National Park Service
U.S. Department of the Interior

Natural Resource Program Center

Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Acidification Effects from Atmospheric Sulfur and Nitrogen Deposition

Southeast Coast Network (SECN)

Natural Resource Report NPS/NRPC/ARD/NRR—2011/375

ON THE COVER

Some ecosystems and vegetation types, such as remote high-elevation lakes, sugar maple trees, headwater streams, and red spruce trees, are sensitive to the effects of acidification from atmospheric nitrogen and sulfur deposition.
Photograph by: National Park Service

Evaluation of the Sensitivity of Inventory and Monitoring National Parks to Acidification Effects from Atmospheric Sulfur and Nitrogen Deposition

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Natural Resource Program Center
Denver, Colorado

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

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.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from Air Resources Division of the NPS (http://www.nature.nps.gov/air/Permits/ARIS/networks/acidification-eval.cfm) and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/nrpm/).

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NPS 910/107413, April 2011

Southeast Coast Network (SECN)

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

There are 17 parks in the Southeast Coast Network. None are larger than 100 square miles. The majority are located in close proximity to the Atlantic coastline.

Total annual S and N emissions, by county, are shown in Maps E and F, respectively, for lands in and surrounding the Southeast Coast Network. Annual county-level S emissions within the network varied substantially. A large portion of the network had emissions less than 1 ton per square mile. However, there were areas scattered throughout the network with higher emissions, including a few counties that emitted more than 100 tons of S per square mile. County-level N annual emissions within the network ranged from less than 1 ton per square mile to greater than 20 tons per square mile. In general, annual county N emissions were between 1 and 20 tons per square mile throughout most of the network, with scattered counties having both lower and higher emissions. There were many point sources of SO_2 in the network (Map G). Most emitted less than 5,000 tons of S per year, although there were a few that emitted larger amounts, ranging from 5,000 to over 40,000 tons of S per year. Point source emissions of oxidized (nitrogen oxides, NO_x) and reduced (ammonia, NH_3) N are shown in Map H. There were many relatively large (i.e., larger than about 2,000 tons per year) point sources of oxidized N scattered throughout the network. Point sources of reduced N tended to be smaller than 1,000 tons per year.

Urban centers within the network and within a 300-mile buffer around the network are shown in Map I. The largest population center with the network is Jacksonville (more than 500,000 people). There are also a number of moderately sized population centers in the range of 100,000 to 500,000, mainly in the north.

Total S and total N deposition in and around the network are shown in Maps J and K, respectively. Included in this analysis are both wet and dry forms of deposition and both the oxidized and reduced N species. Total S deposition for most of the network was between 5 and 10 kg S/ha/yr. There were large areas, however, where deposition was between 10 and 15 kg S/ha/yr, with scattered pockets of higher deposition (Map J). Total N deposition within the network ranged from as low as 5 to 10 kg N/ha/yr to over 30 kg N/ha/yr in some small areas. Estimated N deposition throughout most of the network was between 5 and 15 kg N/ha/yr.

Land cover in and around the network is shown in Map L. The cover types within this network are mixed, with forest, shrubland, wetland, row crops, pasture/hay, and developed lands all being common.

Watershed slope is shown in Map M. The average slope for all but one (Kennesaw Mountain [KEMO]) of the parks in this network is less than 10^o.

Park lands requiring special protection against potential adverse impacts associated with acidic deposition are shown on Map N. Also shown on Map N are all federal lands designated as wilderness, both lands managed by NPS and lands managed by other federal agencies. The land designations used to identify this heightened protection included Class I designation under the Clean Air Act Amendments and wilderness designation. There are no Class I areas in this network, and limited designated wilderness, all of it 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 Southeast Coast Network ranked at the top of the second highest quintile, among networks, in Pollutant Exposure (Figure A). Emissions and deposition of S and N within the network are fairly high. The network Ecosystem Sensitivity ranking was Very Low, in the bottom quintile among networks (Figure B). This network ranked at the bottom of the second lowest quintile in Park Protection, having limited amounts of protected lands (Figure C). In combination, the network rankings for Pollutant Exposure, Ecosystem Sensitivity, and Park Protection yielded an overall Network Risk ranking that is relatively low among networks (Figure D).

There are no I&M parks in this network that are larger than 100 square miles. Therefore, the figures to compare risks among the larger parks are not shown for parks in this network. Relative ranks for all parks, including the smaller parks, are given in Table A and Appendix A.

Three parks in this network (Chattahoochee River [CHAT], KEMO, and Moores Creek [MOCR]) were ranked in the highest quintile for Pollutant Exposure. The rest of the parks were ranked in the second highest quintile for this theme. Park rankings for Ecosystem Sensitivity were highly variable across the network, with rankings in the second highest quintile for one park (CHAT) and Moderate for two parks (Horseshoe Bend [HOBE] and KEMO). For the remaining parks, Ecosystem Sensitivity was in the lowest quintile for 11 parks and in the second lowest quintile for three parks (Table A). Most (15) of the parks were ranked in the middle quintile in Park Protection; two (Congaree [COSW] and Cumberland Island [CUIS]) were ranked in the second highest quintile.

The overall Summary Risk ranked two of the parks (CHAT and KEMO) in this network as High for risk of acidification. The other parks were ranked Moderate, indicating a moderate overall acidification risk (Table A).

Table A. Relative rankings of individual I&M parks within the network for Pollutant Exposure, Ecosystem Sensitivity, Park Protection, and overall Summary Risk from acidic deposition.

I&M Parks[2] in Network	Relative Ranking of Individual Parks[1]			
	Pollutant Exposure	Ecosystem Sensitivity	Park Protection	Summary Risk
Canaveral	High	Very Low	Moderate	Moderate
Cape Hatteras	High	Very Low	Moderate	Moderate
Cape Lookout	High	Very Low	Moderate	Moderate
Castillo de San Marcos	High	Very Low	Moderate	Moderate
Chattahoochee River	Very High	High	Moderate	High
Congaree	High	Low	High	Moderate
Cumberland Island	High	Low	High	Moderate
Fort Caroline	High	Very Low	Moderate	Moderate
Fort Frederica	High	Very Low	Moderate	Moderate
Fort Matanzas	High	Very Low	Moderate	Moderate
Fort Pulaski	High	Very Low	Moderate	Moderate
Fort Sumter	High	Very Low	Moderate	Moderate
Horseshoe Bend	High	Moderate	Moderate	Moderate
Kennesaw Mountain	Very High	Moderate	Moderate	High
Moores Creek	Very High	Very Low	Moderate	Moderate
Ocmulgee	High	Very Low	Moderate	Moderate
Timucaun Ecological and Historical Preserve	High	Low	Moderate	Moderate

[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 S emissions by county for the year 2002, in units of tons of S per square mile per year. (Source of data: EPA National Emissions Inventory, http://www.epa.gov/ttn/chief/net/2002inventory.html)

Map B. National map of total N emissions by county for the year 2002. Both oxidized (nitrogen oxides, NO_x) and reduced (ammonia, NH_3) 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 C. Total S deposition for the conterminous United States for the year 2002, expressed in units of kilograms of S deposited from the atmosphere to the Earth surface per hectare per year. 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 D. 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, NH_3) 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 E. Total S emissions by county for lands surrounding the network, expressed as tons of S emitted into the atmosphere per square mile per year. (Source of data: EPA National Emissions Inventory, http://www.epa.gov/ttn/chief/net/2002inventory.html)

Map F. 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, NH_3) N. (Source of data: EPA National Emissions Inventory, http://www.epa.gov/ttn/chief/net/2002inventory.html)

Map G. Major point source emissions of SO_2 for lands surrounding the network. (Source of data: EPA National Emissions Inventory, http://www.epa.gov/ttn/chief/net/2002inventory.html)

Map H. Major point source emissions of oxidized (nitrogen oxides, NO_x) and reduced (ammonia, NH_3) 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 I. 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 J. Total S deposition in and around the network. Values are expressed as kilograms of S deposited per hectare per year. (Source of data: Interpolated NADP wet and CMAQ Model dry deposition data for 2002; see information for Map C above for details)

Map K. 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, NH_3) 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 D above for details)

Map L. 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 M. Average land slope within park units that occur within the network, by 10-digit HUC. (Source of data: U.S. EPA National Elevation Dataset [http://ned.usgs.gov/])

