Urban and Suburban Areas

Area of Urban/Suburban Lands

The Indicator

This indicator reports the total number of acres that are classified as "urban and suburban" and the amount of the various "undeveloped" land cover types within these areas. More detail is provided below, but "urban and suburban" is defined here as land that is substantially covered by one of the following land cover types: low-intensity residential, high-intensity residential, commercial–industrial–transportation, or urban and recreational grass. These categories are based on remote-sensing classification of land cover and are defined at http://landcover.usgs.gov/classes.html and http://www.epa.gov/mrlc/classes.html.

It was our intent that urban and suburban areas should include all major metropolises and their outlying suburbs as well as smaller settlements across the country that have a similar character even though they may not be adjacent to a metropolis. Our goal was to define those areas across the United States that should be classified as "urban and suburban"; The Heinz Center examined several possibilities before choosing the approach used here.

The use of the Census Bureau's metropolitan statistical areas (MSAs) was the coarsest approach considered. MSAs include entire counties (or cities and townships in New England) rather than only the large urban centers and those outlying areas that are connected to them in some fashion. In the West especially, vast counties are included in MSAs even though only a fraction of the county area is actually urban or suburban. MSAs account for about 20% of the land area of the lower 48 states; The Heinz Center believes this is a significant overestimate of the area covered by cities and suburbs.

Urbanized areas (UAs), also defined by the Census Bureau, offer a more refined but still incomplete solution. Metropolises and their outlying areas are included in UAs, but smaller settlements, which share many of their characteristics with suburbs, are not included. A drawback to using UAs is that they are determined in part by political/jurisdictional boundaries, in addition to the degree of development. A potentially larger confounding issue is that the rules for delineating UAs have changed significantly since their first use in 1950. The Census Bureau is well aware of this shortcoming and will be releasing newly constructed UA boundaries in early 2002. The U.S. Department of Agriculture (USDA) Economic Research Service (ERS) has estimated urban land area since 1950. ERS's estimate has incorporated the area of UAs as well as the amount of area in Census-defined "places" that have a population of at least 2,500 people. We have used ERS's estimate to gauge the change in urban land area over time in the national extent indicator (p. 40); however, due to the limitations of UAs we chose not to rely on these estimates exclusively to define urban/suburban areas.

A third and still more refined option considered would have relied totally on Block Groups (BGs), which are small regions based on political boundaries within which the Census Bureau counts the population. It would be possible to choose a density threshold—1000 people per square mile is generally accepted as "urbanized" by the Census Bureau—and define those BGs that meet or exceed this density as urban and suburban. A shortcoming of this approach is that BGs dominated by warehouses or railroad yards, for example, which are certainly urban in character, would be excluded because of their low population densities. As is discussed below, the approach chosen for this indicator does, indeed, include most BGs with densities at or above 1000 people per square mile.

A fourth option was to adopt the estimates for developed lands made by the USDA Natural Resources Conservation Service's National Resources Inventory (NRI). The definitions used by the NRI agree, in principle, with those for urban/suburban lands. However, NRI reports on any and all developed areas—including those down to about one-quarter acre. In contrast, this project focuses on those areas with sufficient density and size to qualify as "suburban" in character, as well as areas that are undeniably "urban." As noted below, this project's definition requires an area to be at least 270 acres in size before it is included within the "urban/suburban" definitions. In addition, the NRI data are derived from a statistical sampling rather than a cataloging of all developed lands. Thus, it would not have been possible to delineate individual urban/suburban areas on a map (as is done along with the national extent indicator), which would be necessary to implement several of the other indicators included in this report.

The approach adopted here (see "Data Manipulation" below) uses satellite data to classify land cover. The advantage of this method is that it includes virtually all the BGs with at least 1000 people per square mile, as well as other developed but lightly populated land, such as warehouse districts. In addition, by overlaying BGs on the urban/suburban areas, it was possible to estimate that about 75% of the 1990 population lived in these areas (note that the data used to generate urban/suburban areas came from 1992). As described in more detail below, a series of steps have been used to define the outlines of urban and suburban areas based on four different satellite land cover classifications.

