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Sizzling Cities

Urban Heat Islands Impact on Growth and Development for Trees and Humans

Written by Hamza Ali

Illustrated by Kailey Zaronias

Urbanization-induced infrastructure has created a brand new ecosystem for all life forms settling into those areas. Specifically, the hallmark infrastructure of cities creates issues in both soil and air quality. Each one of these issues has detrimental consequences on plant life and human life alike.

The first overlooked detriment to tree growth is found in the soil quality of cities. Urbanization is marked by heavy construction and dense buildings, contributing to a process known as soil compaction. This is a dangerous growing condition where soil particles are pressed together and packed tightly, reducing the number of pores found underground. With fewer pores, water movement through the soil becomes much less efficient and is reflected in the health of subjected trees. Monika Czaja and his team from the University of Agriculture in Krakow compiled a comprehensive review to find how trees are being impacted by their urban environments. Czaja's team corroborates this packing effect by stating that the trees cannot properly take up water and nutrients; consequently, they are unable to grow as fast as they normally would in healthy soil. They further note that root growth was reduced by 33 percent due to soil compaction. Juxtaposed with more rural environments, the majority of urban soil has a top layer of asphalt or concrete, which absorbs heat. While this upper layer allows for easier walkways, it simultaneously promotes water runoff at unprecedented levels. Czaja's team notes that urban areas witness up to 50 percent of rainfall become runoff as compared to the less than five percent found in forest ecosystems. With less water, trees struggle to upkeep their radial growth; Toril Drabløs Eldhuset finds that trees experiencing drought had only 70 percent of the root diameter of fully watered trees.

Simultaneously, urban areas impact the air quality surrounding many trees. Much like the way in which city infrastructure such as asphalt, curbs, and sidewalks gives rise to overheated and dry soil, a similar effect takes place within the air of urban atmospheres. While global warming has increased the temperature of atmospheres everywhere, urban areas are impacted significantly more than their rural counterparts, with a recorded temperature difference of up to 4 degrees Celsius in the summer seasons. Cities have become such unique atmospheres, progressively collecting heat and becoming drier, to the point that the literature has begun to refer to this trend as the "urban heat island." The increased air temperature and decreased humidity have been linked to disastrous impacts for trees such as cessation of growth, photosynthesis inhibition, and mortality. Alongside pollution being absorbed by the pores in tree leaves, air quality in cities becomes a pressing issue.

Unexpectedly, the most effective long-term solution to these city-specific environmental issues is trees themselves. There are three main ways in which this can be effective. Firstly, leaves can absorb many pollutants out of the air. Increasing the number of trees in an urban ecosystem lets these pollutants spread more evenly across tree leaves, increasing the efficiency of air purification

while minimizing damage to tree growth. Secondly, soil compaction can be minimized by having more roots in the soil, which loosens its structure and creates more pores. In 2013, Dave Armson's team did a study in Great Britain that concluded that planting trees in a one-by-one-meter pit surrounded by asphalt wielded vast benefits such as a 60 percent reduction in runoff as well as better soil structure and moisture. Thirdly, increasing the number of trees helps fight against the urban heat island's low humidity and high air temperatures. The dry air induces an increased rate of transpiration in trees or an increase in the rate at which water exits tree leaves and enters the atmosphere. Furthermore, in addition to transpiration processes, trees are able to remove much of the heat from a heat island by providing new sources of shade and light reflection.

Urban heat islands have detrimental impacts on the human population of urban areas as well. The Environmental

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Protection Agency reports that heat islands create increased respiratory difficulties, heat cramps, heat exhaustion, and heatstroke for those living through them. In total, the United States (U.S.) recorded 10,527 heat-related deaths from 2004 to 2018. To see this macroscopically, one needs to consider exactly which demographics are most impacted by urban heat islands. An article by AP News claims that in almost every large urban area, the average person of color lived in a census tract with higher heat island intensity. In fact, this trend was attributed to every one of the U.S.'s 175 largest cities, except six. This means that 97 percent of urban areas have large disparities within which racial minorities are generally exposed to the greatest impacts of heat. AP News furthers that the root cause driving this contrast is racism within the ultimate structure of modern-day cities. Zoning laws and discriminatory housing are examples of how racism is manifesting itself in the lives of those living in urban heat islands. It seems that the city planning and larger urban governments have found an ever-so-subtle way of creating more equity differences in their populations, leaving trees and their benefits out of poorer and minority neighborhoods.

Ultimately, it is paramount that we see a restructuring of urban environments for the benefit of not only the trees but also the people. There are a plethora of problems that arise from the status quo of city structure. The simplest solution to all of these issues is to implement more green spaces and trees throughout major cities. Doing so in an even, equitable manner is the only way to promote the well-being of all urban life. ● ● ●