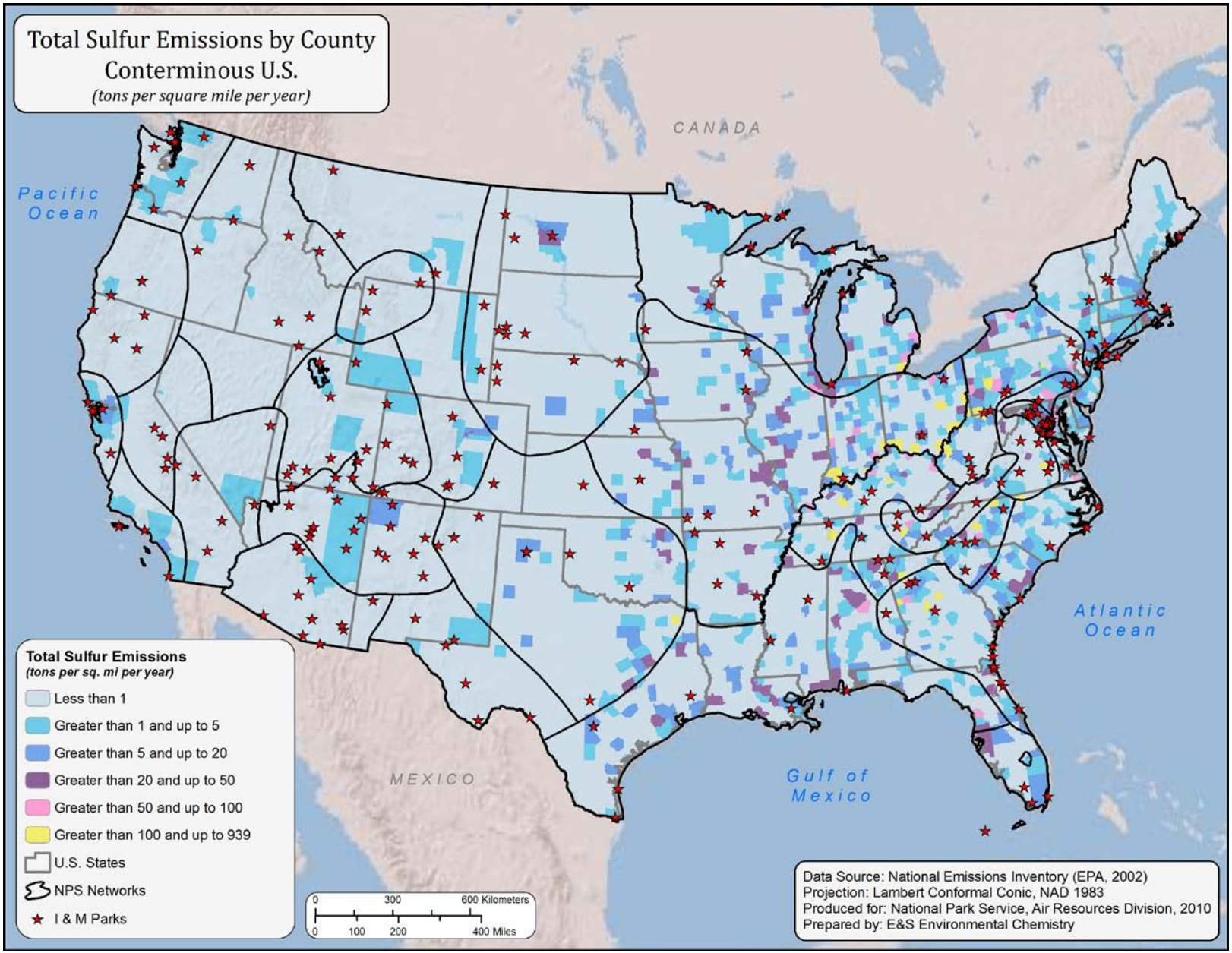
Map N. Lands within the network that are classified as Class I or wilderness area. (Source of data: USGS 2005 [National Atlas; http://nationalatlas.gov] and NPS)

Figure A. Network rankings for Pollutant Exposure, calculated as the average of scores for all Pollutant Exposure variables.

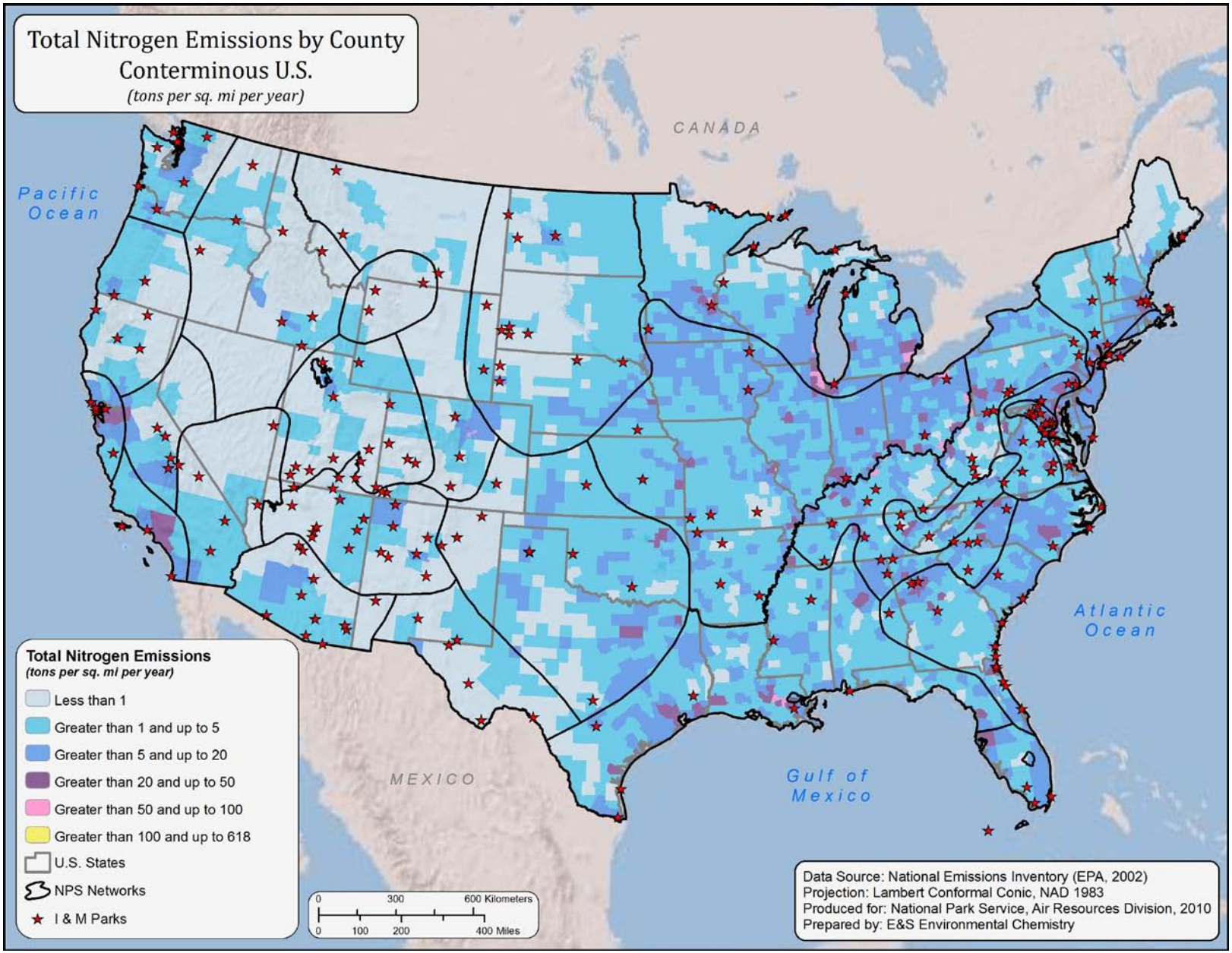
Figure B. Network rankings for Ecosystem Sensitivity, calculated as the average of scores for all Ecosystem Sensitivity variables.

Figure C. Network rankings for Park Protection, calculated as the average of scores for all Park Protection variables.

