From: Living in the Anthropocen: Earth in the Age of Humans, pp. 58-61; edited by W.J. Kress and J.K. Stine; 2017, Smithsonian Books, Washington DC.

URBAN NATURE / HUMAN NATURE

PETER DEL TREDICI

From their humble beginnings as isolated settlements at the intersections of important transportation routes, today's cities have evolved into pillars of the Anthropocene. They house half of the world's human population and produce 70 percent of its fossil fuel emissions while occupying only 3 percent of the earth's land area. In cities, human values—driven by socioeconomic factors—trump ecological values, such that people encourage the presence of organisms that make the environment a more attractive, livable, or profitable place to be, and vilify as weeds and pests those species that flourish in opposition to these goals.

In most modern cities, the native vegetation that originally occupied the site is long gone. In its place, one typically finds a cosmopolitan array of species—some planted intentionally, some growing spontaneously—that are adapted to the ecological conditions created by the city itself. In urban areas in northeastern North America, it has been estimated that 25 to 40 percent of the spontaneous vegetation is nonnative, a figure that rises to 70 percent when one looks at only the densely populated core regions. Just as they are for people, cities are melting pots for plants, and questions about where they came from become irrelevant after a few generations.

From a functional perspective, most vegetated urban land can be classified into one of three broad categories: remnant native landscapes, which are left over from the earliest days of urban settlement and are composed mainly of native plants; managed horticultural landscapes, which are composed of horticultural plants cultivated for specific purposes (e.g., ball fields, parks, gardens, street trees); and abandoned or neglected landscapes, which no one takes care of and which are dominated by plants that flourish without human intervention. Depending on the socioeconomic conditions of a given city, this last land-use category can make up from 5 to 40 percent of the total area. While most people have a negative view of spontaneous urban plants, they are actually performing many of the same ecological functions that native species perform in nonurban areas. In short, they help make cities more livable by absorbing excess nutrients that accumulate in wetlands; reducing heat buildup in heavily paved areas; controlling erosion along rivers and streams; mitigating soil, water, and air pollution; providing food and habitat for wildlife; and converting the carbon dioxide produced by the burning of fossil fuels into biomass.

Cities display a suite of environmental characteristics not typically found in natural habitats. The most significant is the ongoing physical disruption and land fragmentation associated with the construction and maintenance of infrastructure. Ongoing construction destabilizes native plant communities by altering soil and drainage conditions, thereby creating opportunities for the establishment of disturbance-adapted, early successional plants. Going hand in hand with disturbance is the covering of most urban land with pavement and structures that shed water. The density of these impervious surfaces is greatest in the center of the city and decreases as one moves out to the edges, while the amount of open ground typically follows the reverse pattern. Compounding the problem of imperviousness is the issue of soil compaction produced by pedestrian and vehicular traffic. This reduced porosity inhibits the flow of air and water into the soil and can be particularly serious for native trees and shrubs whose shallow roots require a constant supply of oxygen for proper growth. When the pavement in a town exceeds 25 to 30 percent, it can be considered urbanized from the biological perspective, independent of the density of its human population.

In most cities, the quality of the soil, like that of the vegetation, is a mixed bag. One can certainly find existing pockets of native soil that support remnant native ecosystems, but most cities, especially those along coasts, have large areas filled in with construction rubble to create more land. Roughly 17 percent of Boston as it currently exists is built on fill soil, as are significant parts of New York City near the ocean. Such filled land, by definition, can never support a native ecosystem—which is not to say that it cannot support a functional cosmopolitan ecology.

Another distinguishing characteristic of urban environments, and a function of their abundance of impervious surfaces, is their high temperatures relative to the surrounding nonurbanized land, a phenomenon referred to as the urban heat island effect. Because buildings and pavement absorb and retain heat during the day—to say nothing of cars, air conditioners, heating units, and electrical equipment, which also generate heat—the annual mean temperatures of large urban areas can be up to 5°F (3°C) higher than those of the surrounding nonurban areas. In extreme cases, the difference between a city and the nearby countryside can be as much as 21°F (12°C). This means that cities are already providing people with a preview of what climate change will look like on a much broader scale in the not-too-distant future.

Based on extensive research in Europe, scientists have determined that the typical urban plant is well adapted to soils that are relatively fertile, dry, unshaded, and alkaline. Through a twist of evolutionary fate, many of these species have evolved life-history traits in their native habitats that have "preadapted" them to flourish in cities. Marble or brick buildings, for example, are analogous to naturally occurring limestone cliffs. Similarly, the increased use of deicing salts along walkways and highways has resulted in the development of high-pH microhabitats that are often colonized by either grassland species adapted to limestone soils or salt-loving plants from coastal habitats. Finally, the hotter, drier conditions one finds in cities favor species that come from exposed, sunny habitats in nature. Preadaptation is a useful idea for understanding the emergent ecology of cities because it helps to explain why some plants and not others grow on piles of construction rubble, chain-link fence lines, highway median strips, pavement cracks, and compacted turf.

Any discussion of urban ecology would be incomplete without a consideration of the cultural significance of the plants that grow in cities. Indeed, the changing composition of spontaneous urban vegetation over time reflects the constantly shifting value judgments, socioeconomic cycles, and technological advances that shape the evolution of cities. The shift from horses to automobiles in the early twentieth century, for example, effectively transformed land once used for hayfields and pastures into roads and parking lots.

While most biologists view invasive plants as a serious biological problem, the fact remains that their initial introduction and distribution were usually the result of deliberate decisions that reflected the economic, ornamental, or conservation values of the day. Between the 1930s and the 1960s, various federal, state, and local agencies encouraged—and often subsidized—the cultivation of plants such as kudzu, multiflora rose, and autumn olive for erosion control and wildlife habitat purposes. It should come as no surprise that they became major problems forty years later, after millions of them had been planted. Indeed, the spread of nonnative species across the landscape is as much a cultural as a biological phenomenon, a fact often overlooked by advocates of strict ecological restoration.

The interacting forces of urbanization, globalization, and climate change have led to the formation of novel associations of plants that have become the de facto native vegetation of the city. These plants not only reflect the city's socioeconomic history but also project its future trajectory. Given the environmental uncertainty that is a hallmark of the Anthropocene, now is the time for people to acknowledge the role that spontaneous urban vegetation can play in helping to clean up the ecological mess that we have made of the planet.