A potential shortcoming of using a satellite-based approach rather than a delineation based in Census data is that it will be more challenging to correlate environmental quality trends like air and water quality with human demographic and health data. However, a geographic information system (GIS) can be generated to associate Census BGs, for example, with urban/suburban areas. This would permit such correlations to be done for studies of demographics and human health.

It may be useful in future editions of this report to consider presenting the data on urban/suburban lands based on the number of people associated with them. This would require shifting priorities for the indicator and a GIS analysis as described above. Also, as data become available, it would be good to add the proportion of native and non-native species to the graph showing the composition of the undeveloped portion of urban and suburban lands.

The Data

Data Source: Satellite data are derived from the National Land Cover Dataset (NLCD), a product of the Multi-Resolution Land Characterization (MRLC) Consortium, which is a partnership between the U.S. Geographical Survey (USGS), the U.S. Forest Service, the National Oceanographic and Atmospheric Administration (NOAA), and the Environmental Protection Agency (EPA) (see http://www.epa.gov/mrlc/ or http://landcover.usgs.gov/nationallandcover.html).

Data Collection Methodology: Please refer to the national extent indicator technical note (page 207) for a discussion of the NLCD.

Data Manipulation: The NLCD divides the lower 48 states of the United States into several billion square pixels that are about 100 feet on a side. The data presented for this indicator are based on analysis of larger pixels (1000 ft on a side), each of which contains 100 of the smaller pixels. The first step was to classify any 1000-ft pixel as urban and suburban if a majority of the 100-ft pixels within it fell into one of the four "developed" land cover types available in the NLCD: low-intensity residential, high-intensity residential, commercial–industrial–transportation, or urban and recreational grasses. Very large aggregates of the 1000-ft pixels, which were found for metropolises such as New York City, were "smoothed" to some degree; that is, small clusters of "undeveloped land" pixels that were wholly included within a metropolis were subsumed in the urban and suburban areas. Other clusters of undeveloped-land pixels within an urban and suburban area, although connected to the perimeter by one or more pixels on a diagonal, were also included in the urban and suburban area. For clusters of developed-land pixels to be counted as urban/suburban in outlying areas, at least 13 of the 1000-ft pixels had to touch at their sides or corners for a minimum size of 270 acres.

The final step for this indicator was to evaluate the proportion of different land cover types within the 1000-foot pixels. This process yielded estimates of the amount of both developed land and undeveloped land (in several categories) by region.

Data Quality/Caveats: It is important to note that the methods used to establish the NLCD relied on two different satellite images of a given area, plus ancillary data. An image taken during the "leaf-off" period in the late fall to early spring was often more important to the classification process than the fully vegetated image. This was especially true in urban settings with a good deal of tree-lined streets; the foliage of deciduous trees should not have obscured the constructed surfaces during the leaf-off period and, therefore, should not have led to an underestimate of developed lands in these regions.

Given that the method used here to establish urban/suburban areas is based on square pixels that are roughly 100 feet on a side, some detail would have been missed in a typical urban setting. Specifically, the trees on a tree-lined streets would most likely not be distinguished from the street and sidewalk. However, a large expanse of trees, such as a heavily wooded median strip or a small park, may well have been classified as forest.

Data Access: All these analyses were conducted at the Land Cover Applications Center at USGS's Earth Resources Observations Systems Data Center. The raw data from which this indicator was developed are available at no cost from the MRLC Consortium (http://edcwww.cr.usgs.gov/programs/lccp/mrlcreg.html), but vast computing power was necessary for this analysis. Note: The data available at the Web site listed here are the "raw" data from which estimates of urban/suburban area, and the size of natural areas within, were prepared. The actual data presented in this report were prepared specially for The Heinz Center for this report.

Suburban/Rural Land Use Change

There is no technical note for this indicator.

Patches of Forest, Grasslands and Shrublands, and Wetlands

The Indicator

Undeveloped land in urban and suburban areas was analyzed to identify patches of natural land. "Natural" is defined to include all lands that have been classified in the extent indicator as any of the following: forests, grasslands and shrublands, or wetlands. The indicator presents the size distribution of contiguous patches composed of any of these land cover types, or combinations of them, by region.