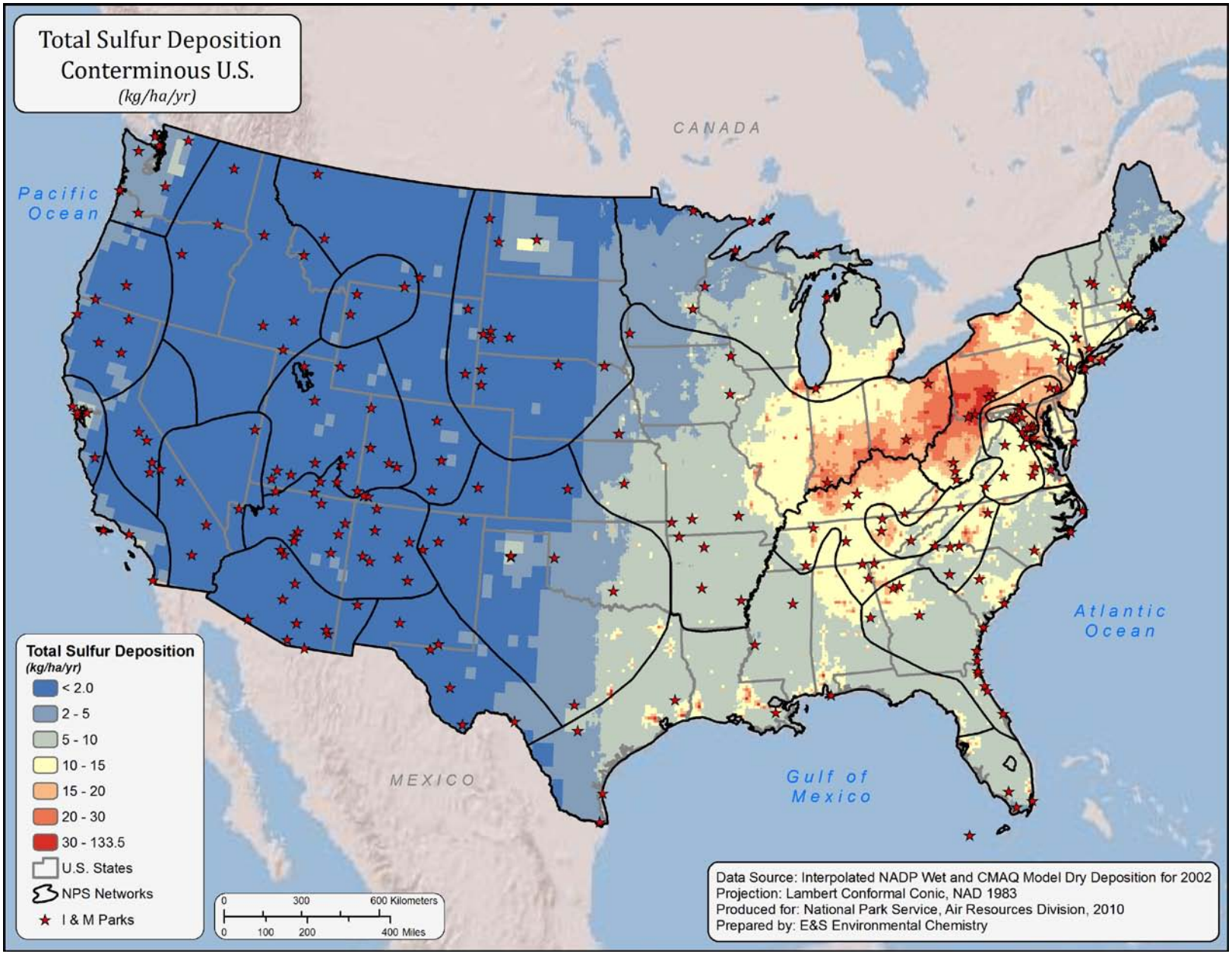
Figure D. Network Summary Risk rankings, calculated as the average of the quintile ranks for the Pollutant Exposure, Ecosystem Sensitivity, and Park Protection themes.


Total Sulfur Emissions by County
Conterminous U.S.
(tons per square mile per year)
CANADA
Pacific Ocean
Atlantic Ocean
MEXICO
Gulf of Mexico
Total Sulfur Emissions
(tons per sq. mi per year)
Less than 1
Greater than 1 and up to 5
Greater than 5 and up to 20
Greater than 20 and up to 50
Greater than 50 and up to 100
Greater than 100 and up to 939
U.S. States
NPS Networks
I & M Parks
0 300 600 Kilometers
0 100 200 400 Miles
Data Source: National Emissions Inventory (EPA, 2002)
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry

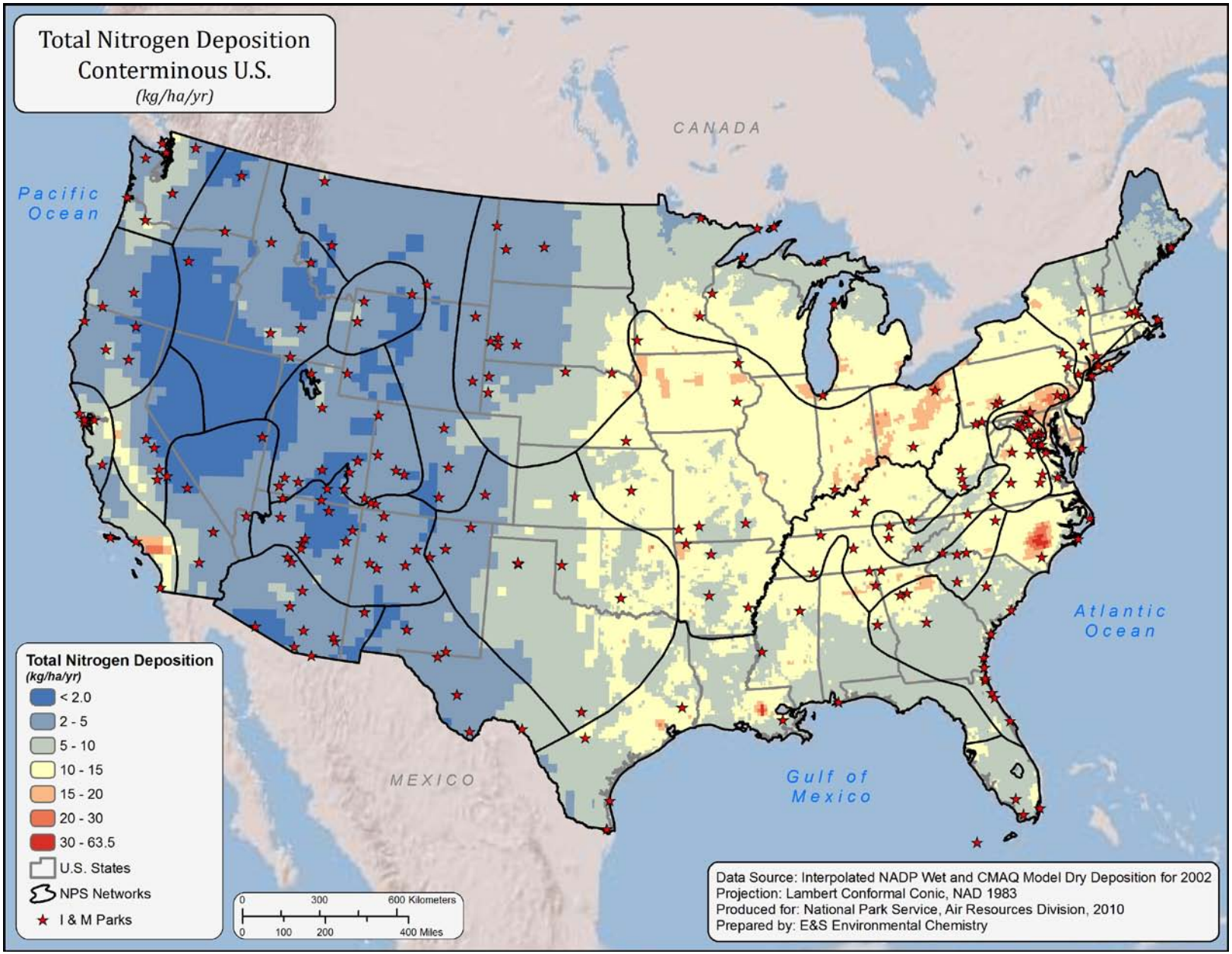
Map A


Total Nitrogen Emissions by County
Conterminous U.S.
(tons per sq. mi per year)
CANADA
Pacific Ocean
Atlantic Ocean
MEXICO
Gulf of Mexico
Total Nitrogen Emissions
(tons per sq. mi per year)
Less than 1
Greater than 1 and up to 5
Greater than 5 and up to 20
Greater than 20 and up to 50
Greater than 50 and up to 100
Greater than 100 and up to 618
U.S. States
NPS Networks
I & M Parks
0 300 600 Kilometers
0 100 200 400 Miles
Data Source: National Emissions Inventory (EPA, 2002)
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry

