



Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Nutrient Enrichment Effects from Atmospheric Nitrogen Deposition

Southern Plains Network (SOPN)

Natural Resource Report NPS/NRPC/ARD/NRR—2011/331



ON THE COVER

Some ecosystems, such as arid shrublands, subalpine meadows, remote high elevation lakes, and wetlands, are sensitive to the effects of nutrient enrichment from atmospheric nitrogen deposition.

Photograph by: National Park Service

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February 2011

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Denver, Colorado

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This report received peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Please cite this publication as:

Sullivan, T. J., T. C. McDonnell, G. T. McPherson, S. D. Mackey, and D. Moore. 2011. Evaluation of the sensitivity of inventory and monitoring national parks to nutrient enrichment effects from atmospheric nitrogen deposition: Southern Colorado Plateau Network (SCPN). Natural Resource Report NPS/NRPC/ARD/NRR—2011/331. National Park Service, Denver, Colorado.

Southern Plains Network (SOPN)

National maps of atmospheric N emissions and deposition are provided in Maps A and B as context for subsequent network data presentations. Map A shows county level emissions of total N for the year 2002. Map B shows total N deposition, again for the year 2002.

There are ten parks in the Southern Plains Network. None are larger than 100 square miles. The network includes a number of large urban centers to the southeast and less developed land to the northwest.

Total annual N emissions, by county, are shown in Map C for lands in and surrounding the Southern Plains Network. County-level emissions within the network ranged from less than 1 ton per square mile to more than 20 tons per square mile. In general, annual county N emissions were in the range of 1 to 20 tons per square mile throughout much of the network, with substantial areas being lower than that and some scattered areas being higher than that. Point source emissions of oxidized (nitrogen oxides, NO_x) and reduced (ammonia, NH_3) N are shown in Map D. There are very many point sources of both oxidized and reduced N throughout this network. Most are relatively small (less than a few hundred tons per year). Sources of reduced N are concentrated primarily in Kansas. Urban centers within the network and within a 300 mile buffer around the network are shown in Map E. There are several large human population centers in and near the network. The largest include Dallas, San Antonio (just outside the network boundary), and Oklahoma City.

Total N deposition in and around the network is shown in Map F. Included in this analysis are both wet and dry forms of N deposition and both the oxidized and reduced N species. Total N deposition within the network ranged from less than 5 kg N/ha/yr to as high as 10 to 15 kg N/ha/yr. Total N deposition within this network generally increases from west to east.

Land cover in and around the network is shown in Map G. The predominant cover types within this network are highly mixed, and include row crops, grassland/herbaceous, shrubland, pasture/hay, forest, and developed areas.

Map H, showing the distribution within the parks that occur in this network of the five vegetation types thought to be most responsive to nutrient N enrichment effects (arctic, alpine, grassland and meadow, wetland, and arid and semi-arid), is not shown. Although there are many I&M parks within this network, none are large. Sensitive vegetation types within the parks would not be visible at the network scale.

Park lands requiring special protection against potential adverse impacts associated with nutrient N enrichment from atmospheric N deposition are shown in Map I. Also shown on Map I are all federal lands designated as wilderness, both lands managed by NPS and also lands managed by other federal agencies. The land designations used to identify this heightened protection included Class I designation under the CAAA and wilderness designation. There are no NPS Class I or wilderness areas in this network, however, and there are few wilderness areas outside NPS jurisdiction.

Network rankings are given in Figures A through C as the average ranking of the Pollutant Exposure, Ecosystem Sensitivity, and Park Protection metrics, respectively. Figure D shows the overall network Summary Risk ranking. In each figure, the rank for this particular network is highlighted to show its relative position compared with the ranks of the other 31 networks.

The Southern Plains Network ranks near the median, in the third quintile, among networks, in N pollutant Exposure (Figure A). Nitrogen emissions and N deposition within the network are both moderate. The network Ecosystem Sensitivity ranking is also moderate, again near the median within the third quintile among networks (Figure B). This is because there is limited vegetation in the I&M parks that occur in this network that include vegetation types expected to be especially sensitive to nutrient enrichment effects from N deposition, and there are no high elevation lakes. This network ranks in the lowest quintile in Park Protection, having very little protected land (Figure C).

In combination, the network rankings for Pollutant Exposure, Ecosystem Sensitivity, and Park Protection yield an overall Network Risk ranking that is the lowest quintile among all networks (Figure D). The overall level of concern for nutrient N enrichment effects on I&M parks within this network is considered Very Low.

Because there are no I&M parks in this network that are larger than 100 square miles, figures are not shown to compare parks in this network with the larger parks throughout the NPS system. Relative ranks for all parks, including the smaller parks, are given in Table A and Appendix B.

Pollutant exposure is ranked High, in the second highest quintile among parks, for one park in this network: Chickasaw (CHIC). Other parks are ranked in the lowest (two parks) to middle (five parks) quintile for this theme. Ecosystem Sensitivity is ranked in the highest quintile for three parks: Fort Union (FOUN), Pecos (PECO), and Washita Battlefield (WABA), and in the second highest quintile for Bent's Old Fort (BEOL) and Fort Larned (FOLS), but in the middle (four parks) to second lowest (one park) quintile in the other parks. All parks in this network are ranked in the middle quintile for Park Protection.

The Summary Risk ranking placed WABA in the second highest quintile. None of the other parks in this network were ranked higher than the middle quintile for nutrient N enrichment Summary Risk.

Table A. Relative rankings of individual I&M parks within the network for Pollutant Exposure, Ecosystem Sensitivity, Park Protection, and Summary Risk from atmospheric nutrient N enrichment.

