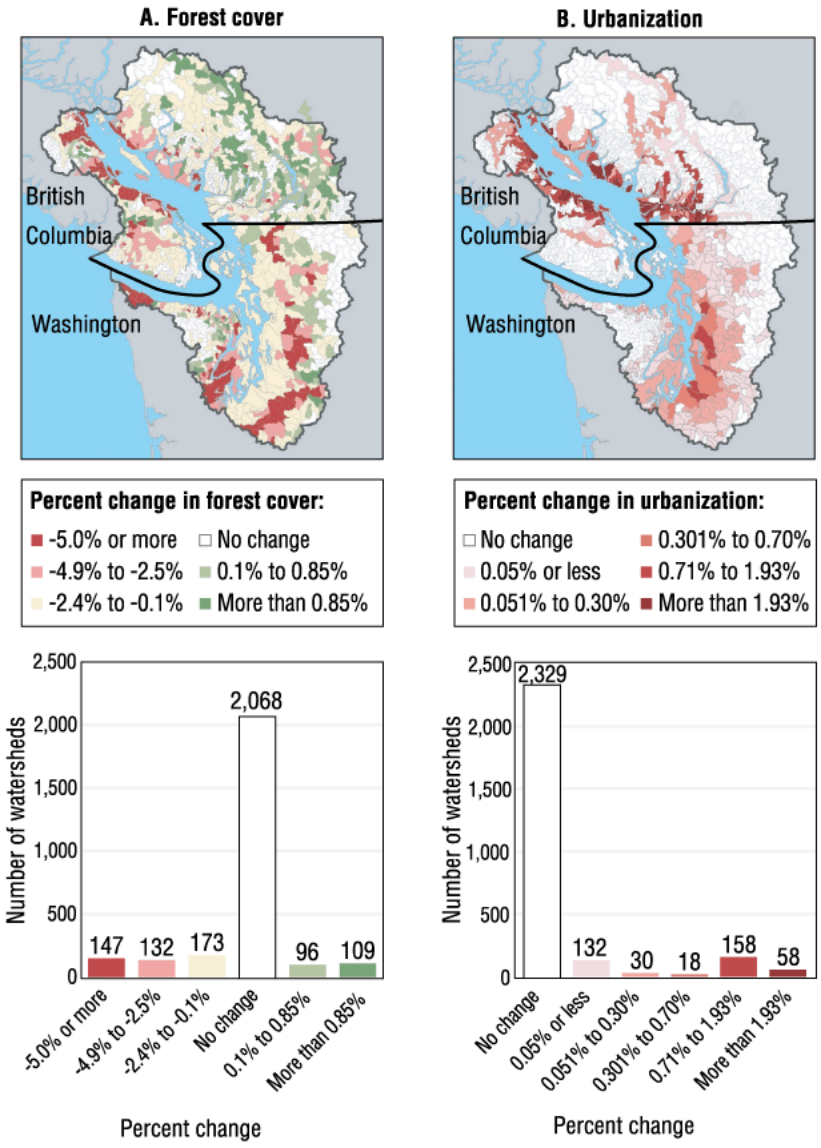
Land Cover in the Puget Sound/Georgia Basin

Exhibits

Exhibit 4-4. Land cover change in watersheds of the Puget Sound/Georgia Basin, 1992-2000[a,b]



[a]**Coverage:** 2,725 watersheds within the Puget Sound/Georgia Basin, located in the state of Washington and the Canadian province of British Columbia. U.S. watersheds are 12-digit Hydrologic Unit Code (HUC12) watersheds.

[b]U.S. data reflect changes from 1995 to 2000, while Canadian data reflect changes from 1992 to 1999.

Data source: *British Columbia Integrated Land Management Bureau, 2001; CommEn Space, 2005; NOAA, 2006*

Introduction

Changes in land use and corresponding changes in land cover can alter the basic functioning and resilience of ecological systems. Watersheds, for example, experience a cascade of effects among critical physical, chemical, and biological processes when land cover changes (NWP, 1995; Thom and Borde, 1998). For instance, removal of vegetation can increase erosion, leading to impacts on soil and water quality, and increases in developed land typically result in a corresponding increase in impervious surfaces with consequences for runoff, among other issues. While individual impacts to a landscape may appear as small changes, the combined impacts of particular land uses or land management practices on watersheds can have substantial effects on water quality, species composition, and flooding patterns (PSAT, 2002, 2004). Such combined impacts are often referred to as "cumulative effects." As a result of their potential to broadly and substantially influence environmental condition, land cover and use are important factors to monitor.