There is a generally understood "rule" among conservation ecologists that smaller patches of habitat generally provide lower quality habitat than larger patches. There is some debate as to whether this is true for wetlands. There is some evidence that the quality of the habitat remains fairly constant regardless of its size (see Gibbs 1993). On the other hand, there is also evidence that isolated wetlands habitats (i.e., those not surrounded by undeveloped upland vegetation) are compromised in their habitat value (see Calhoun and Klemens, 2002).

The Data

Data Source: Satellite data are derived from the National Land Cover Dataset (NLCD), a product of the Multi-Resolution Land Characterization (MRLC) Consortium, which is a partnership between the U.S. Geological Survey (USGS), the U.S. Forest Service, the National Oceanographic and Atmospheric Administration (NOAA), and the Environmental Protection Agency (see http://www.epa.gov/mrlc/ or http://landcover.usgs.gov/nationallandcover.html).

Data Collection Methodology: Please refer to the national extent indicator technical note (p. 207) for a discussion of the NLCD.

Data Manipulation: Eight of the 21 NLCD classifications were defined as "natural" for this analysis. These include three classes considered as "forest" for this report (deciduous forests, evergreen forests, mixed forests); three types considered as "grasslands/shrublands" (shrubland, grasslands/herbaceous, bare rock/sand/clay), and two wetlands types (woody wetlands, emergent herbaceous wetlands). Patches were defined as collections of 30-meter pixels in any of these eight classifications that touched one another either on their sides or at their corners. (Patches can be as few as one or as many as hundreds of pixels.) Data were processed on a state-by-state basis, and then these data were grouped based on the four regions. For a given region, the number of patches of various sizes were counted, thereby creating a distribution.

Data Quality and Caveats: Data were processed on a state-by-state basis, which means that in some cases a patch of natural land may have been broken into two segments at the state boundary by the analysis process. In addition, natural patches may well extend beyond the boundary of urban and suburban areas, meaning that the value reported here would be an underestimate of the actual size of the patch. Also, the smallest patches cannot be characterized by these methods, so estimates of the acreage (and percentage of total urban and suburban areas) in the less-than-10-acre category are an underestimate of the true value. This occurs because it is difficult to distinguish very small patches (e.g., one to a few pixels) that are mixed in with developed land cover types.

Also, the satellite data cannot be used to distinguish between a parcel of land that has always been grassland/shrubland or wooded and one that was developed but has since reverted to this apparently natural land cover (e.g., a dump or landfill). It would be misleading to label such land as "natural." It is expected that this mislabeling occurred infrequently; however, it is not possible to estimate how much of an effect this might have had on the data.

Note: Additional caveats are listed in the technical note for the Area of Urban and Suburban Lands indicator, p. 264.

Data Access: All these analyses were conducted at the Land Cover Applications Center at the USGS's Earth Resources Observations Systems Data Center. The data are available (http://edcwww.cr.usgs.gov/programs/lccp/mrlcreg.html) at no cost from the MRLC Consortium, but considerable computing power is necessary to manipulate them. Note: The data available at the Web site listed here are the "raw" data from which estimates of urban/suburban area, and the size of natural areas within, were prepared. The actual data presented in this report were prepared specially for The Heinz Center for this report.

References

Calhoun, A., and M.W. Klemens. 2002. Best development practices (BDPs) for conserving pool breeding amphibians in residential and commercial developments (MCA Tech. Paper 5).

Gibbs, J.P. 1993. Importance of small wetlands for the persistence of local populations of wetland-associated animals. Wetlands 13(1):25-31.

Total Impervious Area

The Indicator

Perhaps the single most dramatic and pervasive impact of urbanization on the functions and values of a watershed is the replacement of the natural landscape with pavement and other water-impervious (impenetrable) material such as roads, parking lots, driveways, sidewalks, and rooftops. Increased levels of impervious surfaces interrupt the hydrologic cycle, alter stream structure, and degrade the chemical profile of the water that flows through streams. These changes affect fish and wildlife in various ways, and are cumulative within watersheds. Research indicates that when total impervious area (TIA) in a watershed reaches 10%, stream ecosystems begin to show evidence of degradation. Ecological effects become severe as TIA approaches 30% (for more discussion, see Arnold and Gibbons 1996; Booth and Jackson, 1997; Schueler 1994; Schueler and Holland 2000).