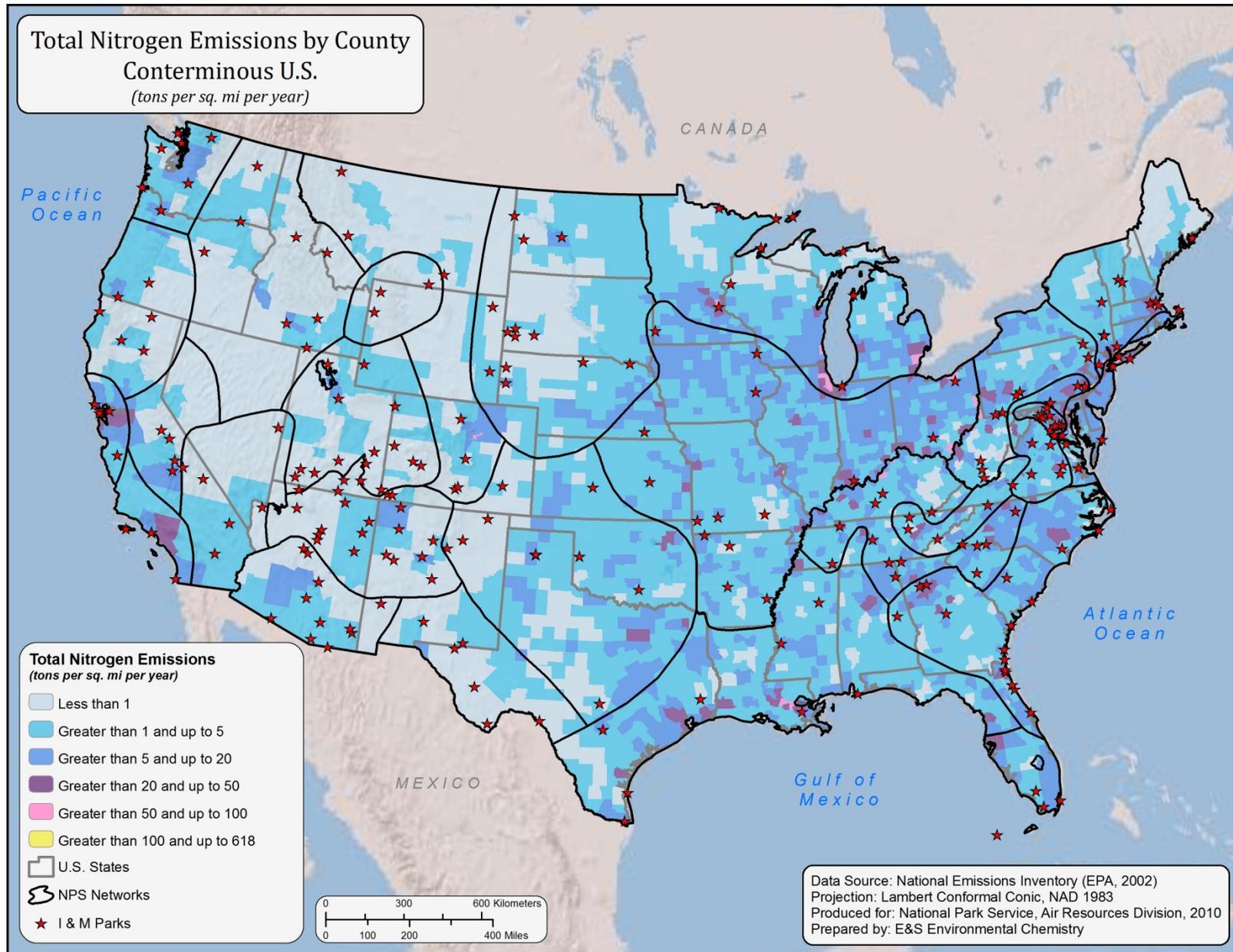
I&M Parks² in Network	Relative Ranking of Individual Parks¹			
	Pollutant Exposure	Ecosystem Sensitivity	Park Protection	Summary Risk
Alibates Flint Quarries	Moderate	Moderate	Moderate	Moderate
Bent's Old Fort	Low	High	Moderate	Low
Capulin Volcano	Very Low	Moderate	Moderate	Very Low
Chickasaw	High	Low	Moderate	Low
Fort Larned	Moderate	High	Moderate	Moderate
Fort Union	Very Low	Very High	Moderate	Very Low
Lake Meredith	Moderate	Moderate	Moderate	Moderate
Lyndon B. Johnson	Moderate	Moderate	Moderate	Moderate
Pecos	Low	Very High	Moderate	Low
Washita Battlefield	Moderate	Very High	Moderate	High

¹ Relative park rankings are designated according to quintile ranking, among all I&M Parks, from the lowest quintile (very low risk) to the highest quintile (very high risk).
² Park name is printed in bold italic for parks larger than 100 square miles.

- Map A. National map of total N emissions by county for the year 2002. Both oxidized (nitrogen oxides, NO_x) and reduced (ammonia, NH₃) forms of N are included. The total is expressed in tons per square mile per year. (Source of data: EPA National Emissions Inventory, <http://www.epa.gov/ttn/chief/net/2002inventory.html>)
- Map B. Total N deposition for the conterminous United States for the year 2002, expressed in units of kilograms of N deposited from the atmosphere to the earth surface per hectare per year. Wet and dry forms of both oxidized (nitrogen oxides, NO_x) and reduced (ammonia, NH₃) N are included. For the eastern half of the country, wet deposition values were derived from interpolated measured values from NADP (three-year average centered on 2002) and dry deposition values were derived from 12-km CMAQ model projections for 2002. For the western half of the country, both wet and dry deposition values were derived from 36-km CMAQ model projections for 2002. NADP interpolations were performed using the approach of Grimm and Lynch (1997). CMAQ model projections were provided by Robin Dennis, U.S. EPA.
- Map C. Total N emissions by county for lands surrounding the network, expressed as tons of N emitted into the atmosphere per square mile per year. The total includes both oxidized (nitrogen oxides, NO_x) and reduced (ammonia, NH₃) N. (Source of data: EPA National Emissions Inventory, <http://www.epa.gov/ttn/chief/net/2002inventory.html>)