This indicator compares changes in two land cover metrics for the Puget Sound and Georgia Basin in Washington state and part of British Columbia, Canada. The metrics include percent change of urban and forest land cover. Data cover the period from 1995 to 2000 for the U.S. portion of the basin and from 1992 to 1999 for the Canadian side of the basin. The metrics represent the change in total urban or forested land area divided by total land area in the watershed. Forest and urban land cover are two of the most important factors affecting the condition of watersheds in the Puget Sound Basin (Alberti and Marzluff, 2004; Alberti, 2005). In contrast to the nationwide land cover indicator, which is based on NLCD data, this indicator relies on data derived from four assembled USGS Landsat scenes covering the U.S. portion of the Puget Sound Basin and from a combined scene covering the Canadian land area. The land cover data for all USGS 6th field watersheds in the basin were produced from NOAA Coastal Change Analysis Program (C-CAP) data and from Canadian Baseline Thematic Mapping (BTM) data. The USGS Hydrologic Unit Codes and Canadian watershed groupings provide topographically delineated watersheds, which are aggregated, or "nested," into larger sub-basin and basin units.

What The Data Show

Forest Cover

Little or no change in forest cover was observed in 2,068 watersheds (76 percent) of the 2,725 watersheds assessed (Exhibit 4-4, panel A). However, 279 watersheds (10 percent) saw at least 2.5 percent of their mature forest cover converted to some other land cover, often bare ground, immature vegetation, or industrial/urban uses. At the same time, another group of 205 watersheds (8 percent), generally those at higher elevations, indicated a net increase in forest cover as young stands or cleared areas have re-grown into more mature forest cover classes.

Urbanization

During the same period, little or no change in urban land cover was observed in approximately 90 percent of the 2,725 assessed watersheds within the basin (Exhibit 4-4, panel B). However, urbanization increased across many low-elevation watersheds and shoreline areas, with 158 watersheds (6 percent) expanding the urban portion of the watershed by between 0.7 and 1.93 percent, and another 58 watersheds (2 percent) showing increases of more than 1.93 percent. Research has shown that as a watershed's drainage area becomes paved or otherwise impervious, there is a high potential for physical, chemical, and biological impairments to both water quality conditions and other aquatic resources (NWP, 1995; Alberti and Marzluff, 2004).

Limitations

- While the U.S. C-CAP data and the Canadian BTM data have similar and overlapping time periods, as currently presented, the U.S. data reflect change from 1995 to 2000 and the Canadian data reflect change from 1992 to 1999.

- The size of the data pixels and the minimum mapping unit size affect the classification of certain features such as narrow riparian corridors, and can affect the percentages in the indicators.

Data Sources

The full analysis has not been published as a data set, but it is based on publicly available data sets compiled by CommEn Space (http://www.commenspace.org). Raw data for the U.S. portion of this indicator are available from C-CAP (NOAA, 2006), and Canadian data are available from the British Columbia Integrated Land Management Bureau (2001). Additional technical background is provided by U.S. EPA (2006).

References

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Metadata (Technical Documentation)

Identification

1. Indicator Title

Land Cover in the Puget Sound/Georgia Basin

2. ROE Question(s) This Indicator Helps to Answer

This indicator is used to help answer two ROE questions: "What are the trends in land cover and their effects on human health and the environment?" and "What are the trends in the extent and distribution of the Nation's ecological systems?"

3. Indicator Abstract

This indicator compares changes in two land cover metrics (urban and forest land cover area) for the Puget Sound and Georgia Basin in Washington state and part of British Columbia, Canada. Data cover the period from 1995 to 2000 for the U.S. portion of the basin and from 1992 to 1999 for the Canadian side of the basin. This information improves our understanding of how land cover is changing in a sensitive watershed region.