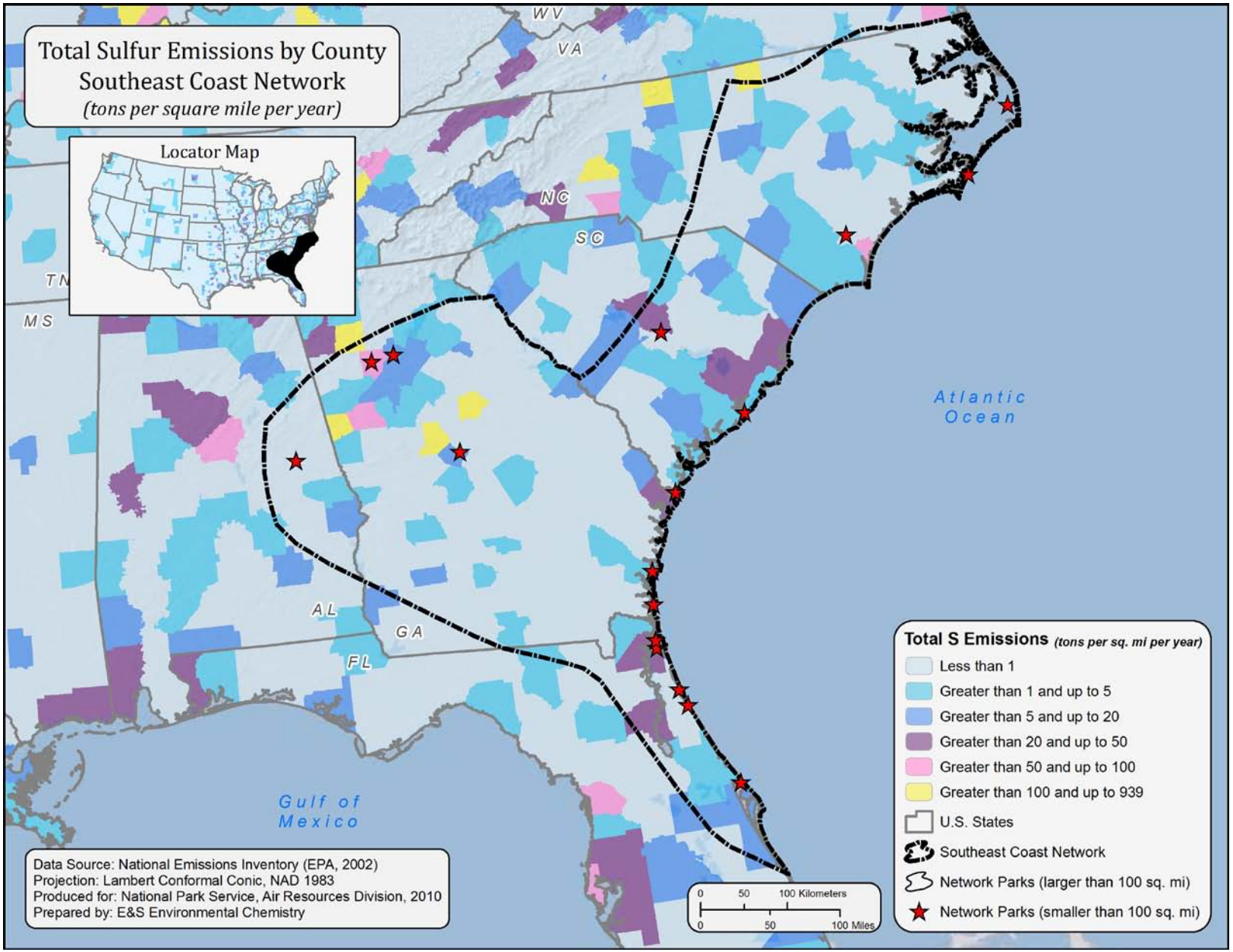
Map B


Total Sulfur Deposition
Conterminous U.S.
(kg/ha/yr)
CANADA
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
MEXICO
Total Sulfur Deposition
(kg/ha/yr)
< 2.0
2 - 5
5 - 10
10 - 15
15 - 20
20 - 30
30 - 133.5
U.S. States
NPS Networks
I & M Parks
0 300 600 Kilometers
0 100 200 400 Miles
Data Source: Interpolated NADP Wet and CMAQ Model Dry Deposition for 2002
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry

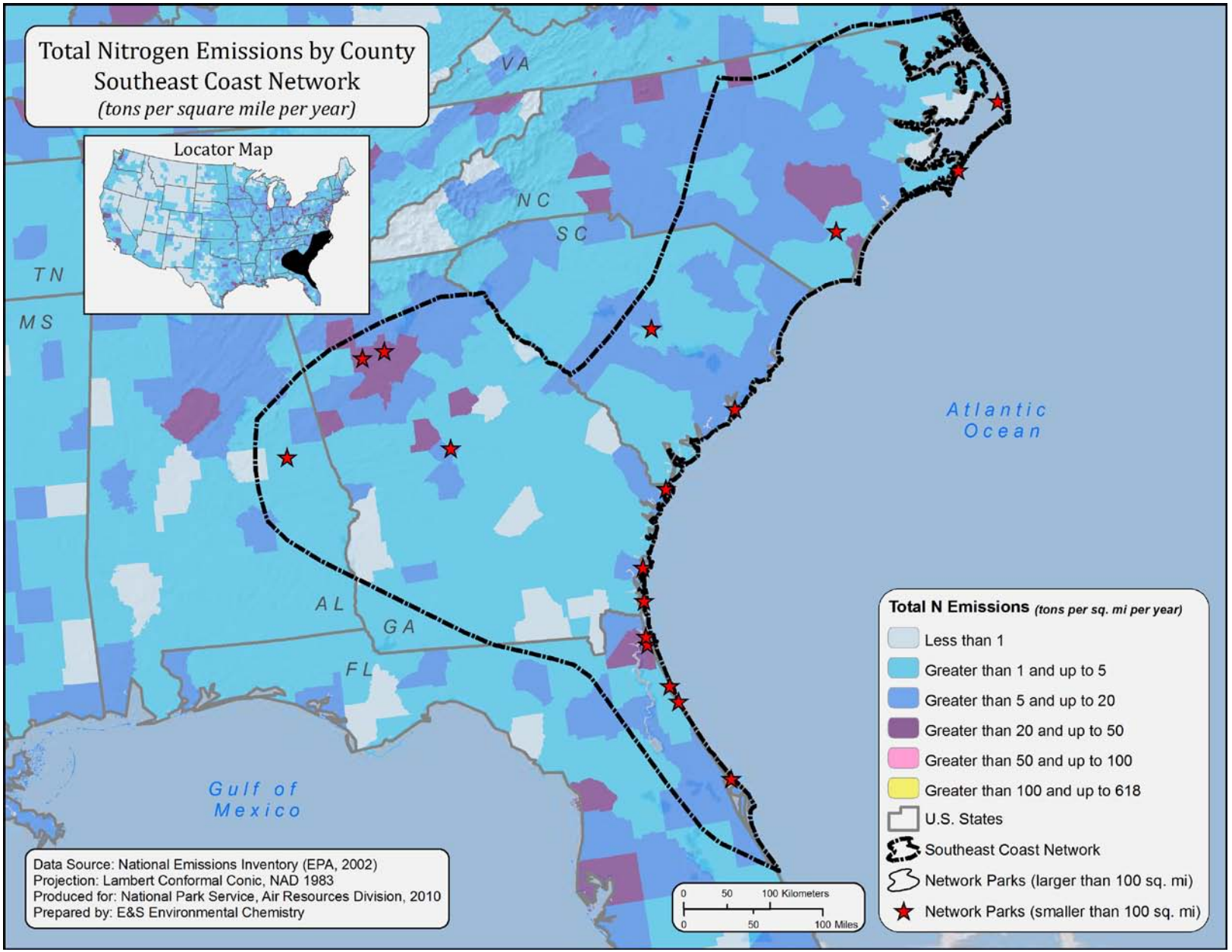
Map C


Total Nitrogen Deposition
Conterminous U.S.
(kg/ha/yr)
CANADA
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
MEXICO
Total Nitrogen Deposition
(kg/ha/yr)
< 2.0
2 - 5
5 - 10
10 - 15
15 - 20
20 - 30
30 - 63.5
U.S. States
NPS Networks
I & M Parks
0 300 600 Kilometers
0 100 200 400 Miles
Data Source: Interpolated NADP Wet and CMAQ Model Dry Deposition for 2002
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry