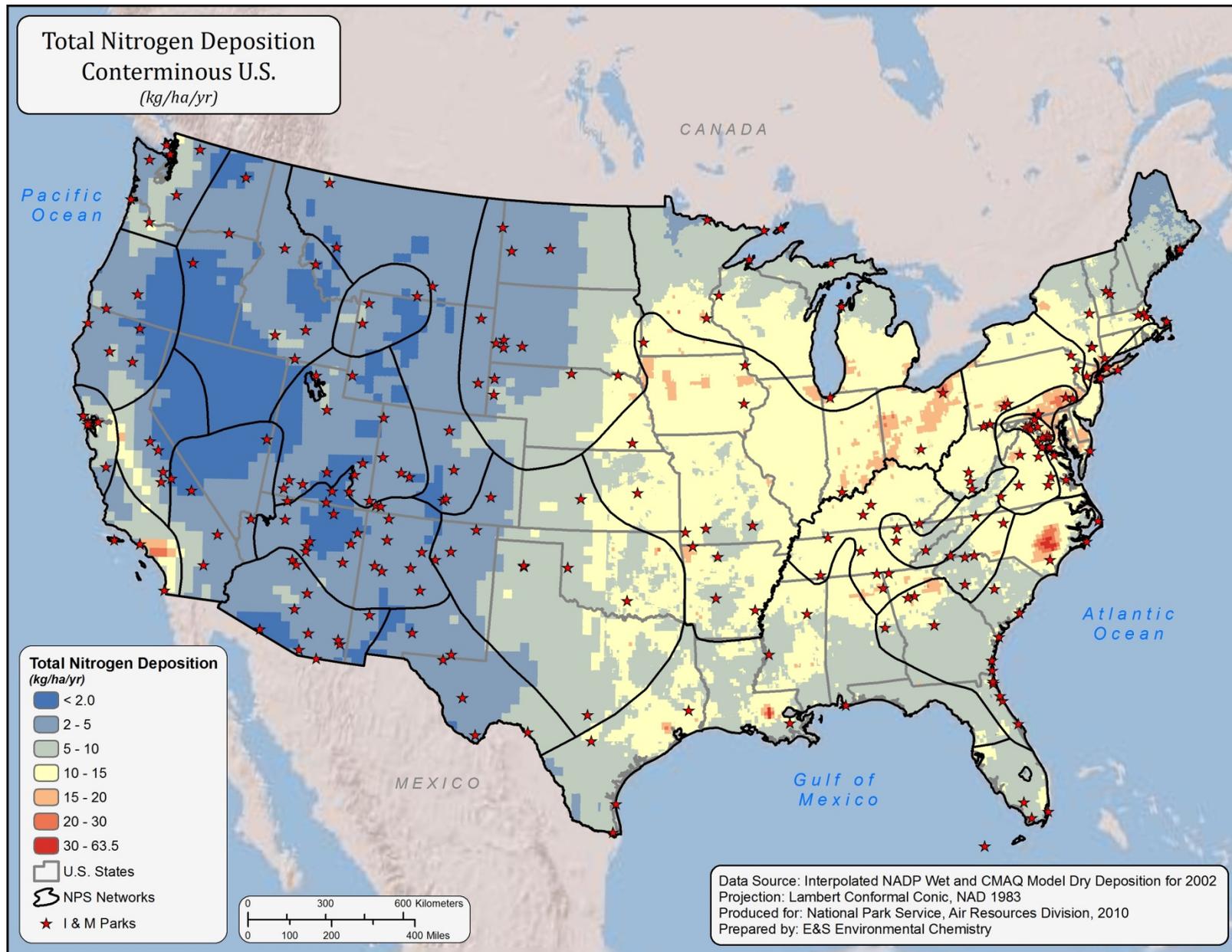
- Map D. Major point source emissions of oxidized (nitrogen oxides, NO_x) and reduced (ammonia, NH₃) N in and around the network. The base of each vertical bar is positioned in the map at the approximate location of the source. The height of the bar is proportional to the magnitude of the source. (Source of data: EPA National Emissions Inventory, <http://www.epa.gov/ttn/chief/net/2002inventory.html>)
- Map E. Urban centers having more than 10,000 people within the network and within a 300-mile buffer around the perimeter of the network. (Source of data: U.S. Census 2000)
- Map F. Total N deposition in and around the network. Included in the total are wet plus dry forms of both oxidized (nitrogen oxides, NO_x) and reduced (ammonia, NH₃) N. Values are expressed as kilograms of N deposited per hectare per year. (Source of data: Interpolated NADP wet and CMAQ Model dry deposition data for 2002; see information for Map B above for details)
- Map G. Land cover types in and around the network, based on the National Land Cover dataset. (Source of data: National Land Cover Dataset, http://www.mrlc.gov/nlcd_multizone_map.php)
- Map I. Lands within the network that are classified as Class I or wilderness area. (Source of data: USGS 2005 [National Atlas; <http://nationalatlas.gov>] and NPS)
- Figure A. Network rankings for Pollutant Exposure, calculated as the average of scores for all Pollutant Exposure variables.
- Figure B. Network rankings for Ecosystem Sensitivity, calculated as the average of scores for all Ecosystem Sensitivity variables.
- Figure C. Network rankings for Park Protection, calculated as the average of scores for all Park Protection variables.
- Figure D. Network Summary Risk ranking, calculated as the sum of the averages of the scores for Pollutant Exposure, Ecosystem Sensitivity, and Park Protection.

