Chapter 2: The National Context

Before looking in detail at the mid–Atlantic region, it is helpful to place the region within a national perspective. This chapter paints a picture of the lower 48 United States, showing differences and patterns among watersheds at a continental scale. A national context helps us interpret the overall condition of the mid–Atlantic region, relative to the rest of the country. It also helps to determine if the conditions like those found in the mid–Atlantic region exist elsewhere.

While it would be desirable to look in great detail over the entire nation, in practice only a few aspects of environmental condition can be described in a consistent fashion nationwide. The coarse–scale maps in this chapter show watershed rankings based on a variety of landscape indicators (Table 2.1). The rankings portray relative conditions across the nation but do not show the absolute values of indicators for each watershed. Indicator values are summarized in the companion bar charts.

Data Sources

Four main data sources were used here. The most important was a national map of land cover (Figure 2.1) which shows areas dominated by urban communities, water, or vegetation such as forest, crops or pasture. Although the resolution (spatial and land cover) is fairly coarse (1 square kilometer units, each assigned to 1 of 9 general land cover classes), the familiar national pattern is apparent — forests in the East, grasslands and crops in the Midwest, and shrublands, deserts, and mountain forests in the West. The mid–Atlantic region is typical of other eastern regions — coastal and riverside urban areas, agricultural valleys and coastal plain, and forested mountains and plateaus. Relative to other regions in the United States, the complexity of land cover in the mid–Atlantic region can make spatial pattern an important factor for environmental decisions.

Three other sources of information were used to calculate landscape indicators nationwide. Figure 2.2 shows the maps of roads, streams, and watersheds. Clearly, not all the roads and streams are included. These maps may be appropriate for a nationwide overview, but much more detailed maps are needed for regional assessments such as the mid–Atlantic analysis. The watershed boundaries identify 2,099 individual watershed units.

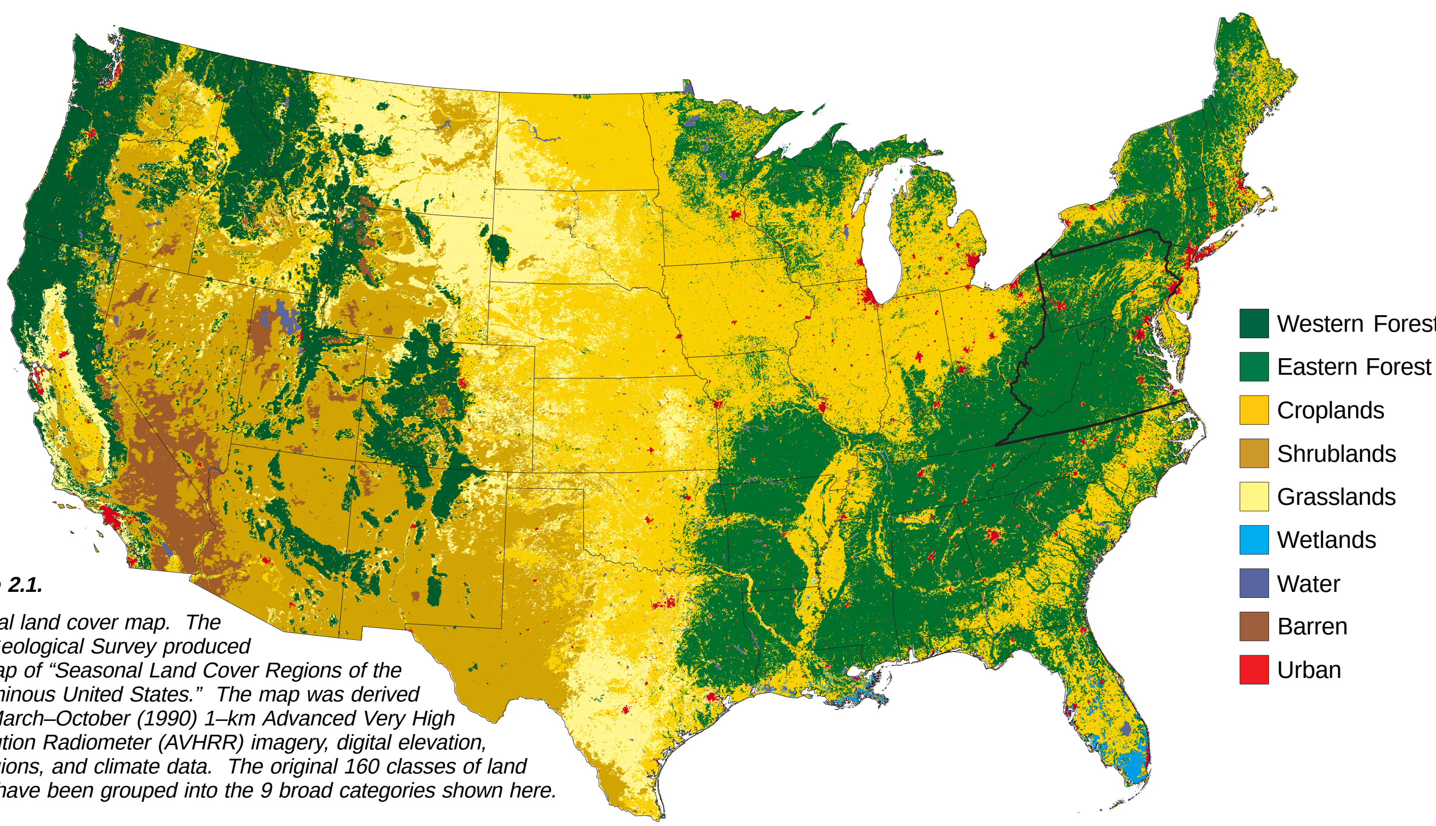


Figure 2.1.

National land cover map. The U.S. Geological Survey produced this map of "Seasonal Land Cover Regions of the Coterminous United States." The map was derived from March–October (1990) 1–km Advanced Very High Resolution Radiometer (AVHRR) imagery, digital elevation, ecoregions, and climate data. The original 160 classes of land cover have been grouped into the 9 broad categories shown here.

For each watershed, the nine indicators included in this chapter were calculated from land cover and from the spatial relationships among roads, streams, and land cover. The maps are color–coded to show relative conditions among watersheds (as described in Chapter 1).

