building permit and rodent sighting data.

Key Takeaways

- Rodent control best practices recommend habitat management – reducing environmental factors that foster rodent population growth – rather than reactive, short-term baiting and poisoning.
- The three important factors for rodent population growth are the availability of food, water, and harborage.
- Construction may disturb rodents if they are already living in the building under construction or in the soil next to it. Construction activity may correspond to rodent sightings if rodents are displaced, however construction activity is not a primary causal factor for rodent population growth.
- The use of baiting with rodenticides may temporarily lower population numbers, however rat populations are capable of rebounding to pre-intervention numbers. Moreover, it is possible that baiting may not be effective even in the short term as rats are intelligent and cautious hunters who will avoid a new food source they learn to be poisonous.
- In summary, baiting construction sites does not address the causal factors that lead to rodents and is a short-term solution that will not curtail the future growth of rodent populations in that area. Therefore, to most effectively and efficiently address constituent concerns related to rats, I recommend that the City take a holistic approach to rodent management by focusing more resources on habitat management rather than extensive baiting activity.

Literature Review

This literature review focuses on urban rodents, specifically the Norway rat, also known as the brown rat, which is found in Somerville. The most significant finding from a review of rodent and rodent management literature is that the siting and growth of rodent populations are driven by the availability of habitat factors. According to Traweger and Slotta-Bachmayr (2005), “Food, vegetation, natural soil and shelter are essential factors for brown rat habitats. If no anthropogenic shelter is available, suitable soil, for building burrows, is often the limiting factor.” In their literature review of several decades of rodent research, Feng and Himsworth (2014) state,

> Rats actively select certain habitats within a city depending on the availability of adequate harbourage, food, and water (Masi et al. 2010; Sacchi et al. 2008).
>
> Among these three factors, food availability is thought to determine the carrying capacity of a habitat (i.e., the maximum number of animals that that habitat can sustain) (Orgain and Schein 1953). In urban environment, food and organic waste that are improperly stored or disposed of constitutes the most significant food source for rats (Promkerd et al. 2008; Traweger et al. 2006). Interestingly, presence of domestic animals at a residence may also attract rats due to the fact that pet food is often left out for long periods of time and may be easily accessible (Sharp 2007).
>
> Although access to water has received less attention in studies of rat ecology, it is no doubt an important factor, as rats require daily access to fresh water for survival (Sacchi et al. 2008). While food may determine the size of a rat population, the availability of harborage will determine whether a population is able to become established in the first place (Masi et al 2010). (p. 158-9)

Construction activity is identified as a factor for displacement of existing rodent populations (Colvin et al. 1999, Colvin 2000). Poor sanitation and habitat management at a construction site could attract rodents to the site, however this could be resolved through proactive site sanitation measures (Colvin 2000). During Boston's Big Dig, the City implemented an Integrated Pest Management (IPM) plan that included sanitation and habitat management efforts in the year leading up to construction activity (Colvin et. al 1999). The preemptive and ongoing sanitation and habitat management efforts were designed to reduce the level of dependence on baiting during construction and to establish a more sustainable long-term pest control strategy (Colvin et. al 1999, p.67). The City-driven sanitation and habitat management efforts included public outreach and education. The key takeaway from this project is that baiting alone is not a sufficient response to construction-displaced rodents.

The rodent management literature is clear on effective rodent control strategies. Best practice is to manage habitat factors rather than relying on rodenticides which are a short-term response and become ineffective over time as rats learn the consequences of the poison bait. According to Colvin and Jackson (1999),

> Rats need to be viewed as an 'indicator species' of environmental quality (or degradation), and programs need to focus on causal factors for species success rather than simply being reactive and poison dependent. The goal must be to manage populations at the low end of the sigmoid growth curve by reducing carrying capacity and giving greater emphasis to surveillance monitoring and sanitation controls. A behavioural shift from rat hunting to environmental management and monitoring is needed. This represents an ecologically based strategy. (p. 252)

The literature points to the ability of rat populations to rebound after short-term poisoning campaigns to pre-poison numbers. Feng and Himsworth (2014) state that:

> Intensive live-trapping or poisoning of rats has also been shown to alter the size and social structure of a rat colony (Davis and Christian 1958). This is most likely a result of the removal of dominant individuals (which may be more likely to enter a trap or to eat