SOPN-5

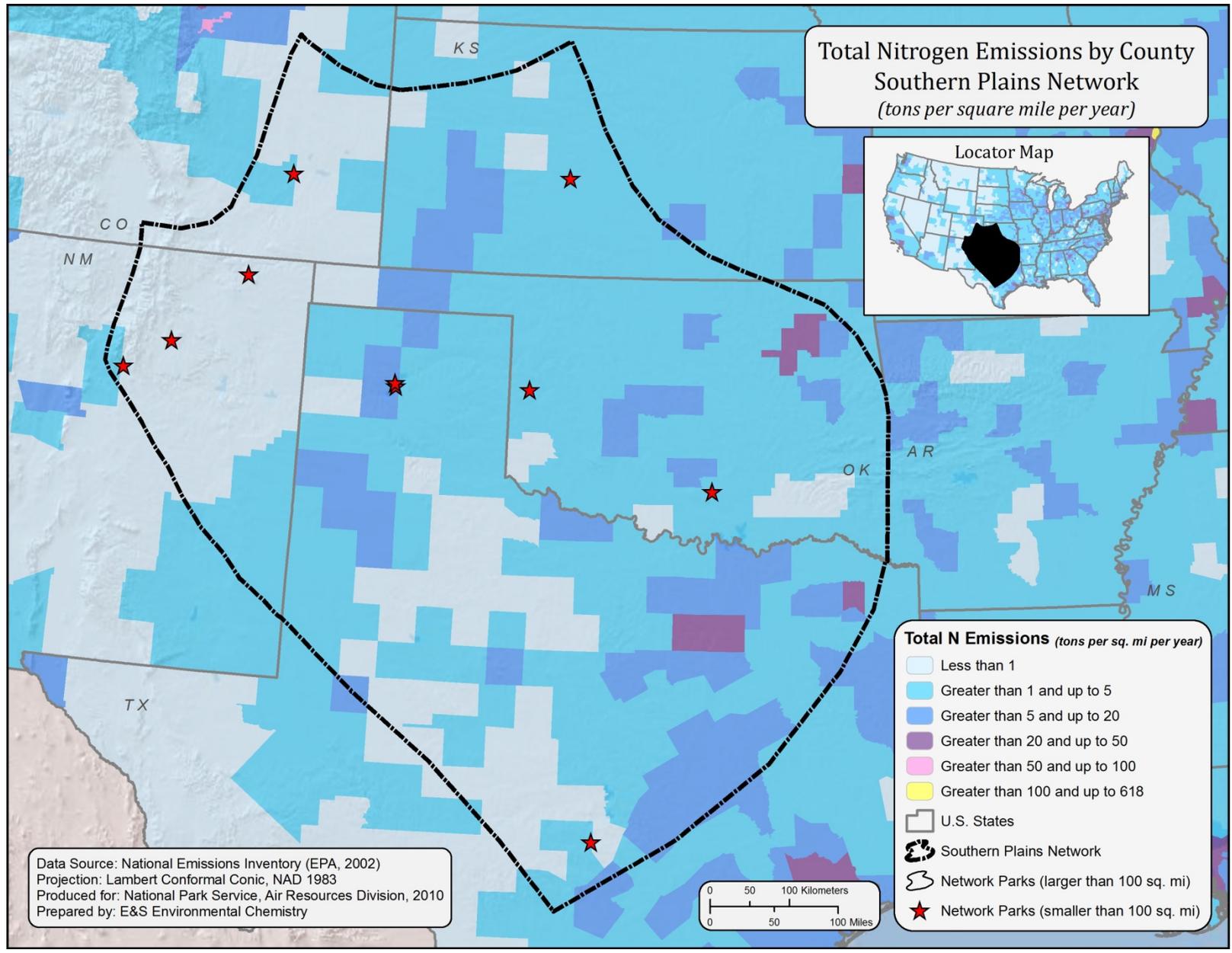


Map A

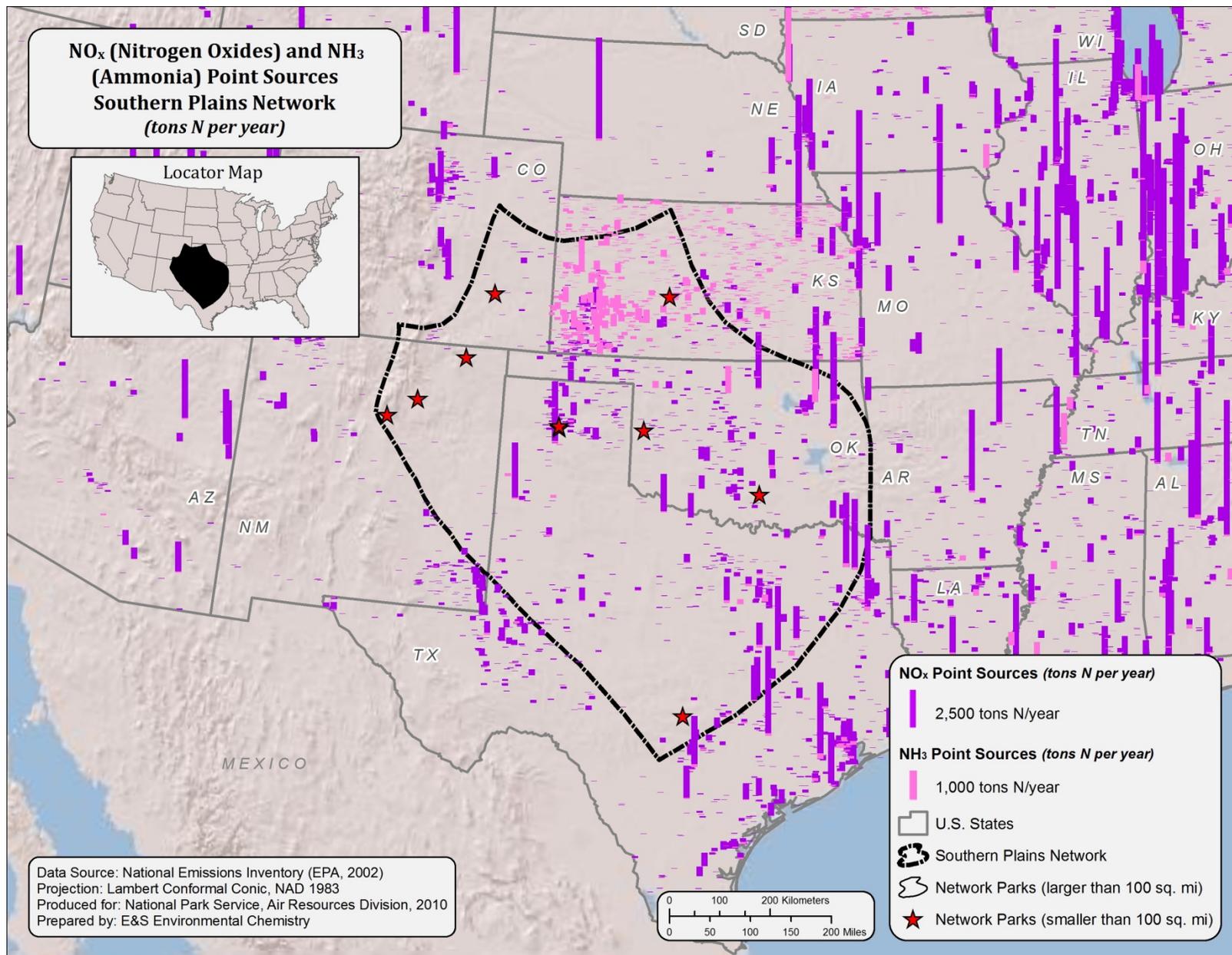
SOPN-6