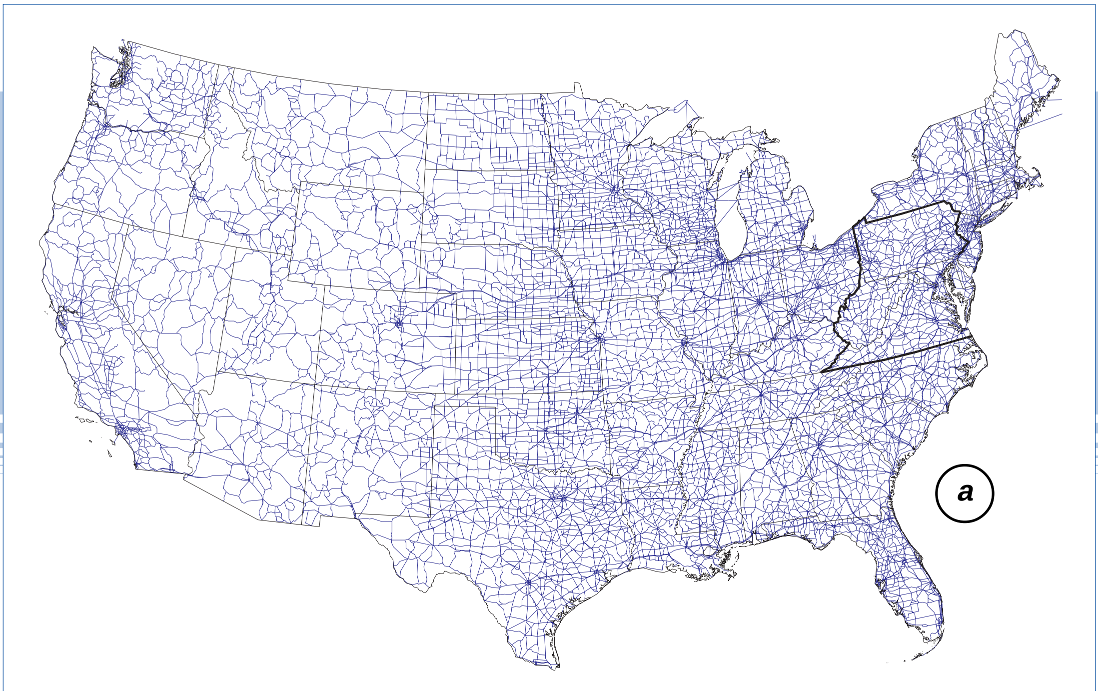
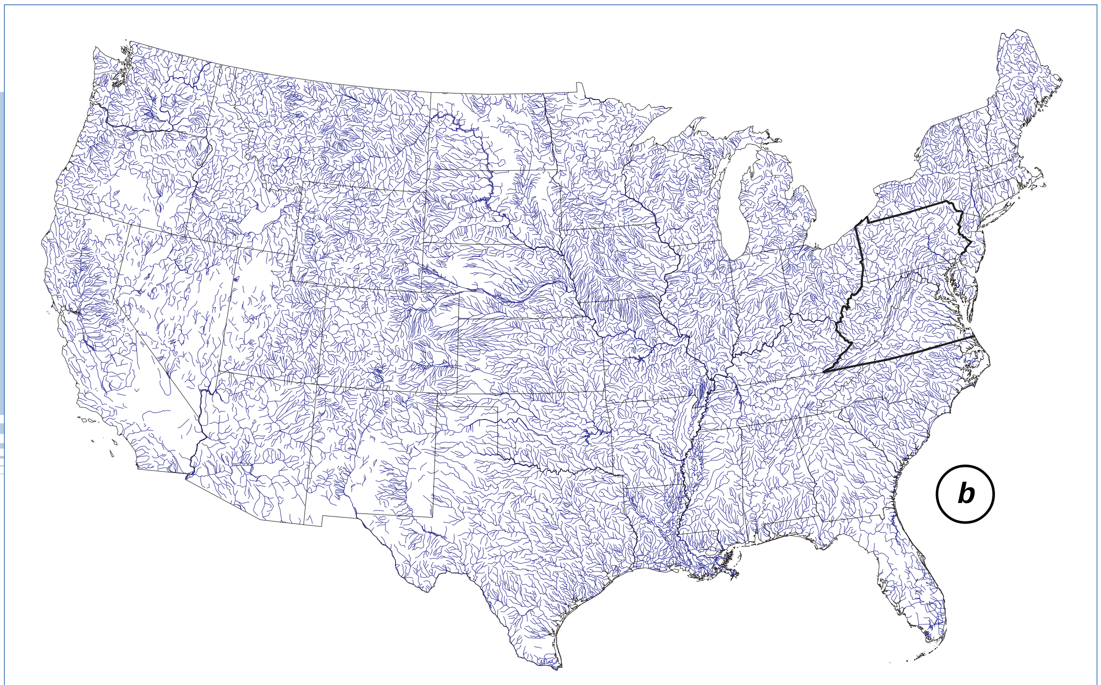


Figure 2.2.

National maps of (a) roads, (b) rivers, and (c) watershed boundaries. The maps are from the ArcUSA distribution of the U.S. Geological Survey Digital Line Graph maps of rivers (1973) and roads (1980), and the U.S. Geological Survey map of 8–digit hydrologic accounting units.

Table 2.1. List of landscape indicators used for the national context.

U–Index (proportion of watershed area with anthropogenic land cover)
Agriculture Index (proportion of watershed area with agriculture land cover)
Number of natural land cover types per unit area
Proportion of watershed that has forest land cover
Average forest patch size as a percentage of watershed area
Index of forest connectivity
Proportion of total stream length with forest land cover
Proportion of total stream length with anthropogenic land cover
Number of roads crossing streams per unit stream length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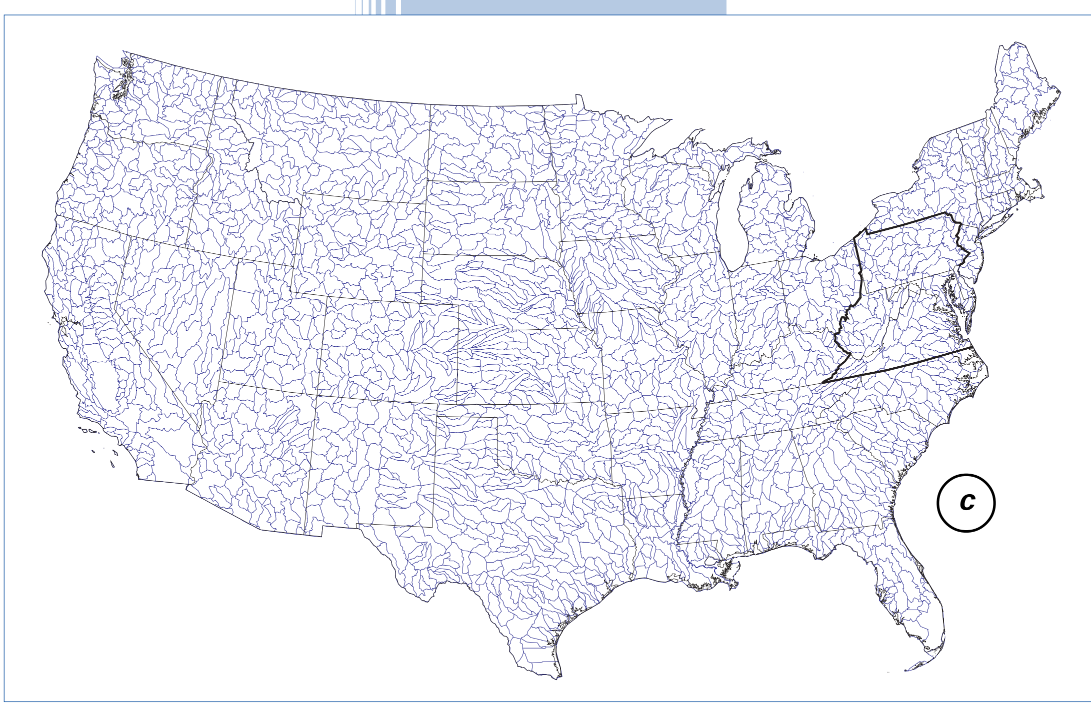
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Human Use Patterns

One of the simplest and most informative indicators of environmental impact is the extent to which humans have changed the natural vegetation to crops or urban land cover. These indicators are easy to interpret because profound land cover changes influence almost every aspect of the environment from wildlife habitat to soil erosion.

