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Plant communities of selected urbanized areas of Halifax, Nova Scotia, Canada

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Abstract

This study was designed to compare plant biodiversity and community indicators among urban residential areas and more-natural habitats in the vicinity of Halifax, Nova Scotia. Six house lots were examined in each of three age-categories of residential neighborhoods (>80 years, 30–50 years, and <10 years), and these were compared to four forested plots in semi-natural urban parks and four in a natural forest. The residential areas represented broad stages of successional development of "urban forest," while the stands of semi-natural and natural forest are representative of the original habitats that have been converted into residential land-use. In general, the observed plant species richness was much higher in the residential areas, but these habitats were strongly dominated by non-indigenous species whereas the natural and semi-natural habitats supported native taxa. This obvious difference between residential areas and semi-natural/natural habitats was confirmed by cluster analysis and principal components analysis, both of which separated the sample sites into two groups of plant communities. Neighborhood age and proximity of the residential sites had little influence on these multivariate analyses, suggesting that site-specific management practices (such as horticultural choices of landowners) had a strong influence on plant-community structure. Woody vegetation (trees and shrubs) in the semi-natural and natural forest had a higher basal area and stored more biomass and carbon than in residential habitats. However, there was a successional progression in the urban forest, in that older habitats stored much more woody carbon than younger ones. Although well-vegetated residential neighborhoods provide important environmental services, their striking dominance by exotic species, as well as their lower carbon storage in vegetation, contribute to an impoverishment of ecological integrity. This circumstance could be partially mitigated by changing horticultural management to encourage naturalization, particularly through the planting of indigenous species.

Keywords: Biodiversity; Carbon storage; Ecological integrity; Horticultural practices; Native and alien species; Naturalization; Urban ecosystems

1. Introduction

On a global scale, urbanization is increasing rapidly—cities are expanding in number, size, and population (Pickett et al., 2001). In 1900, only 5–10% of the human population lived in cities, but this grew to half in 2001, and in 2025 it is projected to be 2/3 (World Resources Institute, 2001). The presence of large numbers of people and the extensive infrastructure of urban areas has a powerful influence on environmental factors associated with climate, substrate, hydrology, disturbance regime, and man-

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agement practices, and these in turn profoundly affect urban biodiversity (Goldstein et al., 1982; Pickett et al., 2001; Freedman, 2004). In general, urbanization results in the destruction of natural ecosystems, followed by conversion of the land into buildings and other built structures, and into anthropogenic ecosystems such as lawns and other horticultural areas. An integral aspect of these profound ecological changes is the replacement of most indigenous species by alien ones (Goldstein et al., 1982; Kowarick, 1990; Freedman, 2004). Urbanization also affects ecological productivity, nutrient cycling, and biomass, and there is relatively intense stress associated with pollution by sewage, nutrients, toxic chemicals, heat, and biological pathogens (including invasive species) (Pickett et al., 2001; Freedman, 2004).

Urban habitats vary greatly in their ecological structure and function. For instance, so-called urban "forest" occurs in areas that support trees, along with an "understorey" of shrubs and lower-growing plants. The urban forest may occur as remnants of natural vegetation that survived urbanization, or it may develop from intentional planting, often of non-native species. Such forest and other urban ecosystems provide important environmental benefits (Heisler, 1986; Rowntree and Nowak, 1991; McPherson, 1998; Freedman and Keith, 1996; Nowak et al., 2002), such as:

- an improvement of outdoor aesthetics;
- provision of habitat for biodiversity, including some indigenous species;
- energy savings through decreased requirements for seasonal temperature management of buildings (during summer trees provide shade and cooling through transpiration, and in winter they decrease heating needs by reducing wind speed near buildings);
- a reduction of air pollution through the uptake and filtering of gases and particulates;
- the fixation of atmospheric CO_2 into the aggrading biomass of trees and other vegetation, helping to offset emissions of CO_2 from the use of fossil fuels and by deforestation and other ecosystem disturbances.

Urban vegetation is commonly managed through horticultural practices to achieve aesthetic values that are considered desirable, but are attained mostly through the cultivation of alien species. For example, the verdant, neatly tended, monocultural aesthetic of grass lawns has become a customary horticultural ideal during the past century in North America and elsewhere. Other horticultural aesthetics, such as those of gardens, encourage the cultivation of a diverse assemblage of alien species of trees, shrubs, and herbaceous plants imported from distant regions of the world. These horticultural aesthetics are supported by social pressures, including the commonly held view that urban property owners have a responsibility to maintain tidy lawns, partly achieved through the use of lawn-care products marketed using metaphors of a struggle between humans and natural forces that seek to compromise the grassy ideal (Jenkins, 1994). From the ecological perspective, however, these aesthetics and their associated management practices have negative effects on indigenous biodiversity, ecological integrity, and the attitude that many people develop about the natural world.

The notions of "native" (or indigenous) species and of "natural" ecosystems have been discussed by ecologists and other interested specialists (e.g., Noss, 1995; Schwartz, 1997; Kendle and Rose, 2000; Kitchen and McArthur, 2001). As considered here, and in the context of the Americas, a native species is one that was present in an ecoregion during pre-Columbian times (i.e., before ca. 1500). Species introduced subsequently, either deliberately or accidentally, and that have developed self-maintaining populations, would be considered to be "naturalized" but not indigenous (often they are also considered to be "invasive" species that cause demonstrable ecological damage). "Natural communities" are considered to be self-organizing, co-evolved assemblages of native species appropriate to local environmental conditions.

The presence of native species and self-organizing ecosystems are important aspects of the multi-factorial concept of ecological integrity (Freedman et al., 1995; Noss, 1995; Woodley, 1996). Ecological integrity refers to the completeness and dominance of ecosystems by natural, co-evolved, structural and functional components (Angermeier, 1994). Ecological integrity is sometimes used as an ideal endpoint of management for the conservation of natu-