#02 Gardening for Biodiversity Series

MYTHS & MISCONCEPTIONS: NATURALIZED GARDENS, TICKS, MICE, RATS, & OTHER PESTS

PREPARED BY:
The Ecological Design Lab
Toronto Metropolitan University

IN COLLABORATION WITH:
The National Environmental Treasure

NOV. 2024

COVER IMAGE: N.M. LISTER, 2024

CITATION: Careri, S., Takada-Lien, M. & Lister, N.M. (2024). *Myths and Misconceptions: Naturalized Gardens, ticks, mice, rats, and other pests*. Retrieved from https://ecologicaldesignlab.ca/site/uploads/2024/12/02_myths-misconceptions-naturalized-gardens.pdf

Attract beneficial insects with native plants. [Ontario Nature, 2020]

UNDERSTANDING PEST PRESENCE:

Do naturalized gardens attract ticks, vermin, mice, and rats? What conditions influence their presence? And what is the role of native plants, biodiversity, and other urban animal species?

“Vermin” is an umbrella term that is used to refer to unwanted, often disease-carrying species that can cause negative environmental impacts (applied to a variety of animal species, and not limited to insects and rodents). One of the greatest misconceptions about naturalized landscapes is that they are more likely to host vermin species, compared to traditional turfgrass. However, research shows that the primary factor attracting vermin to urban environments is the availability of food sources, such as domestic animal feed and human garbage coupled with easy movement between harborage sites (Byers et al., 2019; Colvin et al., 1998; Recht et al., 1982).

In fact, naturalized gardens have been proven to be effective at limiting movement of these species across urban environments, opposed to that of traditional turfgrass which facilitates movement more easily (Byers et al., 2019; Recht et al., 1982; Glass, 1989). Further evidence has shown that naturalized gardens boost greater levels of genetic plant and animal diversity, which will decrease pest abundance in urban and suburban areas (Byers et al., Recht et al., 2019; Glass, 1989; Nighswander, et al., 2021; Veres et al., 2013). This is because native plants, specifically, taller grass supports a higher species abundance and richness of beneficial insects, including lady bugs, spiders, bumble bees, praying mantis, hornets, and so on. This is opposed to traditional turfgrass, where frequent lawn mowing can be “consequential for beneficial wildlife such as pollinators, and other ecosystem services associated with urban biodiversity” (Lerman & D’Amico, 2019, p. 3; Nighswander, et al., 2021).

It is undeniable that genetic diversity is directly related to ecosystem health and thus, impacts the provision of ecosystem services provided to humans, including the regulation of disease amongst other benefits (Nighswander, et al., 2021). Conversely, a lack of genetic diversity, and the concomitant invasion by non-native plants can increase the rate of transmission of diseases (e.g. Lyme disease) typically associated with vermin species (Lerman and D’Amico, 2019). The most widely accepted theory to support this argument is known as the dilution effect (Lerman & D’Amico, 2019; Cary Institute of Ecosystem Studies, 2020; Ostfeld & Keesing, 2012).

To illustrate the significant role of native plants, biodiversity, and urban animal species, a case study on the white-footed mouse (Peromyscus leucopus) is presented in the subsequent section. This case exhibits how the higher levels of plant and animal diversity in natural yards, positivity impacts ecosystem health, and the importance of predator-prey balance in urban landscapes. In this case, evidence has proven that healthy biodiverse naturalized yards are more likely to yield a healthier representation of white-footed mice relative to other hosts in the vertebrate community, and as a result, reduces the proportion of ticks infected with Lyme disease (Ostfeld & Keesing, 2000, p. 724; Ostfeld & Keesing, 2012), thereby reducing the likeness of passing the infection onto humans (the dilution effect).

CASE STUDY:

Lyme disease (Lyme borreliosis) is the most well recognized vermin-borne disease of concern in North America, most often associated with transmission from blacklegged ticks (Ixodes scapularis) (Hansford, et al., 2022). The most competent natural reservoir host for spreading Lyme disease onto blacklegged ticks, is considered to be the white-footed mouse (Peromyscus leucopus).