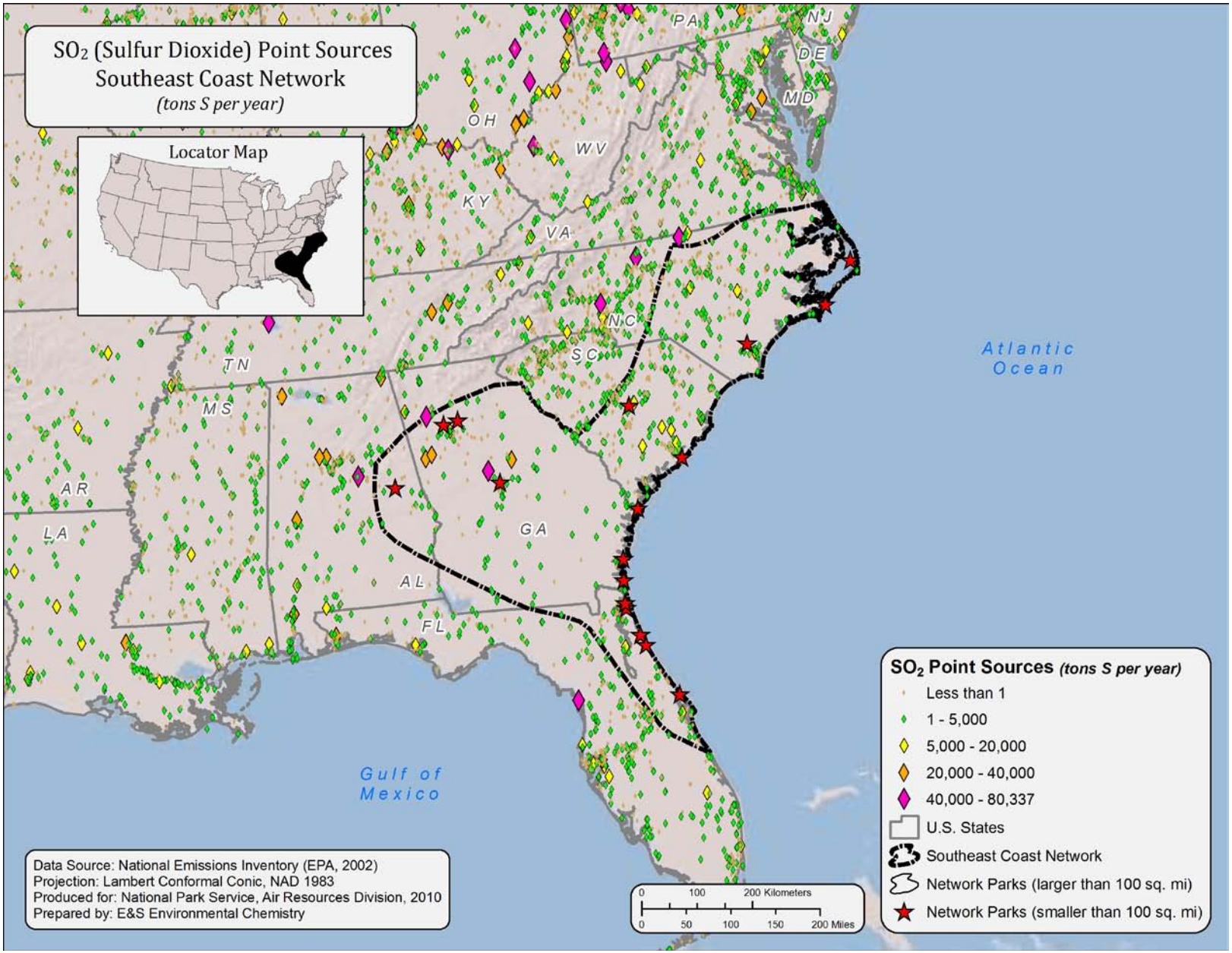
Map D


Total Sulfur Emissions by County
Southeast Coast Network
(tons per square mile per year)
Locator Map
WV
VA
NC
SC
TN
MS
AL
GA
FL
Atlantic Ocean
Gulf of Mexico
Total S Emissions (tons per sq. mi per year)
Less than 1
Greater than 1 and up to 5
Greater than 5 and up to 20
Greater than 20 and up to 50
Greater than 50 and up to 100
Greater than 100 and up to 939
U.S. States
Southeast Coast Network
Network Parks (larger than 100 sq. mi)
Network Parks (smaller than 100 sq. mi)
0 50 100 Kilometers
0 50 100 Miles
Data Source: National Emissions Inventory (EPA, 2002)
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry

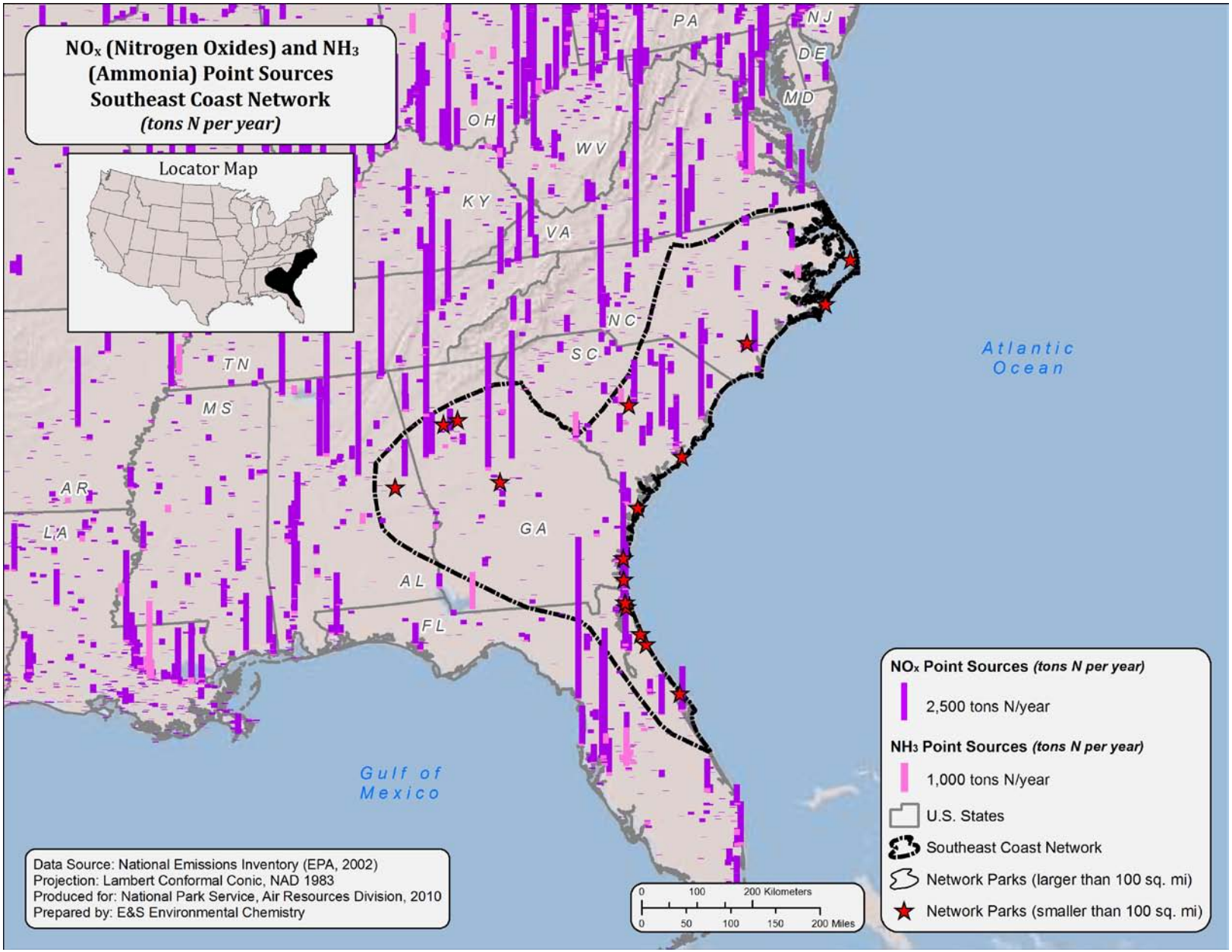
Map E


Total Nitrogen Emissions by County
Southeast Coast Network
(tons per square mile per year)
Locator Map
VA
NC
SC
TN
MS
AL
GA
FL
Atlantic Ocean
Gulf of Mexico
Total N Emissions (tons per sq. mi per year)
Less than 1
Greater than 1 and up to 5
Greater than 5 and up to 20
Greater than 20 and up to 50
Greater than 50 and up to 100
Greater than 100 and up to 618
U.S. States
Southeast Coast Network
Network Parks (larger than 100 sq. mi)
Network Parks (smaller than 100 sq. mi)
0 50 100 Kilometers
0 50 100 Miles
Data Source: National Emissions Inventory (EPA, 2002)
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry

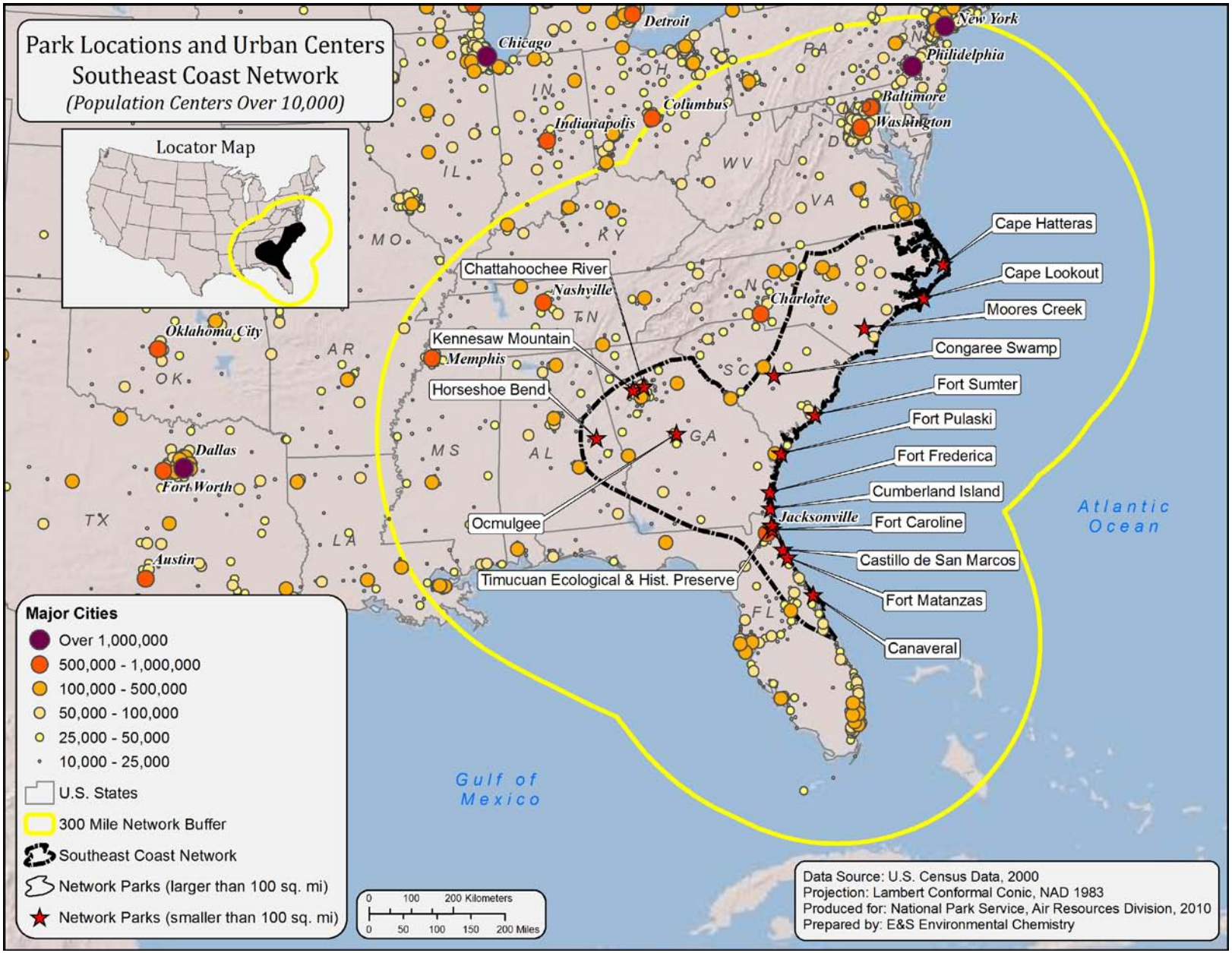
Map F


SO2 (Sulfur Dioxide) Point Sources
Southeast Coast Network
(tons S per year)
Locator Map
PA
NJ
DE
MD
OH
WV
KY
VA
NC
SC
TN
MS
AR
LA
GA
AL
FL
Atlantic Ocean
Gulf of Mexico
SO2 Point Sources (tons S per year)
Less than 1
1 - 5,000
5,000 - 20,000
20,000 - 40,000
40,000 - 80,337
U.S. States
Southeast Coast Network
Network Parks (larger than 100 sq. mi)
Network Parks (smaller than 100 sq. mi)
Data Source: National Emissions Inventory (EPA, 2002)
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry
0 100 200 Kilometers
0 50 100 150 200 Miles