Effects that have been associated with increases in impervious area include the following:

- ***Increases in stream temperature,*** as rain runs over heated pavement. During warmer months, water flowing over impervious surfaces is often 10–12°F warmer than water that passes through fields and forests. Higher water temperatures increase the metabolic rates of stream-dwelling plants and animals, so that an organism living in warmer water needs more oxygen than the same species in cold water. Unfortunately, warmer water cannot hold as much oxygen as cold water.
- ***Changes in stream flows.*** Greater stormwater volumes traveling over the surface and being delivered too rapidly to streams leads to increased stream flashiness and a reduction in summer base flows, sometimes causing perennial streams to become intermittent or to dry up completely. As a result, urbanized watersheds are prone to more frequent and bigger floods.
- ***Stream channel modification.*** The rapid runoff associated with increased stormwater velocity and volume quickly erodes and incises the stream channel and banks. Channels widen and straighten to accommodate higher flows. Ponds, pools, riffles, and sandbars are simplified or washed away, eliminating critical habitat for fish, waterfowl, and other species of animals and plants.
- ***Increased pollutant loadings.*** Concentrations of pollutants in streams increase with increases in impervious area. Common urban pollutants include pesticides, bacteria, nutrients such as phosphorus and nitrogen, and other contaminants, such as PCBs and heavy metals.

The percentage of impervious surfaces within a watershed is a good indicator of the degree of urbanization and the associated negative ecological impacts, but it can be very difficult to measure. Where such data are available, watershed urbanization is most often quantified in terms of the proportion of the basin area covered by impervious surfaces, or TIA.

The Data Gap

Existing data should be examined in order to develop a cost-effective way of estimating impervious area regionally and nationally. This may involve the use of new remote-sensing techniques; collation of existing local information; the use of surrogates, such as the amount of road surface; or other approaches.

References

Arnold, C.L., and C.J. Gibbons. 1996. Impervious surface coverage: The emergence of a key environmental indicator. Journal of the American Planning Association 62(2):243–258.

Booth, D.B., and C.R. Jackson. 1997. Urbanization of aquatic systems: Degradation thresholds, stormwater detection, and the limits of mitigation. Journal of the American Water Resources Association 35(5):1077–1090.

Schueler, T.R. 1994. The importance of imperviousness. Watershed Protection Techniques 1(3):100–111.

Schueler. T.R. and H.K. Holland. eds. 2000. The practice of watershed protection. Ellicott City, MD: Center for Watershed Protection.

Stream Bank Vegetation

The Data Gap

As discussed on the indicator page, it is not yet clear if this indicator will utilize data collected “on-the-ground” or via remote sensing. Use of satellite data would require acquisition of vegetation data, perhaps at a resolution finer than that provided by the National Land Cover Data Set (NLCD), which has 30-m resolution (see http://www.epa.gov/mrlc/ and the National Extent technical note, page 207, for more detail). It will also be necessary to decide how to characterize vegetation, which would probably be based on the ecological functioning of the cover. For example, residential lawns function differently from woods or natural grasslands in the way they shed water, passively clean stormwater runoff or provide habitat for stream-dependent animals. Secondly, the vegetation data would have to be merged with data on the location of streams (probably from the USGS National Hydrography Dataset (NHD), see http://nhd.usgs.gov/). Stream location would have to be limited to those segments that are urban/suburban in nature, which might be achieved by simply restricting the dataset to those stream and river segments that are within the urban and suburban areas defined by this project (see the Area of Urban / Suburban Lands page 181).

Nitrate in Urban/Suburban Streams

See the technical note for Nitrate in Farmland Streams, p. 232

Phosphorus in Urban/Suburban Streams

See the technical note for Nitrate in Farmland Streams, p. 232

Air Quality (High Ozone Levels)

The Indicator

The indicator reports the number of days per year when peak 8-hour average ozone concentrations exceed 0.08 parts per million (ppm). When a monitor exceeds this 8-hour average concentration four or more times per year, an area is likely to be out of compliance with the National Ambient Air Quality Standard (NAAQS) for ozone; this standard was chosen by the Environmental Protection Agency (EPA) to “protect the public health ... with an adequate margin of safety,” as specified by the Clean Air Act. Note that the actual calculation to determine compliance with the NAAQS involves calculation of a 3-year average of the annual fourth-highest daily maximum 8-hour average concentration; if this value exceeds 0.08 ppm an area is in violation.