The national maps of human use intensity (Figure 2.3) show watershed rankings for both total human use (agriculture plus urban, Figure 2.3a) and agriculture alone (Figure 2.3b). Urban areas are relatively minor in terms of total area, and farming areas are more extensive, so the two maps are very similar. Most of the human land use has occurred in the central United States and along the eastern seaboard. Higher elevations and the dry southwest appear to have been less impacted by conversion to agricultural or urban land cover. Like most of the eastern coast, the mid–Atlantic region has a complicated pattern of land use that deserves more detailed attention.

The chart gives some details about the distribution of human use intensity among watersheds. About 10% (200) of the nation's watersheds have been almost com-

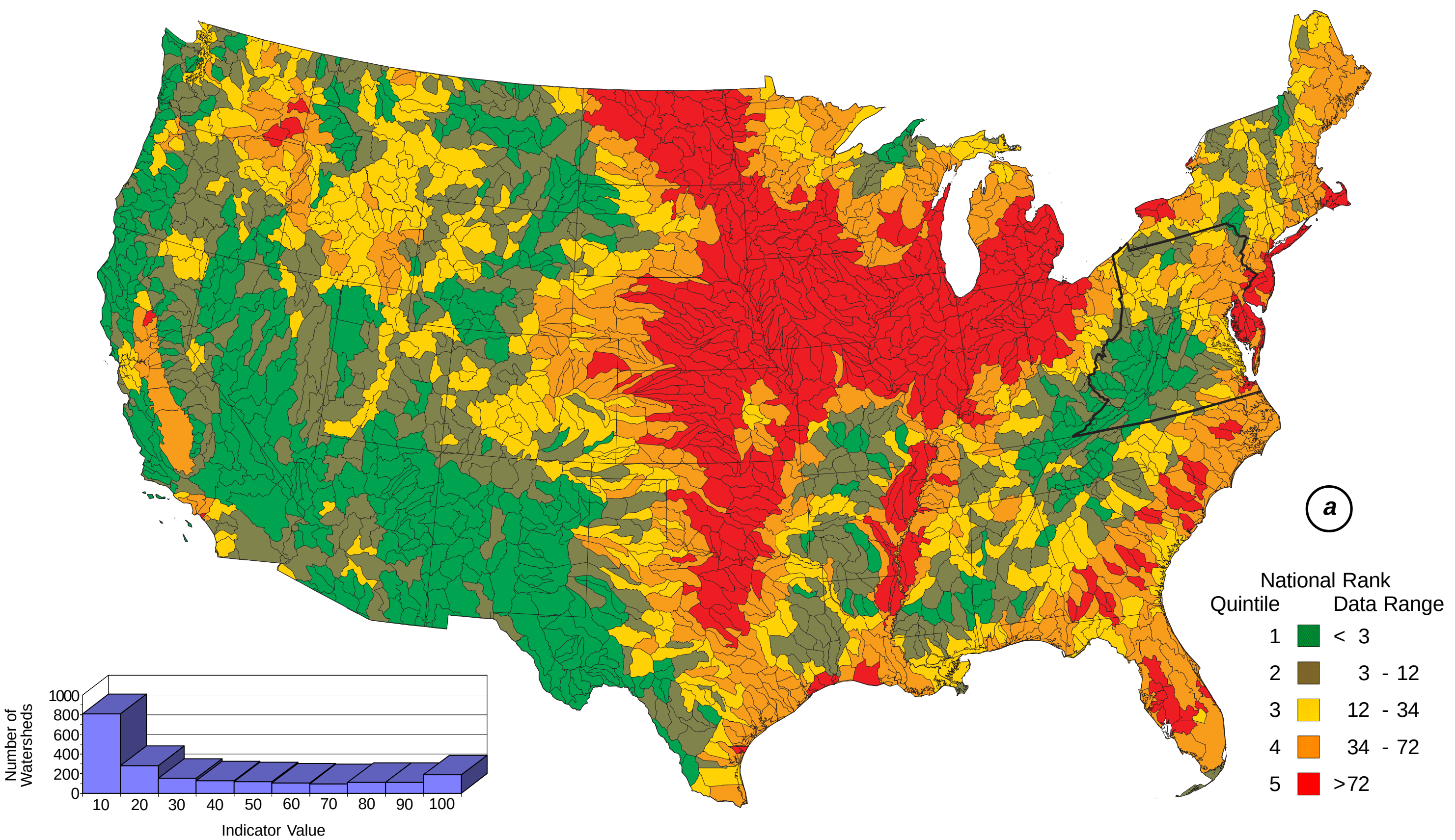
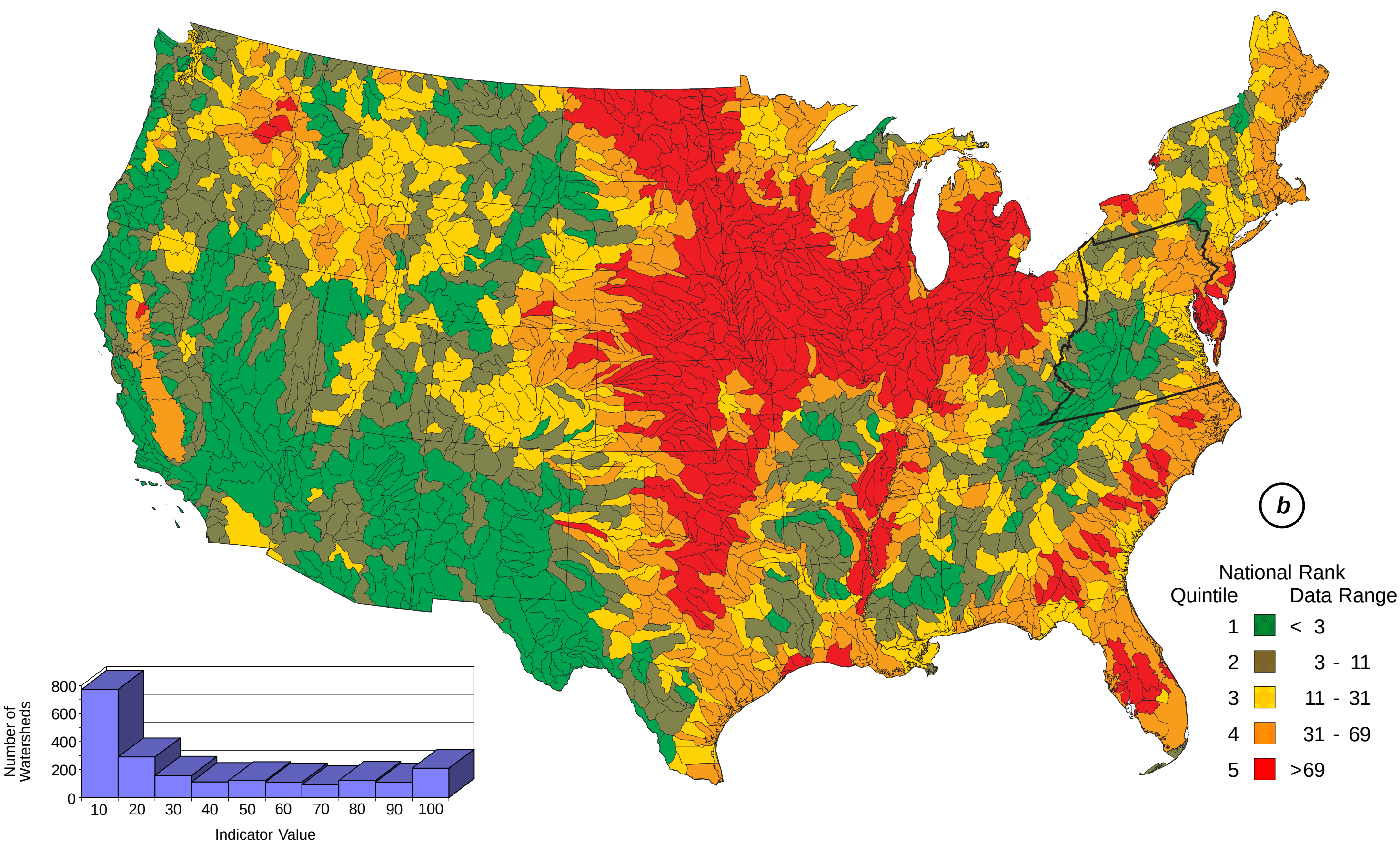