> poisoned bait), as well as immigration of rats from adjacent blocks due to the sudden availability of resources (Davis and Christian 1958). However, once trapping or poisoning ceases, the fecundity of rats will cause the population to rapidly return to pre-intervention size. (p. 154)

Traweger and Slotta-Bachmayer (2005) review the ability of rodents to build up resistance to poisons and point to alternative rodent control measures,

> Thus, the aim to control these animals led to various methods from highly dangerous, acute-acting poisons to rodenticides that work as anticoagulants and often lead to resistances in the rat population. Based on knowledge from recent studies, a shift away from pesticides and towards applied management of the rat's environment has developed—this can include the preventive design of landscapes which consider the spatial relationships of plantings and food availability (Colvin et al. 1996), improvement of housing quality (Langton et al. 2001) and food source removal (Spragins 2002). Today, the use of rodenticides should constitute a final option and, when used, then only within a short, clearly defined time frame in conjunction with other management measures. (p.17)

Finally, last month I attended the Data-Smart Government Summit hosted by Harvard University, where Washington DC Senior Data Scientist Peter Casey presented the data models DC is utilizing to predict rat infestations (Casey et. al, 2017). Data scientists in DC tested 37 variables and found that the top predictors of rat activity: population density (top predictor), building age, zoning, business licenses, alley characteristics, and sewer gates. Importantly, construction was not a predictive variable (Casey, 2017).

Data Analysis

After reviewing the literature, I mapped out the 2,050 building permits issued between January 1 and November 30, 2017 and the 600 rat sightings and residential rat assistance requests received by Somerville's 311 service during the same time frame. The data is openly available through the City of Somerville's Open Data Farm. Utilizing ArcGIS I ran optimized hot spot analysis for building permit locations, building permit values (as a proxy for size of project), and rat reports. The results did not indicate that construction activity is driving the majority of rodent sightings in Somerville. The data show rat report intensity tightly clustered in East Somerville and bordering areas in Winter Hill and Union Square. The data show building permit intensity less tightly clustered and spreading between Union Square, Winter Hill, Magoun Square, Ball Square, Porter Square, Teele Square and Davis Square. These findings suggest other factors may be driving rodent sightings East Somerville.

Conclusion

Although construction may displace rodents, baiting sites will not address the causal factors – food, water, and shelter – that enabled rats to live on the property in the first place. In order to most effectively and efficiently address constituent concerns related to rats, the City should focus efforts on a holistic approach to rodent management and aim to address the causal factors fostering rodent populations. Measures in this approach could include enhanced sanitation efforts, increased public

engagement on the environmental factors encouraging rodent population growth, and a coordinated response across City departments, including the hiring of an Environmental Health Liaison to foster this.

References

Casey, P. (2017) Can Data Science Smell a Rat. Presentation at the Novebmer 8, 2017 Data-Smart Government Summit, Harvard University.

Casey, P., Quinney, S., Wilson, K., Yokum, D. (2017). "PRE-ANALYSIS PLAN: Predicting Rats in the District of Columbia" Open Science Framework. https://osf.io/d9reh/

City of Somerville Data Farm. ISD Permit Daily Applications. https://data.somervillema.gov/City-Services/ISD-Building-Permit-Daily-Applications/q3yh-mp87

City of Somerville Data Farm. 311 Constituent Services Daily Calls.

Colvin, BA. (2000). Pest Control Technology. Accessed November 30, 2017. http://www.pctonline.com/article/rodent-control-at-construction-sites/

Colvin, B. A., Ashton, A. D., McCartney, W. G., & Jackson, W. B. (1990, March). Planning rodent control for Boston's Central Artery/Tunnel Project. In *Proceedings of the Fourteenth Vertebrate Pest Conference 1990* (p. 14). http://digitalcommons.unl.edu/vpc14/14

Colvin BA, Jackson W. (1999) Urban rodent control programs for the 21st century. Canberra, Australia: Australian Centre for International Agricultural Research; (243–57).

Feng, A. Y., & Himsworth, C. G. (2014). The secret life of the city rat: a review of the ecology of urban Norway and black rats (Rattus norvegicus and Rattus rattus). *Urban Ecosystems*, *17*(1), 149-162.

Traweger, D., & Slotta-Bachmayr, L. (2005). Introducing GIS-modelling into the management of a brown rat (Rattus norvegicus Berk.)(Mamm. Rodentia Muridae) population in an urban habitat. *Journal of Pest Science*, *78*(1), 17-24.