Oxides of nitrogen (NO_x), which are byproducts of fossil fuel combustion, when in the presence of sunlight in the atmosphere, will break apart and generate nitric oxide (NO) and a single atom of oxygen (O). This oxygen atom quickly combines with molecular oxygen (O_2) forming ozone (O_3). Ozone can oxidize NO back to nitrous oxide (NO_2), which allows the cycle to start over again. Volatile organic compounds (VOCs), which come from paints and solvents, unburned fuel, and industrial sources, factor into the equation because they also can oxidize NO to NO_2. Hence, with both NO_x and VOCs present, ozone accumulates in the atmosphere and ultimately poses a threat to human health, wildlife, pets, and building materials.

The Data

Data Source: Data are maintained by EPA in the Aerometric Information Retrieval System (AIRS). The Clean Air Act requires every state to establish a network of air-monitoring stations for pollutants, including ozone, using criteria set by EPA for their location and operation; there are approximately 1500 ozone monitors in this network. The states must provide EPA with an annual summary of results from each monitor.

Data Collection Methodology: Ozone monitoring instruments are intended to produce a measurement every hour, for a possible total of 8,760 hourly measurements in a year. A monitor is considered operational if it reports a measurement for more than half the hours in a year.

Data Manipulation: For each of the 1500 ozone monitors nationwide, EPA provided The Heinz Center with 10 years of data on the number of days per year that peak 8-hour average ozone concentrations exceeded 0.08 ppm. Data were not reported for years missing more than half the daily peak concentrations during the ozone season (typically May through September). From these monitors, The Heinz Center selected the 624 monitors that are located in urban and suburban areas (as defined for this report; see Area of Urban/Suburban Lands and associated technical note, pp. 181 and 264). The trend graphs include only those monitors with data for at least 8 of the 10 years between 1990 and 1999; 397 monitors meet the criteria for data completeness. For the maps, which provide the locations of monitors according to their 1999 values, 486 monitors had data.

In Hawaii, there are three ozone monitors; however, we do not have satellite data on the extent of urban and suburban areas for this state. Therefore, it was not possible to identify the urban and suburban monitors in Hawaii in the same fashion as in the lower 48 states. As is discussed in the technical note for Area of Urban/Suburban Lands (p. 264), there is reasonable overlap between the urban and suburban areas defined using satellite data and Census Bureau Block Groups having at least 1000 people per square mile. For this reason, we identified Hawaiian monitors located in Block Groups having a density of at least 1000 people per square mile. Two of the Hawaiian monitors passed this screen; ultimately one of these was dropped due to insufficient data. There is a single monitor in Alaska and following the method used for Hawaii, it was excluded from our analysis because it is not within a Block Group having at least 1000 people per square mile.

Data Quality and Caveats: The monitors that make up this national network conform to uniform criteria for monitor siting, instrumentation, and quality assurance.

Data Access: Air quality data upon which this indicator is based are collected regularly by EPA and are available at http://www.epa.gov/airs/. EPA provided the specific data used in this analysis to The Heinz Center especially for this project. However, annual summary monitoring data are available at EPA's AIRData Web site (http://www.epa.gov/air/data/index.html).

Chemical Contamination

See the technical note for the core national contaminants indicator, p. 210.

Urban Heat Island

The Indicator

Cities have modified climates based on factors such as building density and type and energy use, as well as local topography and regional weather patterns. The "urban heat island" represents the difference between urban and nearby rural air temperatures and is directly related to urban land cover and human energy use. For most cities, this difference often is negligible in the daytime but develops rapidly after sunset. Maximum difference occurs 2–3 hours after sunset and may be as great as 18°F. In general, as the population density of a city increases, the difference in minimum temperature between the urban core and rural site increases nonlinearly. Urban heat island effect for a city is calculated by comparing the temperature of a monitoring station in the urban core with a monitoring station from a neighboring rural location. This difference might be reported as the average monthly difference between urban and rural sites. Nationally, the indicator might report the number of cities with various levels of difference between urban and rural sites: 0–6°F, 6 to less than 13°F, or more than 13°F.