Figure 2.3.

Proportion of watershed area with: (a) agriculture or urban land cover, (b) agriculture land cover.

pletely converted to agricultural land. These are located mostly in the fertile central United States.

About 40% (800) of the watersheds have only small amounts of agriculture. These watersheds are primarily located in arid and mountainous areas. Some human uses of the land are undetectable at this scale. For example grazing, an important agricultural activity in the western United States, does not change the grassland cover type designation at this scale.



The complicated spatial patterns in the mid–Atlantic region are evident in the map of land cover diversity (Figure 2.4). The map shows the watershed ranking for the number of different natural land cover types (anything except urban and agriculture) per unit area. These rankings are based on the original 160–class version of land cover and not the 9–class version shown in Figure 2.1.

The greatest diversity of natural land cover is found in the western United States, where large changes in elevation produce different vegetation types at the top and bottom of the same watershed. But there are also diverse watersheds in coastal areas, including parts of the mid–Atlantic region.

Forest Patterns

Forest patterns are particularly relevant in the eastern United States because forests are the dominant natural vegetation cover. In contrast, natural land cover in the western United States also includes grasslands and shrublands, so forest patterns alone do not describe departures from potential natural vegetation types. We used three different indices of forest pattern in the watersheds: amount of forest, average forest patch size, and forest connectivity. The resulting national rankings of watersheds for these forest indices are shown in Figure 2.5.

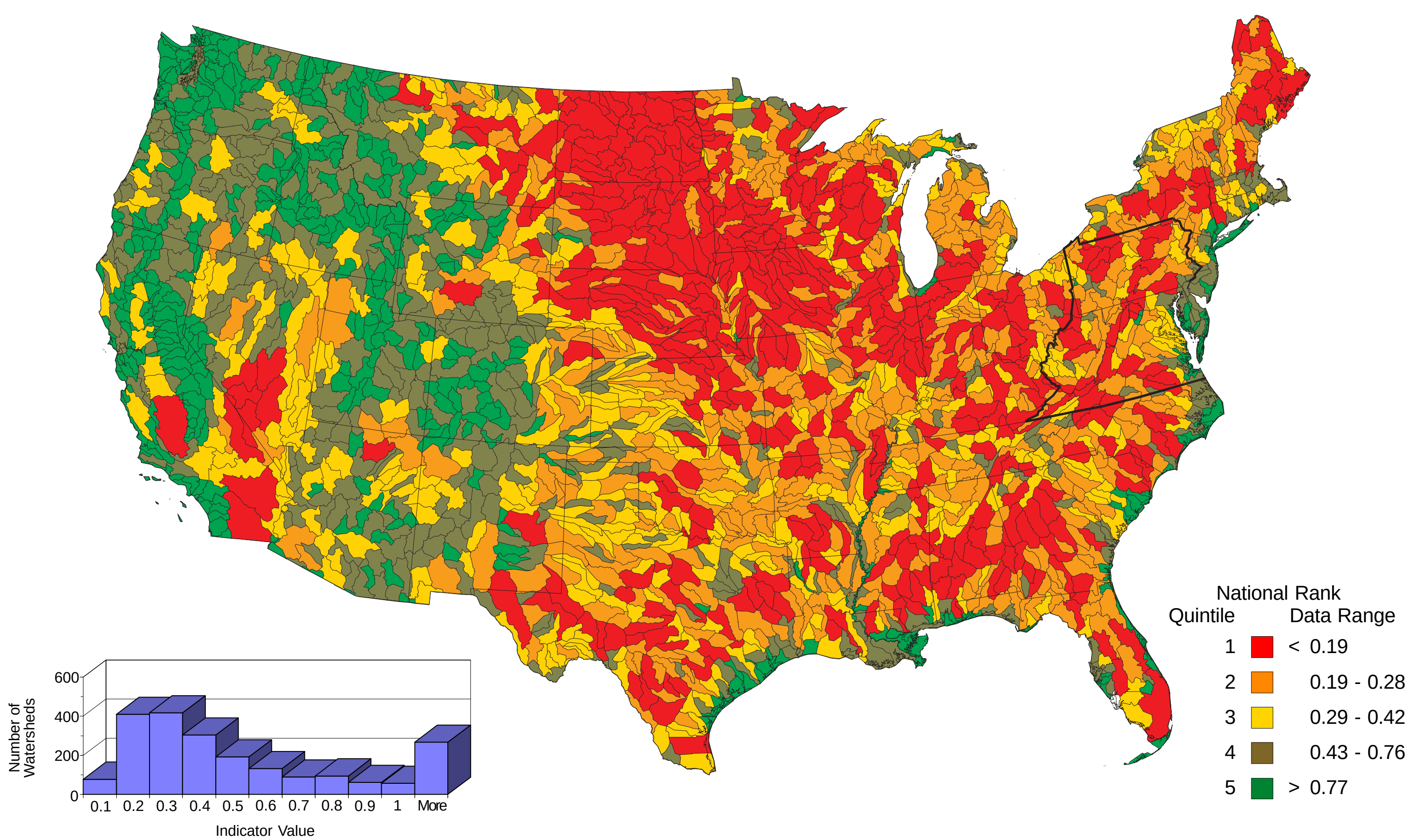


Figure 2.4.

Number of natural land-cover types per 100 square kilometers of watershed area.

The first map (Figure 2.5a) shows the watershed rankings of forest area, expressed as the percentage of total watershed area. Patterns of forest loss are evident along the east coast, and once again the mid–Atlantic region has a complicated pattern that will be interesting to explore in more detail. The chart indicates that about 20% (400) of the nation's watersheds are almost completely forested, and that about 30% have little forest cover. About 100 watersheds have no forests at all when measured at this scale. Forest cover is the most common vegetation type in nearly all of the watersheds east of the Ohio River. Many western watersheds are only forested at higher elevations.