The levels of genetic diversity in a garden directly influence predation, and thus is fundamentally critical in reducing the human risk of exposure to certain zoonotic diseases, including Lyme disease (Ostfeld & Keesing, 2000, p. 723). All species have a different reservoir competence and ability to carry and transmit the pathogen responsible for diseases (Lou & Wu, 2014). As genetic diversity in an ecosystem increases, the number of disease-buffering predators (e.g. birds, bats, opossums, foxes, weasels, owls, etc.) to small urban mammals, such as the white-footed mouse, increases as well, predictably decreasing the number infected hosts in an ecosystem (Granter, et al., 2014). This is because species such as opossums, are poor hosts for the pathogen and kill the vast majority of ticks that attempt to feed on them. However, these tick-eating species are absent from low-diversity ecosystem fragments - opposite to the white footed mouse which thrive when biodiversity levels are low (Ostfeld, et al., 2012; Granter, et al.,2014).

On the other hand, when diversity is greater in our yards and gardens, it means that ticks are more likely to feed on these stronger other species such as chipmunks, lizards, or ground-dwelling birds and opossums, becoming less likely to get infected by diseases (Ostfeld, et al., 2010; Cary Institute of Ecosystem Studies, 2020). Consequently, a more diverse biotic community also plays a role in reducing tick infestations as studies have found a positive correlation with it and tree species diversity in particular (Bouchard et al., 2013).

The smallest of actions we take in our gardens are our greatest defense against the impacts of climate change, which include the loss of genetic diversity. Without these actions taken against biodiversity loss in our yards and gardens, the strong hosts with strong buffering effects to the virus will continue to disappear from our cities, and therefore increase the likelihood of zoonotic disease transmission (Lerman & D’Amico, 2019; Granter, et al., 2014).

REFERENCES:

Baldock, K. C. (2020). Opportunities and threats for pollinator conservation in global towns and cities. Current Opinion in Insect Science, 38, 63-71. doi:10.1016/j.cois.2020.01.006

Bouchard, C., Beauchamp, G., Leighton, P. A., Lindsay, R., Bélanger, D., & Ogden, N. H. (2013). Does high biodiversity reduce the risk of Lyme disease invasion? Parasites & Vectors, 6(1), 195–195. https://doi.org/10.1186/1756-3305-6-195

Byers, K.A., Lee, M.J., Patrick, D.M., & Himsworth, C.G. (2019). Rats About Town: A Systematic Review of Rat Movement in Urban Ecosystems. Frontiers in Ecology and Evolution, 7, 13. doi: 10.3389/fevo.2019.00013

Cary Institute of Ecosystem Studies. (2020). Biodiversity, Community Ecology, and the Dilution Effect. https://www.caryinstitute.org/science/research-projects/biodiversity-community-ecology-and-dilution-effect

Colvin, B. A., Swift, T. B., & Fothergill, F. E. (1998). Control of Norway rats in sewer and utility systems using pulsed baiting methods. In Proceedings of the Vertebrate Pest Conference (Vol. 18, No. 18).

Del Toro, I., & Ribbons, R. R. (2020). No mow may lawns have higher pollinator richness and abundances: An engaged community provides floral resources for pollinators. PeerJ, 8, e10021-e10021. doi:10.7717/peerj.10021

Glass, G. E. (1989). Comparative ecology and social interactions of Norway rat (Rattus norvegicus) populations in Baltimore, Maryland. Museum of Natural History, the University of Kansas.

Granter, S. R., Bernstein, A., & Ostfeld, R. S. (2014). Of mice and men: Lyme disease and biodiversity. Perspectives in Biology and Medicine, 57(2), 198-207. doi:10.1353/pbm.2014.0015

Hansford, K. M., Wheeler, B. W., Tschirren, B., & Medlock, J. M. (2022). Questing Ixodes ricinus ticks and Borrelia spp. in urban green space across Europe: A review. Zoonoses and public health, 69(3), 153-166.