As constructed surfaces replace natural vegetation, an area's ability to absorb and store heat increases; the natural cooling effect mediated by trees and other vegetation is reduced (water moves from the soil into a plant via its roots, exiting ultimately by evaporation through pores in the leaves in a process called evapotranspiration—a cooling process much like when sweat evaporates from our skin). The urban heat island represents a change in the diurnal pattern of ambient temperature. Because many biological processes are temperature dependent, changes in the temperature regime may have profound effects on species and ecological processes. In fact, many of the proposed effects from elevated global temperatures occur in urban areas because of the urban heat island effect.

It is reported by the Centers for Disease Control's National Center for Environmental Health that extreme heat events, some of which may be directly attributable to the heat island effect, are responsible for greater loss of human life in the United States than hurricanes, lightning, tornadoes, floods, and earthquakes combined (http://www.cdc.gov/nceh/hsb/extremeheat/). Other effects may include physiological stress in some species, altered species composition and structure in ecological communities, modified nutrient and carbon availability, and altered home range of pathogens. For example, physiological stress results from altered phenology and modified moisture nutrient availability. The urban heat island also modifies energy use for heating and cooling buildings and vehicles.

The Data Gap

National Weather Service temperature data are available for a large number of locations in the United States and could be used to determine urban heat island effect and how this temperature differential has changed over time. Analyzing historical data would require a significant amount of time, energy, and funding to retrieve archival information, to conduct quality assurance and quality control on data, and to perform the analysis. Data problems include obtaining long-term data records for both urban and adjacent rural sites and accounting for changes in monitoring locations or instrumentation and for changes in population densities and human activities around monitoring sites. Another problem occurs for desert cities where the maximum temperature difference between urban and rural monitoring locations may occur during midday rather at sunset. Although a temperature differential exists 2–3 hours after sunset, the evaporative cooling from vegetation within the city may create cooler temperatures during the day than adjacent desert temperature.

Remote-sensing data have been used to examine temperature differences between urban and rural sites; however, these measurements record surface temperatures rather than ambient temperatures.

Species Status

The Indicator

This indicator reports the percentage of "original" vertebrate animals and vascular plants that are at risk of displacement or have been displaced from metropolitan areas (i.e., major cities and their suburbs found within the urban/suburban areas defined by this report; small, isolated cities or suburbs would be excluded because it would likely not be feasible to include them in the necessary monitoring program). "Original" is defined as existing prior to European settlement in the area that is now a metropolitan area. Using the reference point of presettlement is in some sense an arbitrary choice; its use does not necessarily mean that it would be desirable to have all original species present in urban/suburban areas. This indicator includes only vertebrate animals (not insects, worms, and the like) and vascular plants (not mosses, fungi, algae, and so on).

The Data Gap

This indicator should be reported for larger metropolitan regions, where expertise and information are likely to be available. For each of these areas, a list of plant and animal species present before settlement must be compiled. These lists can be derived from reviews of the historical literature, museum records, Natural Heritage program data, and agency files. Information on current status must be obtained through field surveys, which will need to be repeated periodically. If scientists develop standardized protocols for observation and reporting, much of the data could be collected by trained volunteers.

Many organizations collect data about the current distribution and status of species, but few of these provide information on species status or population trends within areas as small as a metropolitan area. For example, most states have Natural Heritage programs, which provide status information on a wide variety of species (http://www.natureserve.org/about_nhnoverview.htm), but generally on a statewide or larger area basis.

There are a growing number of city, county, and regional efforts to gather and use biodiversity information, and these efforts could form the basis for reporting this indicator. Two programs that exemplify this trend are the Illinois EcoWatch Network and Chicago Wilderness. EcoWatch is a series of volunteer monitoring programs coordinated through the Illinois Department of Natural Resources (http://dnr.state.il.us/orep/inrin/ecowatch). The program has an UrbanWatch component (http://www.fmnh.org/urbanwatch/splash.asp), as well as RiverWatch, ForestWatch, and PrairieWatch components. Chicago Wilderness (http://www.chiwild.org) is a partnership of more than 130 organizations working to protect, restore, and manage natural areas in the three-state Chicago metropolitan area. In addition, Robinson et al. (1994), in a study in Staten Island, New York, showed a loss of over 40% of native flora and an increase of over 33% non-native flora during the period 1879 to 1991. DeCandido (2001) found similar results for The Bronx, New York.