The two other maps are different ways of looking at whether the forests that do occur in a watershed are continuous, or fragmented into smaller patches. Figure 2.5b shows watershed rankings of average forest patch area or size, expressed as a percentage of total watershed area. Figure 2.5c shows watershed rankings of forest connectivity, defined as the probability that a randomly–selected forested spot on the map is adjacent to another forested spot.

All three maps have a similar pattern. Forest cover is usually continuous where most of the watershed is forested. In other cases, such as some watersheds in the southwest, forest cover is a minor component overall, and yet is still continuous where it does occur.

Compared to potential natural cover conditions, forest loss and fragmentation of the remainder is significant in the northeast United States, along the east coast, and in the Mississippi River valley. The patterns in the mid–Atlantic region are typical of those found in other places in the eastern half of the country.

Although the three maps have a similar pattern, the charts illustrate different views obtained by using different indicators. The distribution of watersheds is more or less uniform for the indicator based on percentage of forested area. The charts for the other two indicators suggest that in most watersheds, the average forest patch is a small percentage of total area, but that forest cover tends to be connected in whatever amount actually exists.

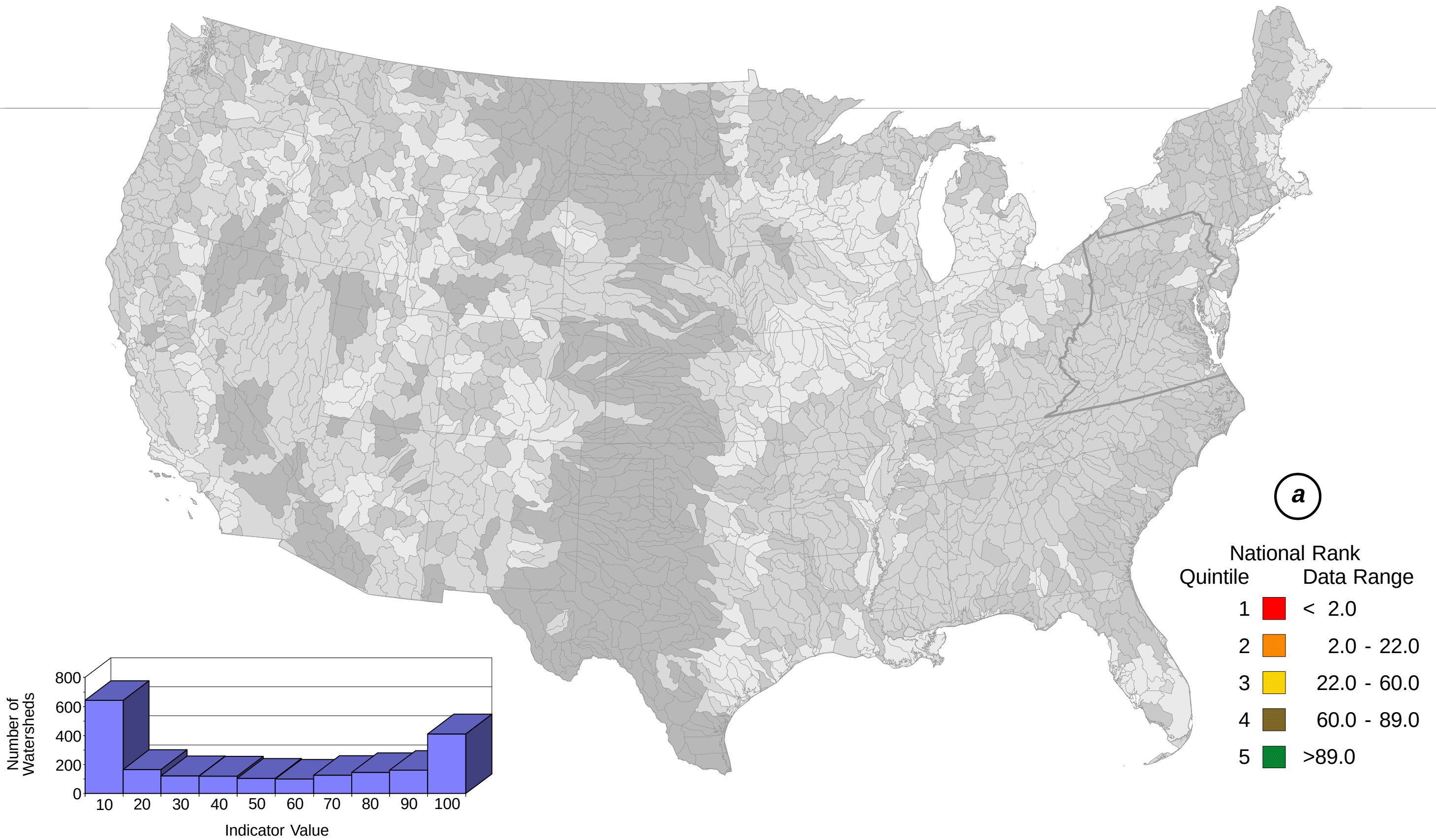
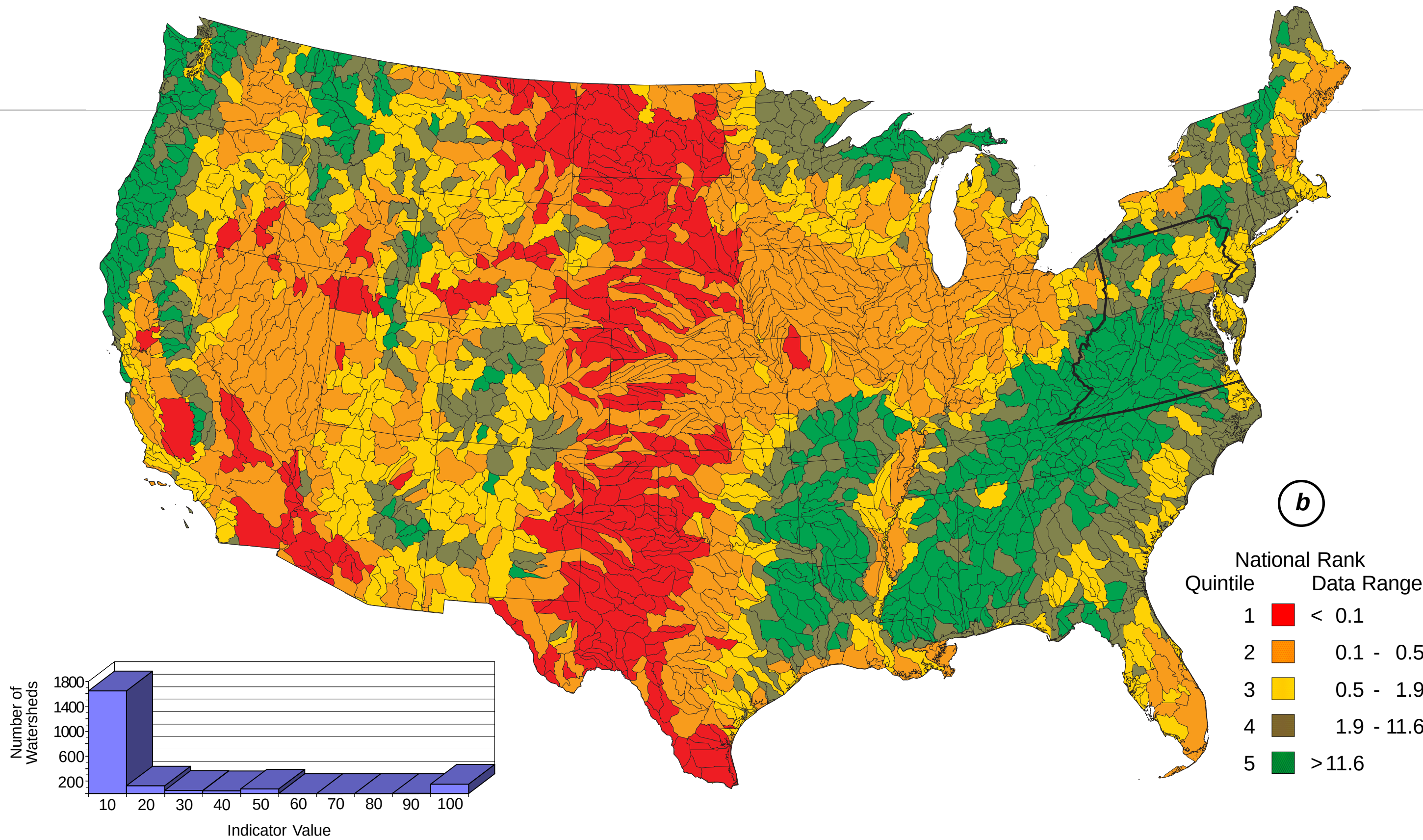