Lerman, S. B., Contosta, A. R., Milam, J., & Bang, C. (2018). To mow or to mow less: Lawn mowing frequency affects bee abundance and diversity in suburban yards. Biological Conservation, 221, 160-174. doi:10.1016/j.biocon.2018.01.025

Lerman SB, D'Amico V (2019) Lawn mowing frequency in suburban areas has no detectable effect on Borrelia spp. vector Ixodes scapularis (Acari: Ixodidae). PLoS ONE, 14(4): e0214615. https://doi.org/10.1371/journal.pone.0214615

Lou, Y., & Wu, J. (2014). Tick seeking assumptions and their implications for Lyme disease predictions. Ecological Complexity, 17, 99–106. https://doi.org/10.1016/j.ecocom.2013.11.003

Majewska, A. A., Sims, S., Wenger, S. J., Davis, A. K., Altizer, S., Schonrogge, K., & Barbero, F. (2018). Do characteristics of pollinator-friendly gardens predict the diversity, abundance, and reproduction of butterflies? Insect Conservation and Diversity, 11(4), 370-382. https://doi.org/10.1111/icad.12286

Nighswander, G. P., Sinclair, J. S., Dale, A. G., Qiu, J., & Iannone, B. V. (2021). Importance of plant diversity and structure for urban garden pest resistance. Landscape and Urban Planning, 215, 104211-. https://doi.org/10.1016/j.landurbplan.2021.104211

Ostfeld, R. S., & Keesing, F. (2000). Biodiversity and disease risk: The case of lyme disease. Conservation Biology, 14(3), 722-728. https://doi.org/10.1046/j.1523-1739.2000.99014.x

Ostfeld, R. S., & Keesing, F. (2012). Effects of host diversity on infectious disease. Annual Review of Ecology, Evolution, and Systematics, 43(1), 157-182. doi:10.1146/annurev-ecolsys-102710-145022

Pardee, G. L., & Philpott, S. M. (2014). Native plants are the bee's knees: Local and landscape predictors of bee richness and abundance in backyard gardens. Urban Ecosystems, 17(3), 641-659. doi:10.1007/s11252-014-0349-0

Recht, M. A. (1982). The fine structure of the home range and activity pattern of free-ranging telemetered urban Norway rats, Rattus norvegicus (Berkenhout). Bulletin of the Society of Vector Ecology, 7, 29–36.

Roome, A., Spathis, R., Hill, L., Darcy, J. M., & Garruto, R. M. (2018). Lyme disease transmission risk: Seasonal variation in the built environment. Healthcare (Basel), 6(3), 84. doi:10.3390/healthcare6030084

Talbot, B., Slatculescu, A., Thickstun, C.R. et al. (2019). Landscape determinants of density of blacklegged ticks, vectors of Lyme disease, at the northern edge of their distribution in Canada. Scientific Reports, 9, 16652. https://doi.org/10.1038/s41598-019-50858-x

The David Suzuki Foundation. (2021). How to create a pollinator-friendly garden. https://davidsuzuki.org/queen-of-green/create-pollinator-friendly-garden-birds-bees-butterflies/

Toronto and Region Conservation Authority (TRCA). (2016). Maintaining your pollinator habitat. https://trca.ca/app/uploads/2016/04/PollinatorMaintenanceGuide_WEB.pdf

Veres, A., Petit, S., Conord, C., & Lavigne, C. (2013). Does landscape composition affect pest abundance and their control by natural enemies? A review. Agriculture, Ecosystems & Environment, 166, 110-117.

Wastian, L., Unterweger, P. A., & Betz, O. (2016). Influence of the reduction of urban lawn mowing on wild bee diversity (hymenoptera, apoidea). Journal of Hymenoptera Research, 49(49), 51-63. doi:10.3897/JHR.49.7929

ECO/
LOGICAL
DESIGN
LAB

Website:
ecologicaldesignlab.ca

Twitter:
@EcoDesignLabTMU

Instagram:
@ecodesignlabtmu