Map B

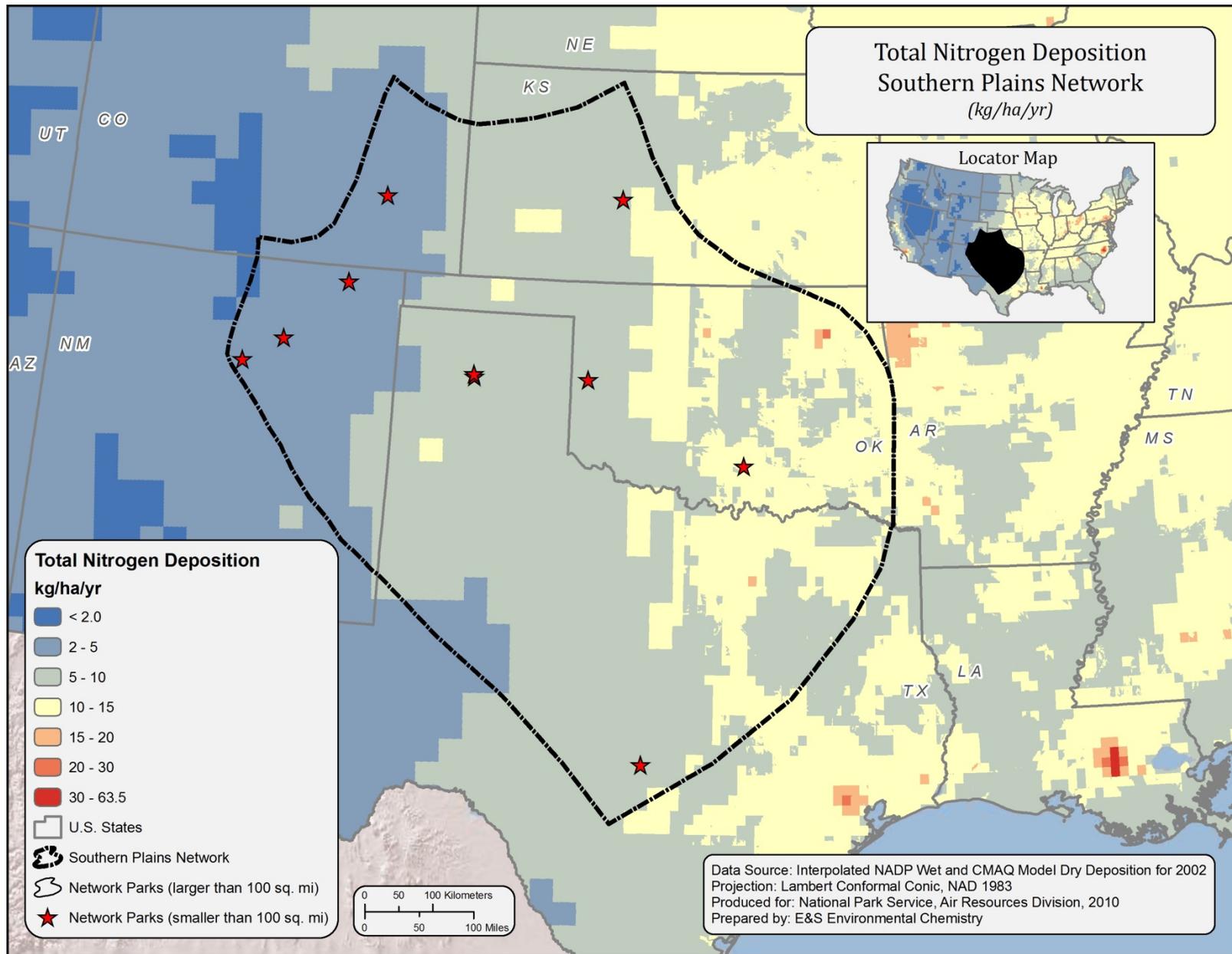


Map C

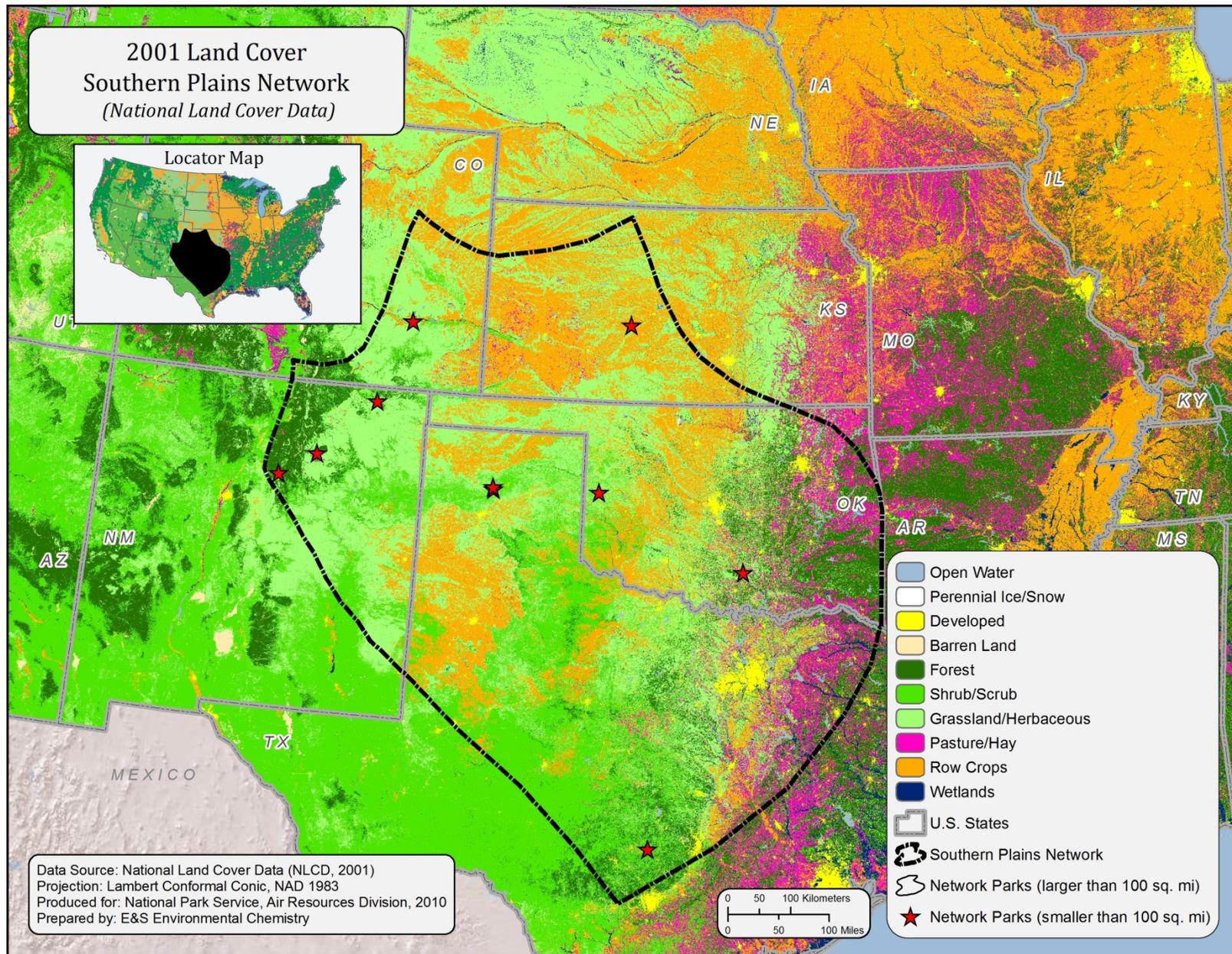


Map D

