Rebecca Mills

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Squirrel Population Dynamics

Population dynamics can be affected by a variety of factors, which can change how the population’s temporal structure exists. Populations interact with each other, other species, and the environment. This applies to small mammals, such as squirrels, that will be the main focus of this research. Tree squirrels normally inhabit rural, wooded areas, but they are also present in more urban areas, such as college campuses (Parker, T. S., & Nilon, C. H., 2008). Many factors within these types of environments can quickly shift the dynamic of squirrel populations. Squirrels over time have become increasingly familiar and unafraid of human interaction, which has made them more suitable for inhabiting heavily populated, more urban areas (Parker, T. S., & Nilon, C. H., 2008). Squirrel populations also fluctuate in urban environments based on artificial feeding and lack of predators that are present in these areas (Jokimäki, J. et al., 2017). In this paper, I will study how disease, food availability, human interaction, and habitat availability in urban areas affect population dynamics of squirrels. These dynamics include changes to genetic, spatial, and temporal shifts in these species. Urbanization allows for the increase in artificial food availability, human interaction, and disease, however, habitat availability is more limited in these environments.

**Spatial Structure**

 When discussing spatial structure, an important aspect to consider is the population’s abundance (Lecture Notes, 8/30/21). One major factor that affects squirrel population abundance is disease (Chantrey, et al., 2014). Squirrels and other small mammals can be prone to disease passed on from each other as well as passed on from other species (Chantrey, et al., 2014). Certain tree squirrel species host certain diseases that can be passed onto a competing squirrel species to increase their fitness (Bruemmer, C. M. et al., 2010). Urban locations for squirrel habitats can affect disease transmission due to the multiple different habitats, as well as possible nearby urban habitats, which can contain a completely different community of squirrels (Chantrey, et al., 2014). Many urban squirrel populations have been known to develop disease transmitted from nonnative species, which causes a decline in overall squirrel abundance and health in those given areas (Chantrey, et al., 2014). A specific example is a disease common in red squirrels, known as the parapoxvirus, can easily be passed on to grey squirrel populations (Rushton et al., 2001). When red and grey squirrels are inhabiting different parts of close proximity urban areas, it is predictable that these diseases will be transmitted between the two species, and possibly other small mammal species as well. Disease in squirrels can cause the fitness of these populations to decline, therefore causing a shift towards increased death rates and decreased birth rate.

 Another factor affecting spatial structure that easily fluctuates squirrel population dynamics in urban areas is food availability. Food availability can greatly affect the dispersion of squirrels, as they will likely be more abundant where food is more available, whether that be artificial or natural food (Lecture Notes, 8/30/21). Squirrel populations in general have a diet consisting of various nuts from trees, which are clearly less abundant in urban areas (Chantley, et al., 2014). Urban areas have a decreased tree canopy range as well as lower tree density than rural, wooded areas. This obviously varies from location to location, but in general, tree abundance is less, and in return, food availability for these species. Although, decreased natural food is exchanged for human fed food in these areas (Williamson, 1983). Abundant human population benefits squirrel populations by providing them food from trash cans, as well as food dropped or fed to them by humans (Williamson, 1983). A great example of this dynamic is on busy college campuses, where squirrels have access to human food scraps almost 24/7 (Williamson, 1983). Species who are able to easily adapt to different diets and food regulating are often those who adapt better to urban areas and an abundant human populations, and squirrels fall into this category, explaining why they usually thrive in these high populated areas (Rodewald and Gehrt, 2014).

 Human interaction with squirrel species affects their population abundance. Human interaction can also have an association with food availability of the squirrels, which affects their dispersion and abundance in areas where humans are present. Hunting is a major human interaction issue that normally affects squirrel populations in the wild, but that is not an issue in urban areas, where people are not killing wild animals (Mosby, 1969). The lack of recreational hunting by humans increases squirrel abundance and their ability to live in peace in an area, even if human density is high (Mosby, 1969). Another way in which squirrels benefit from the human population is from having more food availability. Humans provide an increase in food supply, usually artificial, for the squirrels (Parker, T. S., & Nilon, C. H., 2008). Although this is a majority of cases, sometimes the way that humans interact with the squirrel populations decreases their fitness (Tattoni, et al., 2006). In some highly human populated areas where squirrels are introduced, the squirrels reproduce at such a high rate, that their presence gets out of control and they need to be controlled by humans (Tattoni, et al., 2006). While this can happen on occasion, urban areas with high human abundance density usually benefit squirrel populations. The connection between food availability and human interaction both allow for an increase in squirrel fitness and are important factors to consider when observing their population. This emphasizes the ability of squirrel populations to thrive in these urban environments, as they provide elements that improve squirrels’ ability to survive.

 One factor that's dramatically different in urban than rural areas is habitat availability. Squirrels don't have as many tree canopies in urban areas, although it can vary a lot (Babińska-Werka and Żółw, 2008). Some urban areas do contain parks, but squirrels normally inhabitat all areas around the park as well (Rezouki, et al., 2014). In general, greater tree canopy percentage covering a given area leads to greater squirrel abundance (Williamson, 1983). As a result, urban areas typically do not have as much habitat available to squirrels. Although, habitat specialists are the species that are normally affected the most by urban development because they are not as flexible with habitat change (Rodewald and Gehrt, 2014). Squirrels are more easily able to adapt to these changes and can create a habitat out of different structures, such as bushes, buildings, etc. (Rodewald and Gehrt, 2014). Due to this, urban settings do not usually play that major of a role in the decline of squirrel abundance. Squirrel populations are able to adapt and thrive in urban areas just like they can in forested areas, though their habitats in urban areas may look different than those in rural areas.

**Genetic Structure**

A majority of this paper has discussed how urban environment factors affect squirrel population abundance, but another population dynamic that can be affected is the genetic structure. Typically, urban areas have more gene flow taking place (Selonen, et al., 2018). This is due to the fact that there is interaction between the urban squirrels as well as squirrels in neighboring areas, which are outside the urban bubble (Selonen, et al., 2018). Because of this increased gene flow, there is often higher genetic differentiation (DeMarco, et al., 2021). This is also predicted to be due to genetic drift over time (DeMarco, et al., 2021). Contrary, small, isolated areas have very low genetic diversity because they only interact with each other in the area (Rezouki, et al., 2014).

 This paper concludes how various factors can easily change population dynamics in a given species. I specifically investigated squirrel population dynamics in an urban area, more populated area, to determine what affects the dynamics the most. It is clear that there is a drastic change in habitat, food availability, human interaction, and genetic diversity in urban areas versus rural, “normal” squirrel habitats. Human interaction allows for more food availability in urban areas and that’s one of the only ways humans interact with them. There is limited hunting or harming of squirrels in urban environments by humans. Squirrels being able to easily adapt to new habitat space also supports the idea that they can thrive in urban ecosystems.

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