

Fragmentation Kurt Riitters

Effective resource management takes into account the administrative and biophysical settings within which natural resources occur. A setting may be described in many ways; for example, by forest land ownership, by reserved and roadless designation, or by the distribution of human populations in relation to forest (chapter 3). The physical arrangement of forest in a landscape—popularly referred as “forest fragmentation”—is another aspect of setting. The Forest Service (2004) used high-resolution satellite imagery to answer the question of how much forest land experiences different types and degrees of fragmentation. This section summarizes an assessment of landscape “context”—an aspect of setting that describes the proximate causes of fragmentation and thus indicates the types of risk associated with fragmentation.

As defined here, the landscape context of a parcel of land refers generally to the relative proportions of different types of land cover in its surrounding neighborhood. This definition is a logical extension of the “forest-urban interface” concept to other types of interfaces such as the “forest-agriculture interface.” The landscape context classification model (fig. 2d.1) is analogous to the familiar “soil triangle” that is used to classify soil texture based on the proportions of sand, silt, and clay in a soil sample. The “landscape context triangle” classifies a parcel of land according to the proportions of three generalized land cover types—agriculture, developed, and natural—in its surrounding neighborhood. The acronyms in figure 2d.1 refer to landscape “mosaic” as explained in the caption. Landscape “background,” a condensed version of landscape mosaics, indicated by the colors in the figure, is called agricultural, seminatural, developed, or mixed, depending on which types of land cover dominate the neighborhood.

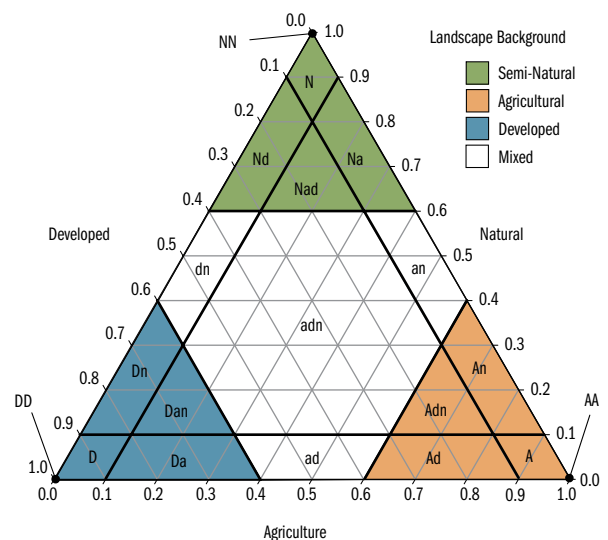


Figure 2d.1. The landscape context triangle classifies landscape mosaic and landscape background according to land cover composition in a neighborhood. The axes of the triangle show the proportions of natural (forest, grassland, shrubland, water, wetland), agricultural (cultivated crops, pastures), and developed (urban, road) land cover types in the neighborhood. The colors and legend indicate the landscape background, and the acronyms indicate the landscape mosaic. In a mosaic acronym, the letters ‘N’ and ‘n’ refer to natural land cover, ‘A’ and ‘a’ refer to agriculture land cover, and ‘D’ and ‘d’ refer to developed land cover. A letter is uppercase if that land cover occupies more than 60 percent of a neighborhood and lowercase if it occupies from 10 to 60 percent of a neighborhood. A letter does not appear if that land cover occupies less than 10 percent of a neighborhood. The three corners of the triangle, indicated by double uppercase letters, correspond to neighborhoods that contain only that one land cover type.

Region	Landscape Background			
	Agricultural	Developed	Seminatural	Mixed
(a) Any land cover		Percent of all land cover in region		
North	38.0	4.2	45.1	12.8
Pacific Coast	10.4	2.8	83.8	3.1
Rocky Mountain	16.0	0.6	79.4	4.1
South	18.0	3.2	66.0	12.8
All regions	20.8	2.3	68.5	8.4
(b) Grassland only		Percent of all grassland in region		
North	14.9	0.8	62.0	22.3
Pacific Coast	0.9	0.6	94.7	3.8
Rocky Mountain	1.8	0.0	93.8	4.4
South	2.5	0.3	87.2	10.0
All regions	2.3	0.1	91.6	6.0
(c) Forest land only		Percent of all forest land in region		
North	3.1	0.4	86.5	9.9
Pacific Coast	0.1	0.2	98.8	0.9
Rocky Mountain	0.8	0.0	97.9	1.3
South	1.6	0.4	90.0	8.0
All regions	1.7	0.3	91.6	6.4

Table 2d.1. Regional and national summary of landscape background (shaded regions in figure 2d.1) within a 37.6-acre neighborhood surrounding a 0.22-acre parcel of (a) any land cover, (b) grassland only, and (c) forest only. Each row shows the percentages of the total area in a region classified as each of four types of landscape background.