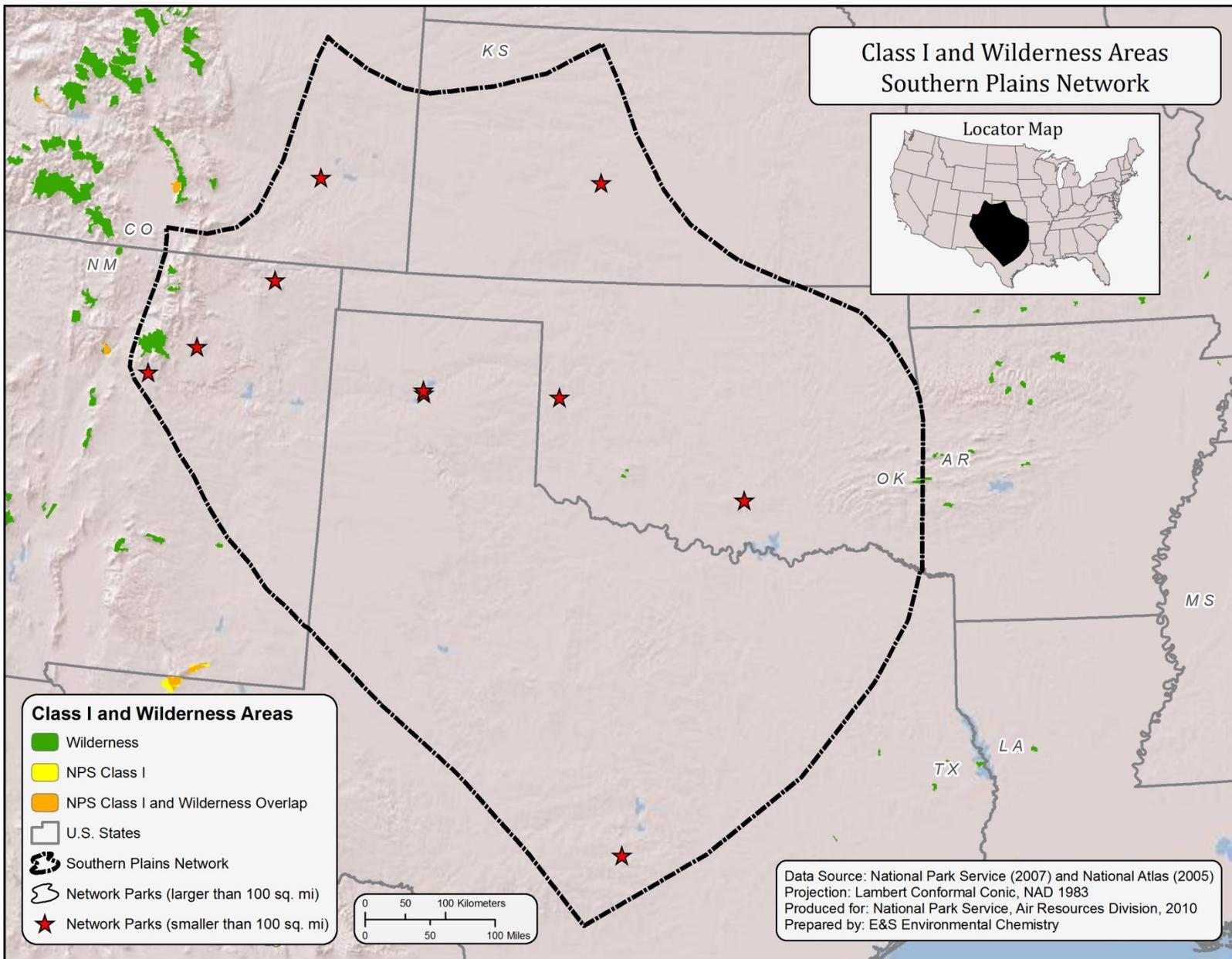
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Map F