4. Revision History

May 2008	-	Original indicator posted
March 2010	-	Metadata updated

Data Sources

5. Data Sources

This indicator is adapted from one of a series of indicators published by EPA on the Puget Sound/Georgia Basin area (US EPA, 2006b). This indicator is based on satellite imagery of the Puget Sound/Georgia Basin. USGS Landsat Thematic Mapper and Landsat Enhanced Thematic Mapper satellite imagery (processed by NOAA's Coastal Change Analysis Project [C-CAP]) from 1995 to 2000 was used for the U.S. portion of the Puget Sound/Georgia Basin, and Canadian Baseline Thematic Mapping (BTM) remote sensing data from 1992 to 2000 were used for the Canadian side of the basin.

6. Data Availability

The original indicator is available online at http://www.epa.gov/region10/psgb/indicators/urbaniz_forest_change/index.htm (U.S. EPA, 2006b). Raw data for the U.S. portion of this indicator are available from C-CAP at http://www.csc.noaa.gov/digitalcoast/data/ccapregional/download.html (NOAA, 2006), and Canadian data are available from the British Columbia Integrated Land Management Bureau (2001) at http://ilmbwww.gov.bc.ca/cis/initiatives/ias/btm/index.html EXIT Disclaimer.

Methodology

7. Data Collection

See U.S. EPA (2006c) and Alberti et al. (2004). Additional information is available at http://www.urbaneco.washington.edu/ EXIT Disclaimer.

8. Indicator Derivation

The two metrics being reported are percent change of urban land cover and percent change of forest cover, as determined at the individual watershed level. Percent of urban land cover is the percent of paved land, calculated by the sum of the area of all paved patches divided by total landscape area. Percent of forest cover is the percent of forest land cover, calculated by the sum of all patches of forested patches divided by total landscape area.

For additional information regarding indicator derivation on the U.S. side of the Puget Sound/Georgia Basin, see Alberti et al. (2004). For more information about the delineation of the 2,725 watersheds analyzed, see U.S. EPA (2006c).

9. Quality Assurance and Quality Control

See: Alberti et al. (2004).

For more information on the 1995–2000 C-CAP trend assessment, contact CommEnSpace [NOTE: CommEnSpace no longer exists as an organization]. See also the Urban Ecology Research Lab, Department of Urban Planning, University of Washington (http://www.urbaneco.washington.edu/ EXIT Disclaimer).

Analysis

10. Reference Points

Research has shown that once watersheds begin approaching or exceeding about 10 percent of their drainage area in an impervious or paved condition, there is a high potential for physical, chemical, and biological impairments to both water quality conditions and other aquatic resources.

Related research has shown that watersheds, particularly those along the west side ranges of the Pacific Northwest, require about 65 percent forest cover to retain the hydrological processes that minimize surface water runoff during storms and infiltrate water into ground water and summer base flows in local streams and rivers (McMurray and Bailey, 1998).

11. Comparability Over Time and Space

While the U.S. C-CAP data and the Canadian BTM data have similar and overlapping time periods, as currently presented, the U.S. data reflect change from 1995 to 2000 and the Canadian data reflect change from 1992 to 1999.

12. Sources of Uncertainty

Content under review.

13. Sources of Variability

Content under review.

14. Statistical/Trend Analysis

Content under review.

Limitations

15. Data Limitations

Limitations to this indicator include the following:

1. Trend data have not been presented in this indicator. Land cover data for the entire nation at adequate resolution to support the indicator were previously available for two points in time (1992 and 2001). Differences in methodology in creation of the data sets limited their comparability. Recently, the MRLC Consortium developed a Land Cover Change Retrofit Product (Fry et al., 2009) that enables comparisons between the two data sets. Future updates of this indicator will rely on this Retrofit product.
2. FIA data for forest land in Alaska and Hawaii were used to complement the NLCD because NLCD data do not currently exist for these states.
3. National estimates of land cover vary, depending on the survey approach, data sources, classification, timing, etc. The interaction of these variables will result in different estimates of the extent of any given land cover category depending on the data set used. Techniques relying on satellite data to generate land cover estimates classify what is visible from above, meaning they may underestimate developed cover in heavily treed urban areas and underestimate forest cover where trees have been harvested. For example, National Resources Inventory (USDA NRCS, 2007) estimates for developed land are 6 percent above the NLCD estimates and FIA estimates of forestland in 2002 are nearly 17 percent above the NLCD. NLCD 2001 developed improved approaches for estimating developed area by focusing on impervious surface.
4. Federal agencies do not consistently rely on a standardized land cover classification system, resulting in no consistency in the assessment of land cover trends across agencies.

References

16. Data Reference

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