The landscape context triangle model was implemented using the 2001 high-resolution national land cover map (Homer et al. 2007) with a detailed road map (ESRI 2005) superimposed. Approximately 8.6 billion pixels (0.22 acres each) are on the land cover map, including approximately 2.6 and 1.3 billion pixels of forest and grassland, respectively. The landscape mosaic was evaluated separately for each land cover pixel, using the landscape context triangle within a 37.6-acre neighborhood (169 pixels) around each. The result was a map of landscape mosaics at the same spatial resolution of 0.22 acres per pixel. Subsets of forest and grassland, defined by the original land cover map, were extracted to provide resource-specific assessments.

About two-thirds of the total area of the conterminous States exists in a neighborhood characterized as having a seminatural background, with regional percentages ranging from 45 percent to 84 percent (table 2d.1a). More than 90 percent of both grassland (table 2d.1b) and forest (table 2d.1c) appear in a seminatural background. Although the developed and agricultural backgrounds apply to 2.3 and 20.8 percent, respectively, of all land (table 2d.1a), much smaller

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Modern forest inventory uses information from satellite imagery in many innovative ways. The Center for Landscape Pattern Analysis, an informal interagency research consortium, adds value to national land cover maps from satellite imagery by measuring, mapping, and interpreting forest fragmentation and other land cover patterns at regional to global scales. Within the United States, the results are linked to inventory data in a geographic information system to expand the scope of forest sector reporting for the RPA and Montreal Process Assessments. Related products were selected for the U.S. Geological Survey's National Atlas (<http://www.nationalatlas.gov/index.html>), and other results have appeared in a variety of reports, including the Millennium Ecosystem Assessment (<http://www.millenniumassessment.org/en/index.aspx>), the State of the Nation's Ecosystems (<http://www.heinzctr.org/ecosystems/index.shtml>), and the Report on the Environment (<http://www.epa.gov/indicators/>).

Region	Landscape Mosaic				
	All natural (NN) ^a	Natural (N)	Natural-developed (Nd)	Natural-agricultural (Na)	Natural-agricultural-developed (Nad)
(a) grassland only		Percent of all grassland in region			
North	14.1	13.7	15.0	14.3	4.9
Pacific Coast	52.4	18.6	20.0	2.9	0.9
Rocky Mountain	58.9	17.2	10.1	6.5	1.2
South	33.5	21.9	18.0	10.7	3.1
All regions	52.1	18.1	12.5	7.4	1.6
(b) forest only		Percent of all forest land in region			
North	39.2	18.7	14.5	11.2	3.0
Pacific Coast	57.8	19.5	20.7	0.6	0.2
Rocky Mountain	74.3	12.9	8.9	1.5	0.3
South	37.4	22.9	15.1	11.5	3.1
All regions	48.0	19.1	14.2	8.1	2.1

Table 2d.2. Regional and national summary of selected landscape mosaics in landscapes with seminatural background within a 37.6-acre neighborhood surrounding a 0.22-acre parcel of (a) grassland only and (b) forest only. Each row shows the percentages of the total forest or grassland area in a region in each of five landscape mosaic types.

^a Refer to figure 2d.1 for definition of acronyms.

Note: The row sums equal the corresponding table entry in the “seminatural” column in table 2d.1.

percentages of grassland (table 2d.1b: 0.1 percent, 2.3 percent) and forest (table 2d.1c: 0.3 percent, 1.7 percent) appear in developed and agricultural backgrounds. Although the risk of degraded forest and grassland condition may be very high in predominantly agricultural or developed landscapes, the overall percentage of grassland and forest exposed to that risk is relatively small. On the other hand, those same small percentages suggest that the risk of direct loss of grassland and forest is of much more concern in those types of landscapes.

In table 2d.2, the grassland and forest areas in seminatural backgrounds are described in more detail in terms of their landscape mosaic (see caption of fig. 2d.1). Overall, approximately half of all grassland and forest is found in neighborhoods that contain only natural land cover types (mosaic class NN), but substantial variation exists among regions. Typically, 15 to 20 percent of all grassland and forest is found in neighborhoods that contain at least some,

but less than 10 percent of developed and agriculture land cover (N), and an additional 10 to 20 percent is found in neighborhoods that also contain at least 10 percent developed land (Nd). In the North and South regions, 10 to 15 percent of grassland and forest is found in neighborhoods that also contain at least 10 percent agriculture land (Na). These results generally indicate that about half of all grassland and forest is exposed to risk associated with proximity to (in a 37.6-acre neighborhood) at least some developed and agriculture land cover. Potentially, a high risk of degradation of grassland and forest condition exists in seminatural landscapes containing 10 to 40 percent developed land cover, and such landscapes are also likely to shift to developed landscape backgrounds over time as a result of urban sprawl. Approximately 20 percent of all grassland and forest exists in these high-risk landscapes in the North, Pacific Coast, and South regions, and the national percentage is approximately 15 percent.

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