Figure 2.5.

Three forest pattern indicators: (a) percentage of watershed that is forested, (b) average forest patch size as a percentage of total watershed area, and (c) index of forest connectivity.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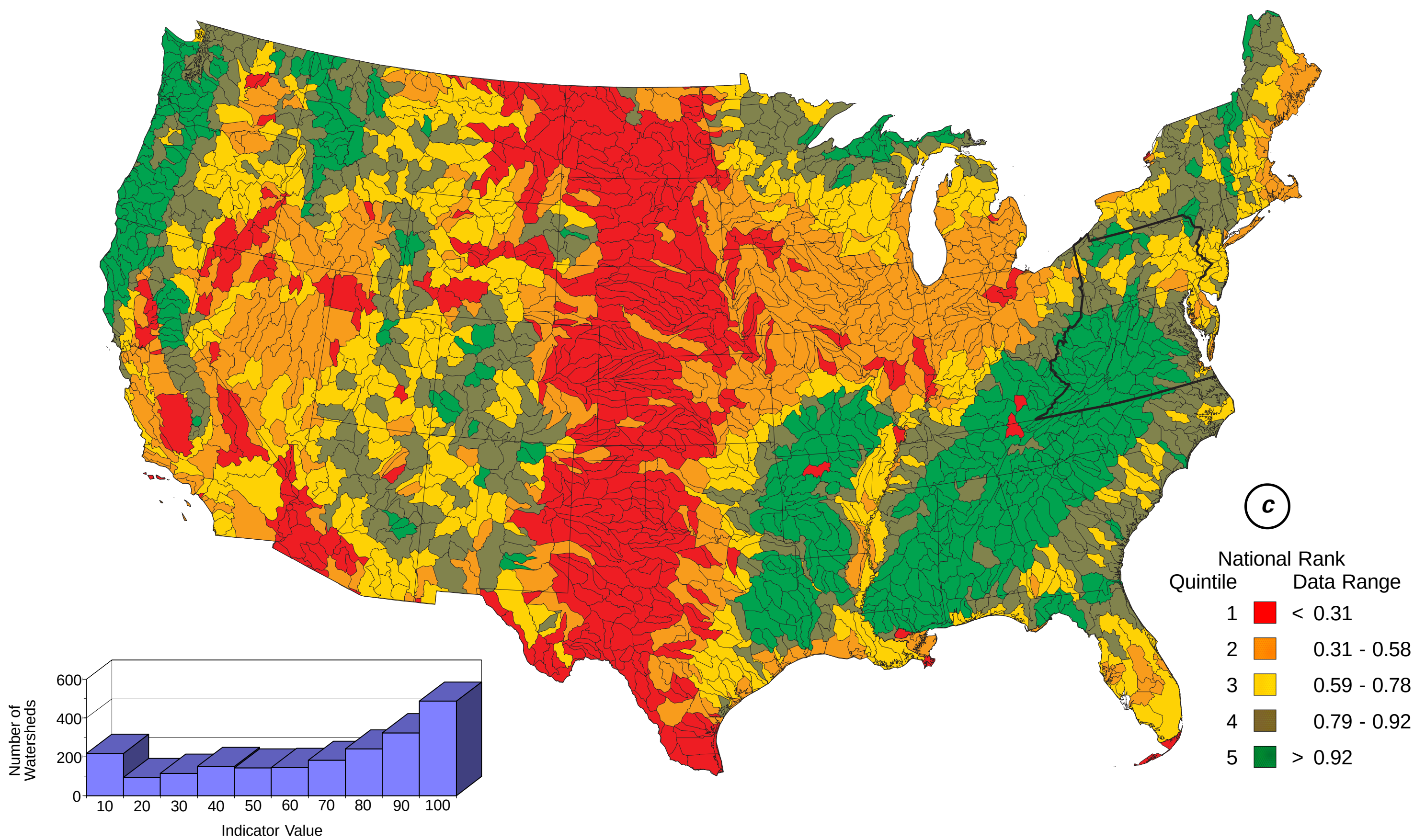
National Rank
Quintile
Data Range
1 < 0.1
2 0.1 - 0.5
3 0.5 - 1.9
4 1.9 - 11.6
5 > 11.6
Number of Watersheds
1800
1400
1000
600
200
10 20 30 40 50 60 70 80 90 100
Indicator Value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National Rank
Quintile
Data Range
1 < 0.31
2 0.31 - 0.58
3 0.59 - 0.78
4 0.79 - 0.92
5 > 0.92
Number of Watersheds
600
400
200
0
10 20 30 40 50 60 70 80 90 100
Indicator Value

Patterns Affecting Water Quality

Water quality and aquatic life are intimately related to land cover near streams. The plant life near streams is referred to as riparian vegetation. It forms an important buffer zone protecting water quality. Natural vegetation absorbs agricultural nutrients, slows the rate of water movement, and is a settling zone for soil particles suspended in runoff. Riparian conditions are often evaluated within a few meters of a stream, but the larger landscape context is also important.

One way to measure environmental conditions is to look at whether streams flow through predominantly forested or developed landscapes within a watershed. If there are no large urban areas or agricultural zones anywhere near streams, then it is less likely that water quality is being affected by these land uses. If forest cover dominates in the vicinity of streams, then there is greater opportunity for forests to buffer the conditions within streams.