Map G



Map I

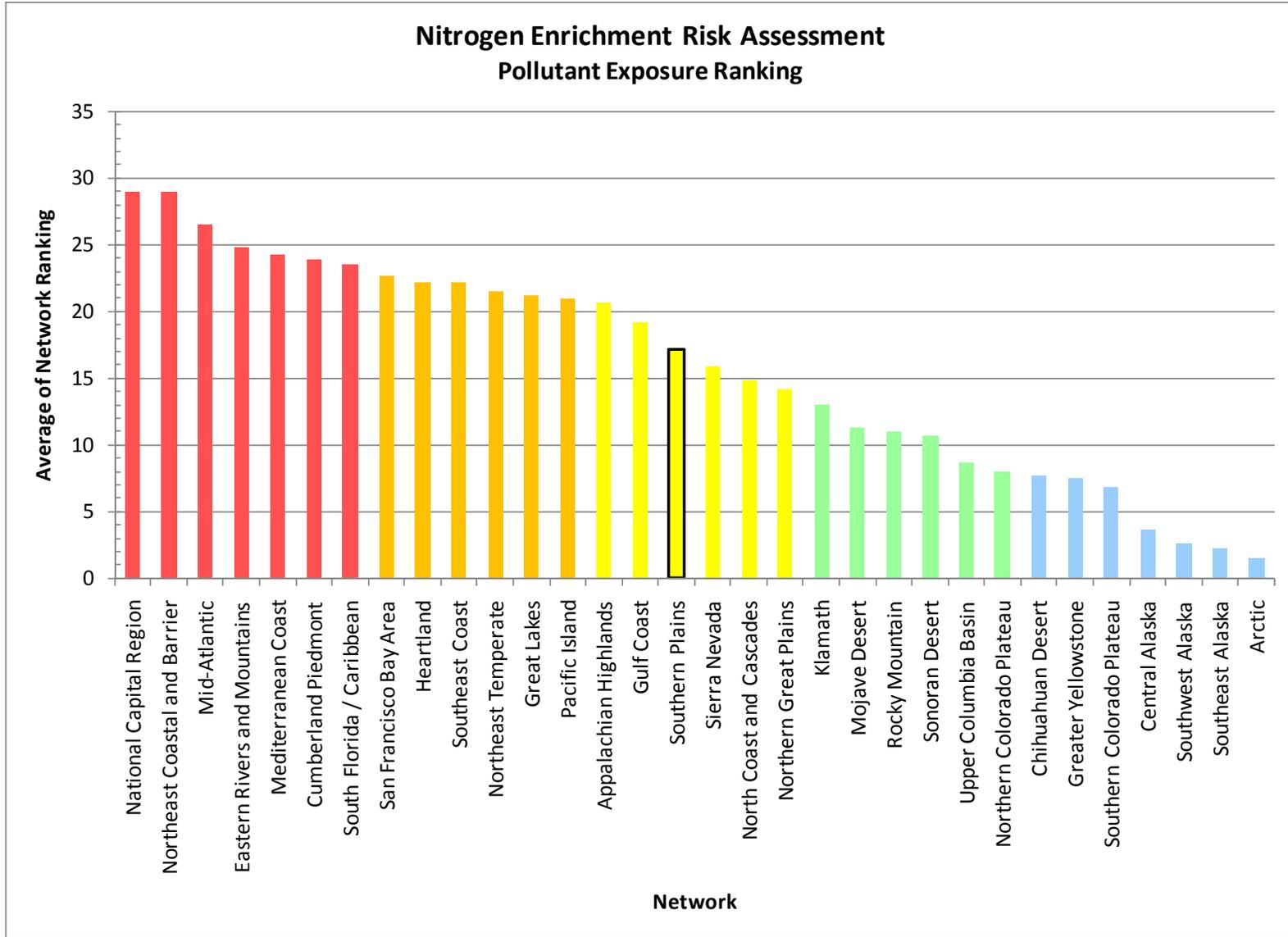


Figure A

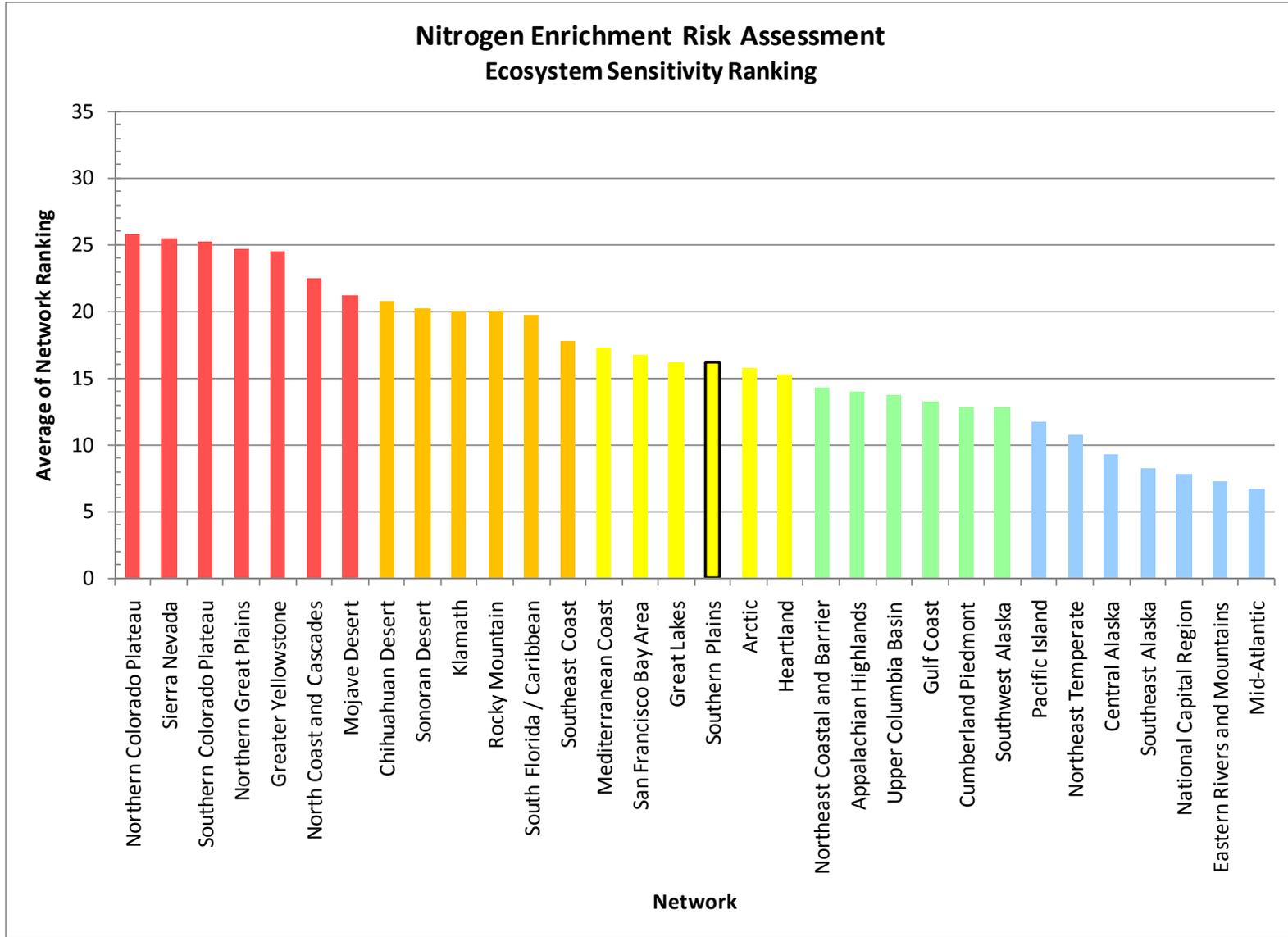


Figure B

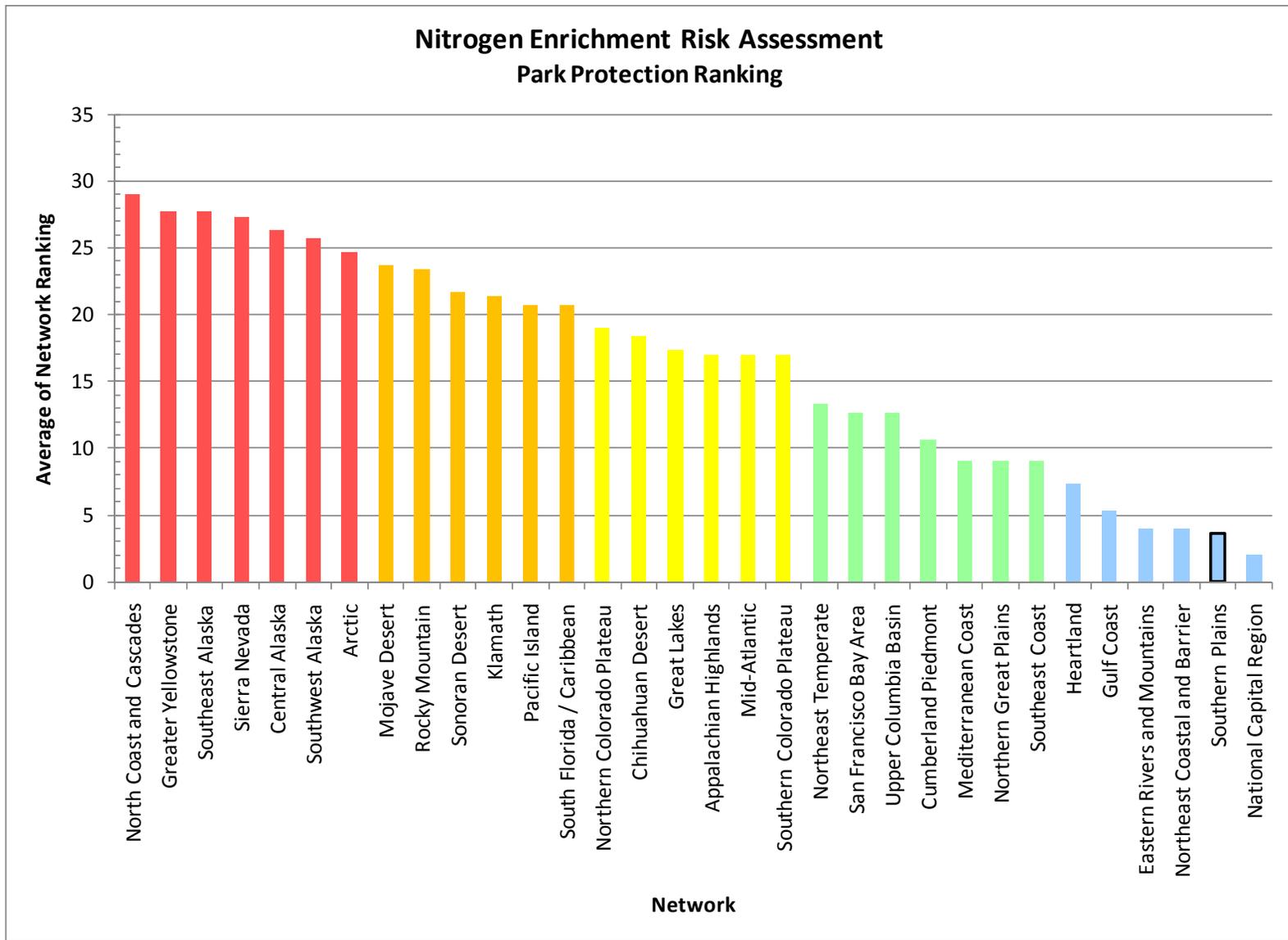


Figure C