Finally, there must be some mechanism that will ensure adequate consistency between local and regional efforts, and that will be responsible for collating data from local sources to produce regional and national statistics.

References

DeCandido, R. 2001. Recent changes in plant species diversity in Pelham Bay Park, Bronx County, New York City, 1947–1998. Ph.D. Dissertation, The City University of New York.

Robinson, G.R., M.E. Yurlina, and S.N. Handel. 1994. A century of change in the Staten Island flora: Ecological correlates of species losses and invasions. Bull. Torrey Bot. Club 121(2):119–129.

Disruptive Species

There is no technical note for this indicator.

Status of Animal Communities in Urban and Suburban Streams

See the technical note for the freshwater indicator for status of animal communities in streams (p. 253).

Public Accessible Open Space per Resident

The Indicator

The indicator reports the amount of publicly accessible open space per resident for major urban and suburban areas in the United States. "Natural" lands include areas managed for their natural values as well as areas that are vegetated, but also relatively highly managed, such as playing fields and parks. Minor amounts of pavement or other "hard" surfaces would not preclude an area from being considered "natural."

According to the National Research Council (2000, p. 22), the natural environment provides people with a variety of ecological goods and services, including "recreation, aesthetic enjoyment, and spiritual experience." This indicator is an important measure of the capacity of urban and suburban areas to provide recreational and aesthetic enjoyment in an unbuilt environment close to home.

Definitions: "Open space" means unbuilt land or water areas dominated by naturally pervious surfaces. A grassy park or golf course would qualify as open space; a paved playground would not. A river or lake would qualify as open space, as would some cemeteries. Satellite imagery will soon provide 5-meter resolution images, but whether there should be a minimum size to qualify for inclusion—that is, whether open space or parkland loses recreational or aesthetic utility below a threshold parcel size—is a question yet to be answered.

"Publicly accessible" means publicly or privately owned open space to which the general public has legal access, with or without an entry fee. A space is not publicly accessible if access is limited to members of specific groups or organizations. For example, a public or private golf course would be considered publicly accessible unless entry was restricted to club members. A farm would not be publicly accessible, nor would a country club. A privately owned but vacant and overgrown industrial site would not be publicly accessible.

The Data Gap

There are at least two methods for calculating the amount of open space and determining whether it is publicly accessible:

Self-Reported Acreage: Cities, counties, special districts, and states can report the acreage of public parks and open spaces they administer inside metropolitan areas. Public parks and publicly owned open spaces would be assumed to be publicly accessible. Accuracy would be limited by inconsistent standards among jurisdictions in the same metropolitan area for defining parks and open spaces. Historical data from cities may be affected by boundary changes associated with annexations. Hardened playground surfaces would likely be included in the data; many water bodies would likely be excluded, as would private lands that are effectively public by virtue of the owners' access policies.

Direct Measurement: Satellite imagery can identify unbuilt open spaces with naturally pervious surfaces. Tax assessment records might be used to locate tax-exempt parcels inside the identified open spaces. The tax records normally identify the basis for each parcel's tax exemption, making it possible to infer which parcels are publicly accessible. More research is needed to determine the suitability of tax assessor records. Although tax assessment records are usually maintained by counties, in some jurisdictions cities, districts, or states may maintain the records. Some assessment records are maintained by these local jurisdictions in geographic information system (GIS) databases. GIS-based records make it easier, faster, and cheaper to derive the indicator, although it would be possible to do it with non-GIS records.

The data from both methods can be aggregated within each metropolitan area and aggregated again across all metropolitan areas for a national measure.

Before such an effort is put in place, some threshold of extent or population size would have to be developed to determine which cities, suburbs, and aggregations of the two should be included. Once this selection is completed, the per capita calculations would be carried out using population data from the Census Bureau.

References

National Research Council. 2000. Ecological indicators for the nation. Washington, DC: National Academy Press.

Natural Ecosystem Services

There is no technical note for this indicator.