Watershed rankings of the proportions of stream length dominated by different land cover types are shown in Figure 2.6. These proportions are based on forest cover (Figure 2.6a) or urban and agriculture cover (Figure 2.6b) within about one–half kilometer of streams in each watershed. In the eastern United States, the rankings for forested riparian zones show a contrast between the highly developed northeast and the more rural southeast. The mid–Atlantic is a transition zone between these regions. Rankings based on the proportion of agriculture

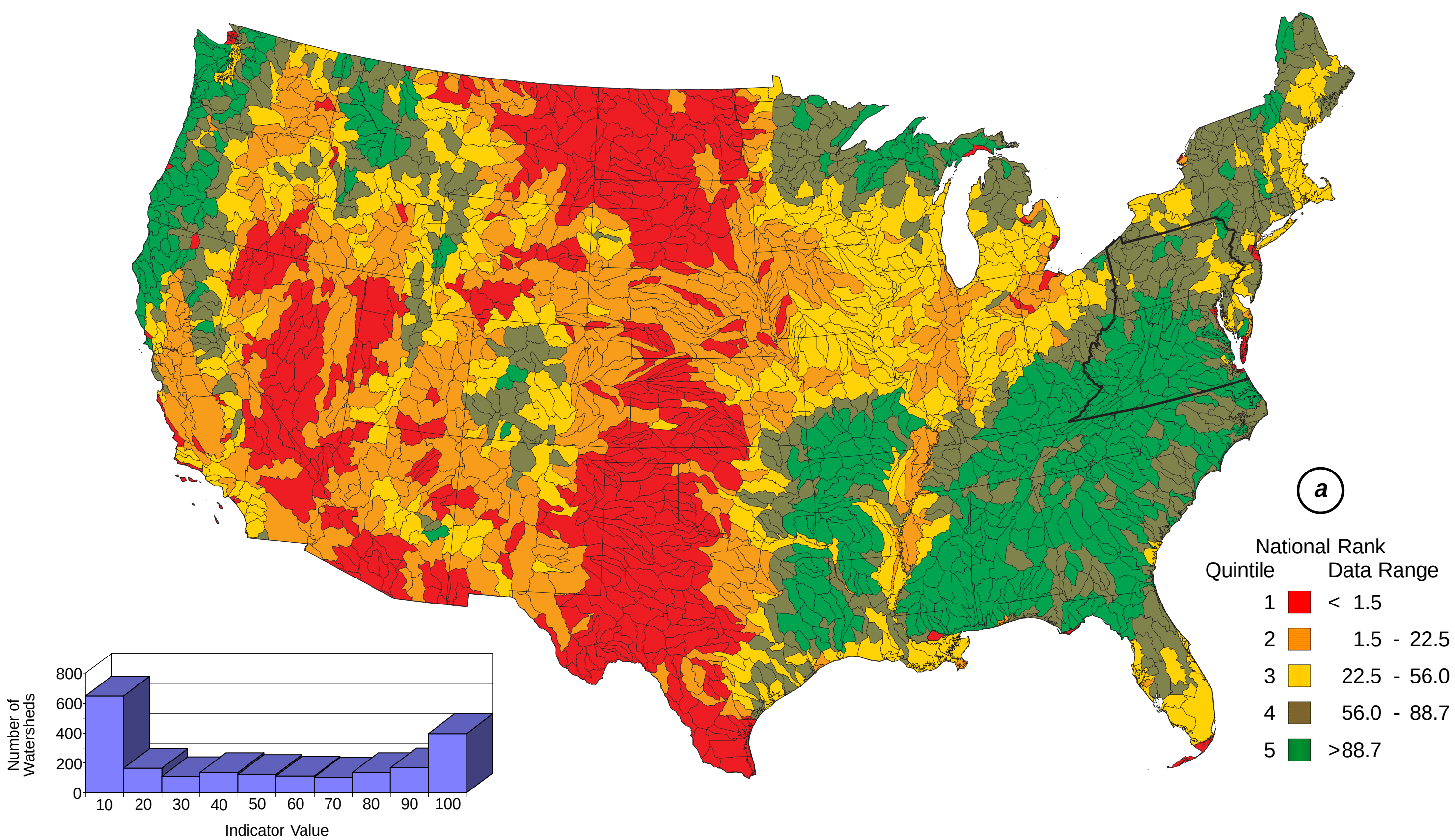


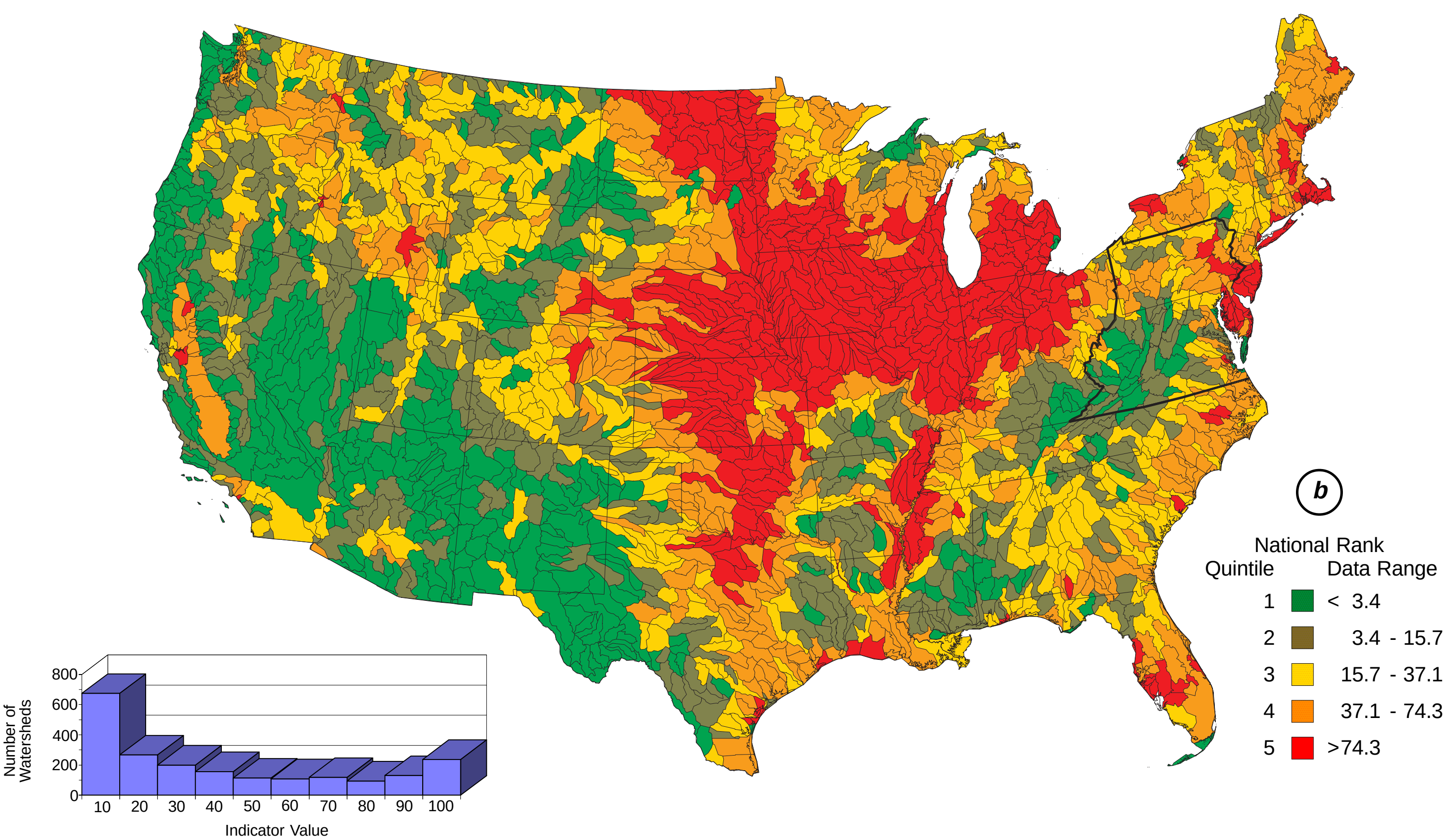
Figure 2.6.