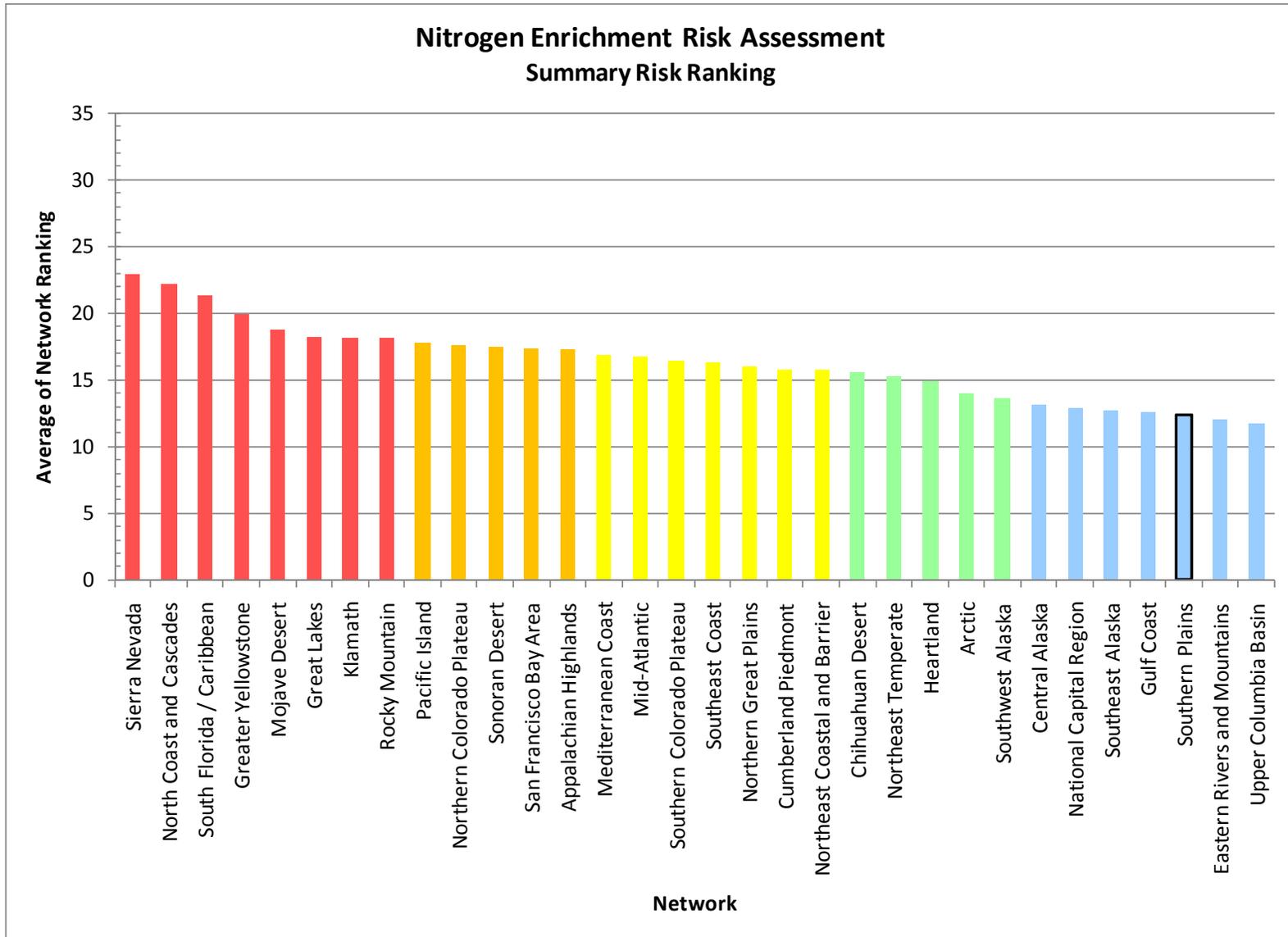


Figure D

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 960/106695, February 2011

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