Proportion of total streamlength that is: (a) forested, or (b) agriculture and urban.

or urban land cover in riparian zones show similar patterns in the eastern United States. Many watersheds in the Upper Mississippi River basin have relatively high proportions of urban or agriculture land cover near streams and rivers. The differences are more complicated in the western United States because non–forest vegetation may also be shrublands or grasslands.

Nationwide, the charts indicate that about 40% of the watersheds have riparian landscapes that are at least 70% forested, but an equal number of watersheds have very little forest cover in riparian landscapes. About 10% (200) of the watersheds have riparian landscapes that are nearly all agriculture or urban, and about 30% are almost completely undeveloped.

Spatial variation in land cover near streams and rivers across the nation suggest some potentially large differences in sediment and contaminant loadings to streams and rivers between regions. For example, the Upper Mississippi River basin has relatively more watersheds with agricultural and urban riparian zones, and this may contribute to relatively higher levels of sediment loadings in the streams and rivers. Large forested areas of the Appalachian Mountains have high proportions of forested riparian zones, and relatively little agriculture. Sediment and contaminant loadings to streams in these areas are likely lower than in the Upper Mississippi River basin.



Water quality is also related to larger patterns of land use over entire watersheds. For example, roads near streams affect water quality not only as direct pollution sources, but also because they represent paths for rapid runoff. The frequency of roads crossing rivers was expressed here as the number of road crossings per unit river length in each watershed. This expression helps to adjust for differences in the total length of rivers between watersheds.

The map of watershed rankings for this indicator (Figure 2.7) is complicated, and it does not closely resemble the national patterns found earlier when looking at land cover. The mid–Atlantic region, like most of the northeast and upper midwest, has extensive road networks. The mountainous areas of the mid–Atlantic have more crossings than would be expected based on land cover alone; this is so because most roads in the mountains follow river valleys and can cross the same river many times.

National Context Summary

Several important features of the mid–Atlantic region can be identified by placing it into a national context. The mid–Atlantic region certainly has complicated spatial patterns of land cover, and the finer–scale analyses shown later in this atlas seem warranted. In fact, the mid–Atlantic region should be an excellent case study area because of the variety of conditions that it contains.

Some patterns in the mid–Atlantic region are typical of other areas along the eastern seacoast. This means that what is learned in the mid–Atlantic may be applicable in other regions. Because the mid–Atlantic is also a transition zone between regions of more or less impact to the north and south, further studies here may also be relevant to environmental monitoring in these other areas.

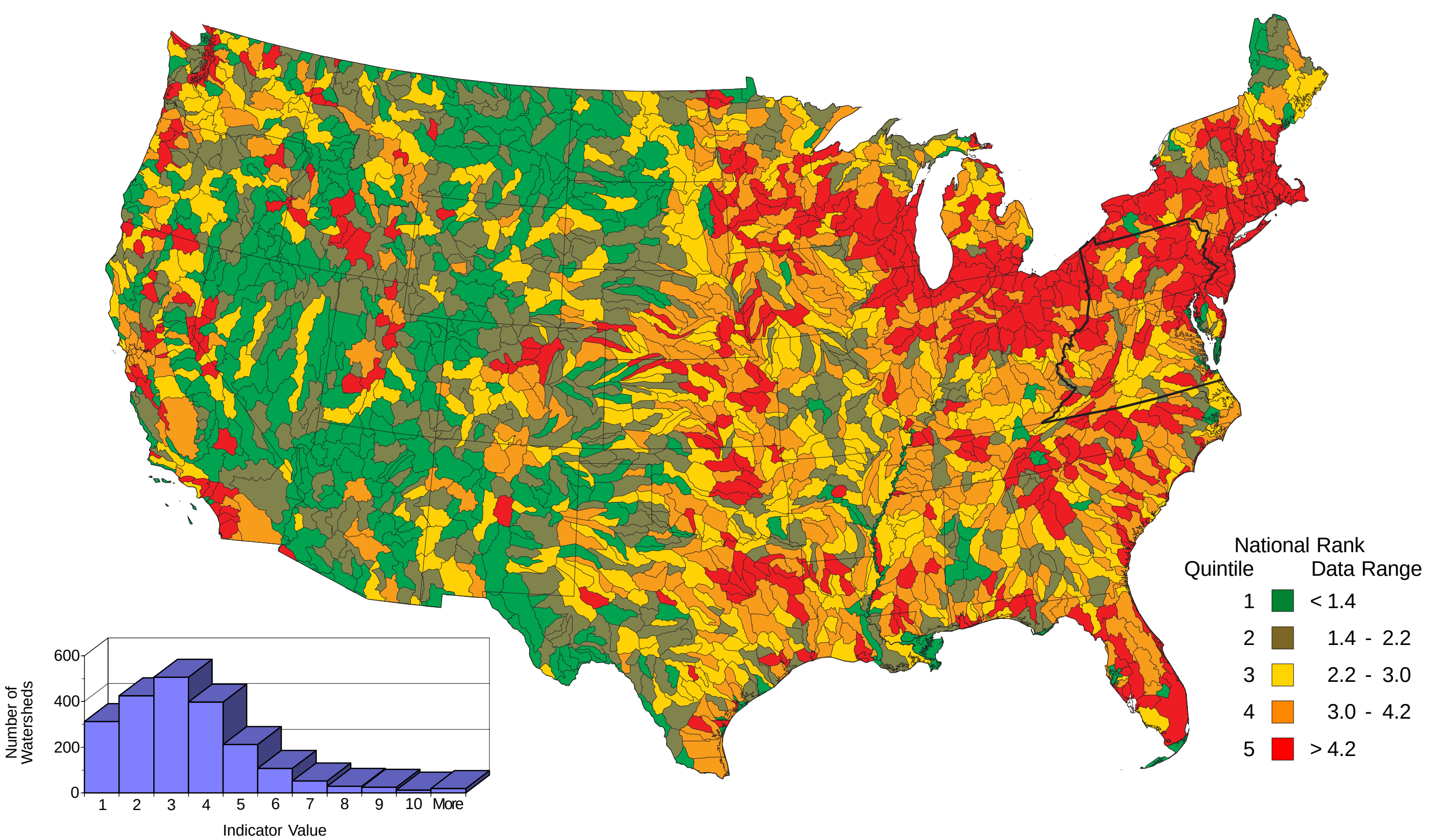


Figure 2.7.

Number of road–stream crossings per 100 kilometers of streams.

The mid–Atlantic is probably not the most highly impacted region in the eastern United States, but it is different from the less impacted areas that are found at higher elevations in the south and west. The complexity of patterns in the region creates an opportunity to consider a full range of environmental strategies from restoration of the more developed areas to protection aimed at particular resources such as high–elevation forests or wetlands. This brief look at the mid–Atlantic region in a national context has confirmed that many broad–scale aspects of environmental quality can be explored here.