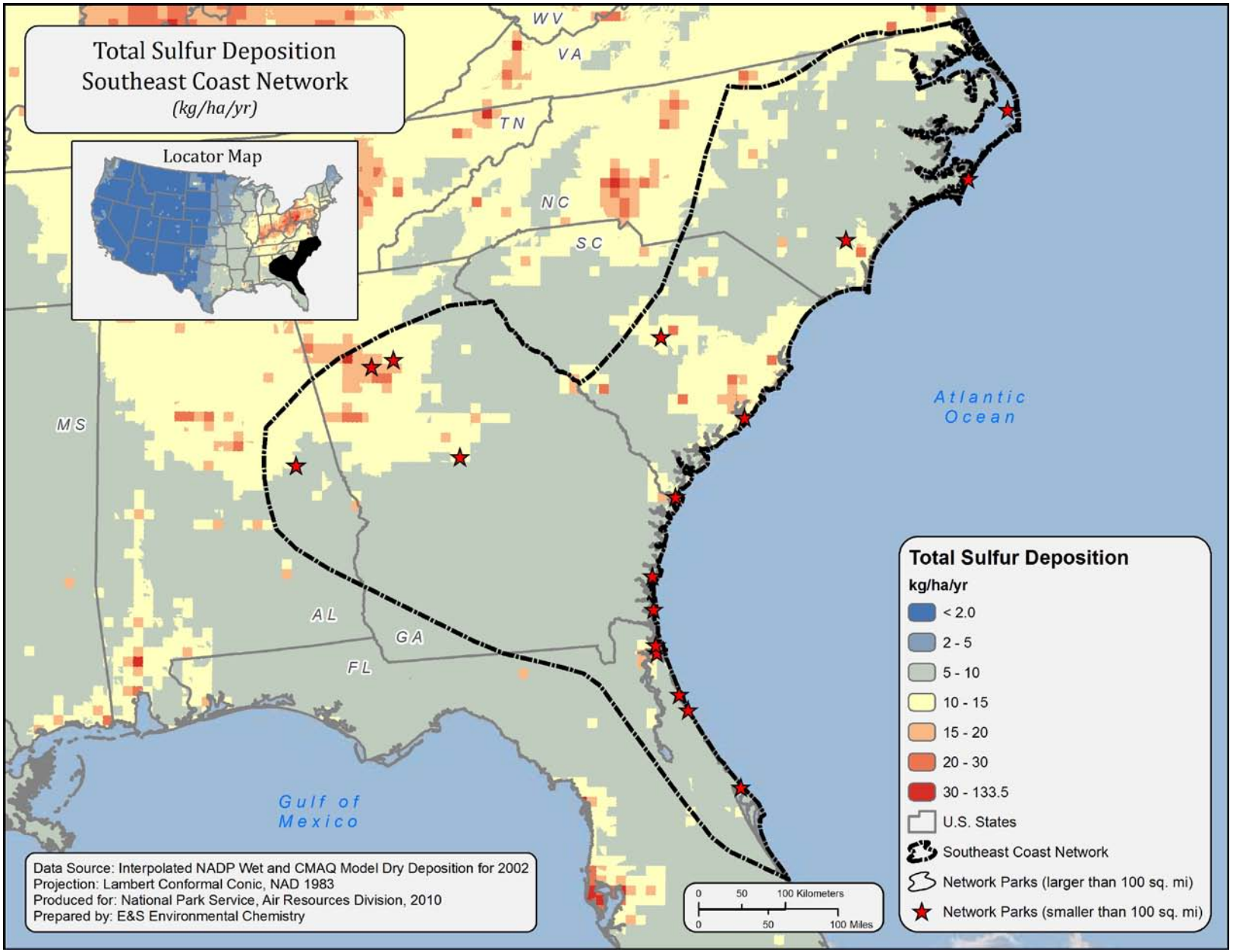
Map G


NOx (Nitrogen Oxides) and NH3 (Ammonia) Point Sources
Southeast Coast Network
(tons N per year)
Locator Map
PA
NJ
DE
MD
OH
WV
KY
VA
NC
SC
TN
MS
AR
LA
GA
AL
FL
Atlantic Ocean
Gulf of Mexico
NOx Point Sources (tons N per year)
2,500 tons N/year
NH3 Point Sources (tons N per year)
1,000 tons N/year
U.S. States
Southeast Coast Network
Network Parks (larger than 100 sq. mi)
Network Parks (smaller than 100 sq. mi)
Data Source: National Emissions Inventory (EPA, 2002)
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry
0 100 200 Kilometers
0 50 100 150 200 Miles

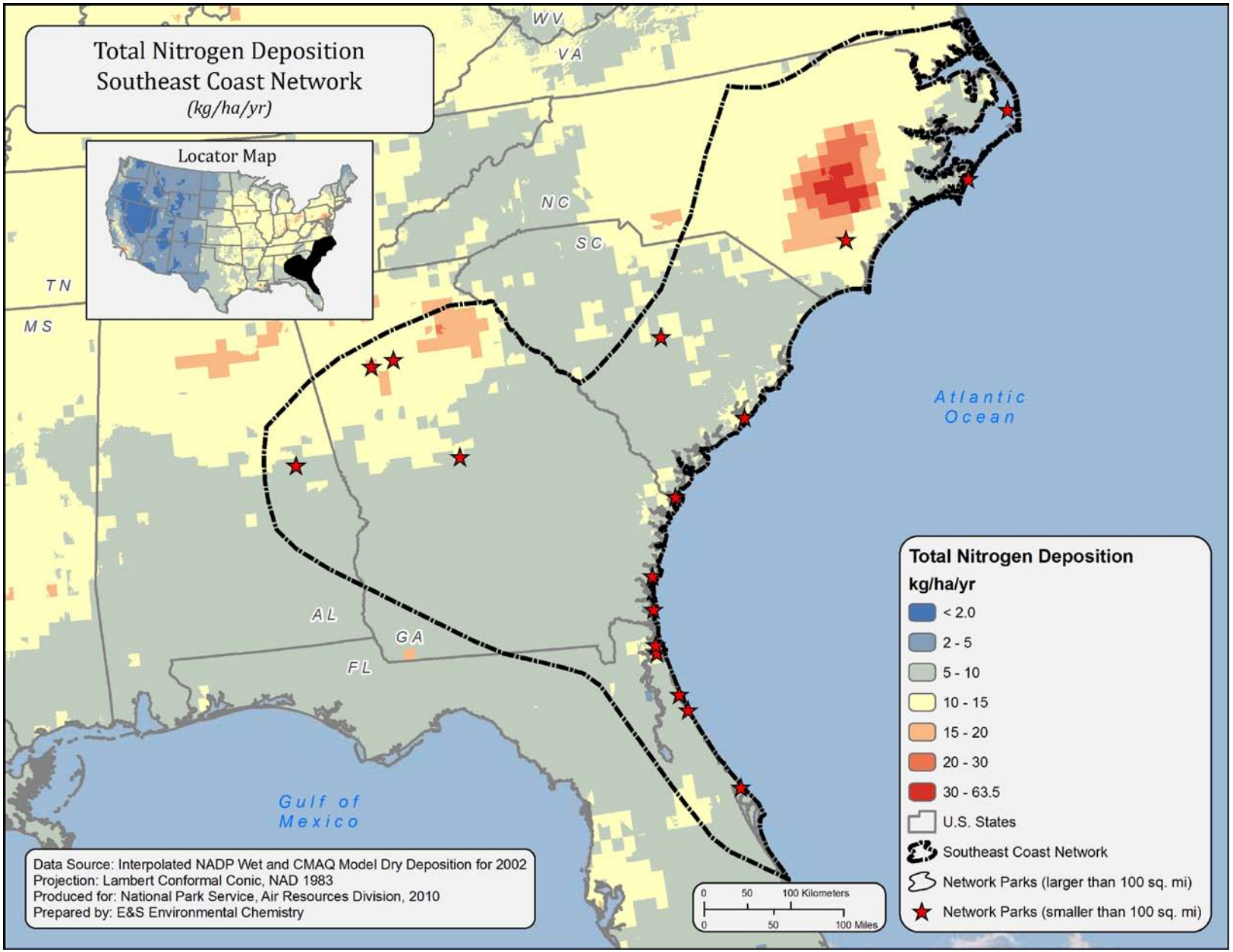
Map H


Park Locations and Urban Centers
Southeast Coast Network
(Population Centers Over 10,000)
Locator Map
Detroit
Chicago
New York
Philidelphia
Baltimore
Washington
Columbus
Indianapolis
Oklahoma City
Memphis
Nashville
Charlotte
Dallas
Fort Worth
Austin
Jacksonville
Cape Hatteras
Cape Lookout
Moores Creek
Congaree Swamp
Fort Sumter
Fort Pulaski
Fort Frederica
Cumberland Island
Fort Caroline
Castillo de San Marcos
Fort Matanzas
Canaveral
Chattahoochee River
Kennesaw Mountain
Horseshoe Bend
Ocmulgee
Timucuan Ecological & Hist. Preserve
Atlantic Ocean
Gulf of Mexico
Major Cities
Over 1,000,000
500,000 - 1,000,000
100,000 - 500,000
50,000 - 100,000
25,000 - 50,000
10,000 - 25,000
U.S. States
300 Mile Network Buffer
Southeast Coast Network
Network Parks (larger than 100 sq. mi)
Network Parks (smaller than 100 sq. mi)
0 100 200 Kilometers
0 50 100 150 200 Miles
Data Source: U.S. Census Data, 2000
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry

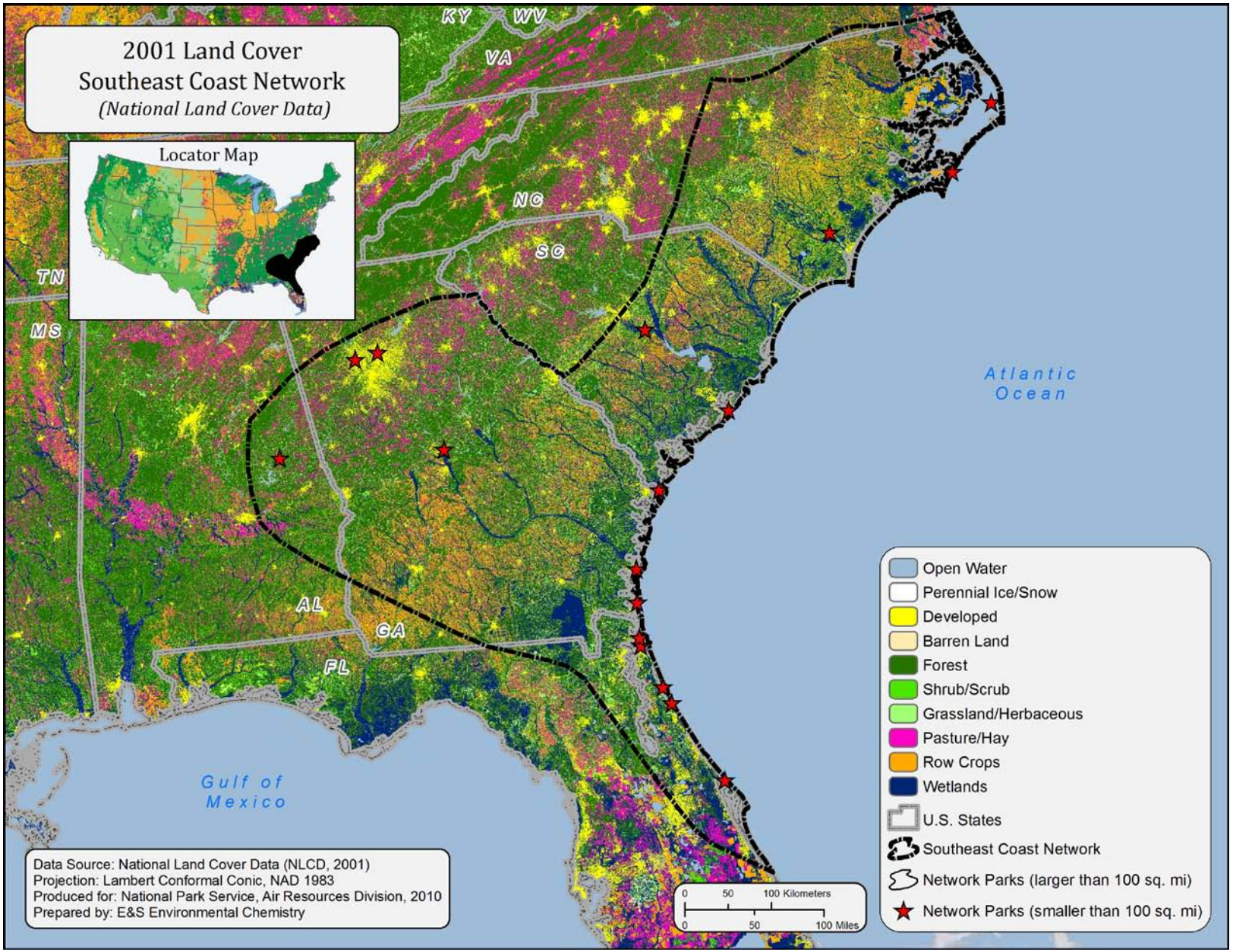
Map I


Total Sulfur Deposition
Southeast Coast Network
(kg/ha/yr)
Locator Map
WV
VA
TN
NC
SC
MS
AL
GA
FL
Atlantic Ocean
Gulf of Mexico
Total Sulfur Deposition
kg/ha/yr
< 2.0
2 - 5
5 - 10
10 - 15
15 - 20
20 - 30
30 - 133.5
U.S. States
Southeast Coast Network
Network Parks (larger than 100 sq. mi)
Network Parks (smaller than 100 sq. mi)
Data Source: Interpolated NADP Wet and CMAQ Model Dry Deposition for 2002
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry
0 50 100 Kilometers
0 50 100 Miles

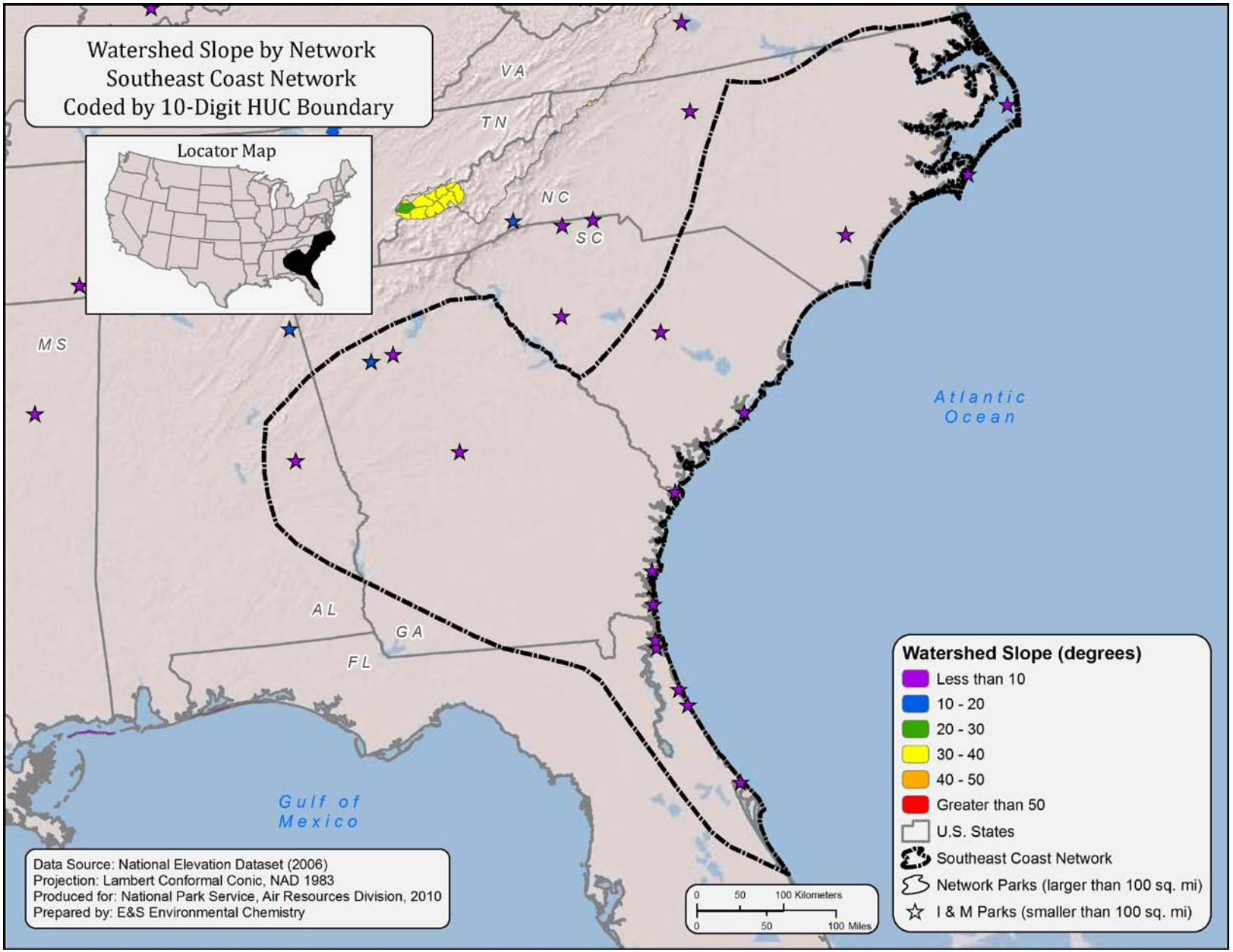
Map J


Total Nitrogen Deposition
Southeast Coast Network
(kg/ha/yr)
Locator Map
WV
VA
NC
SC
TN
MS
AL
GA
FL
Atlantic Ocean
Gulf of Mexico
Total Nitrogen Deposition
kg/ha/yr
< 2.0
2 - 5
5 - 10
10 - 15
15 - 20
20 - 30
30 - 63.5
U.S. States
Southeast Coast Network
Network Parks (larger than 100 sq. mi)
Network Parks (smaller than 100 sq. mi)
0 50 100 Kilometers
0 50 100 Miles
Data Source: Interpolated NADP Wet and CMAQ Model Dry Deposition for 2002
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry

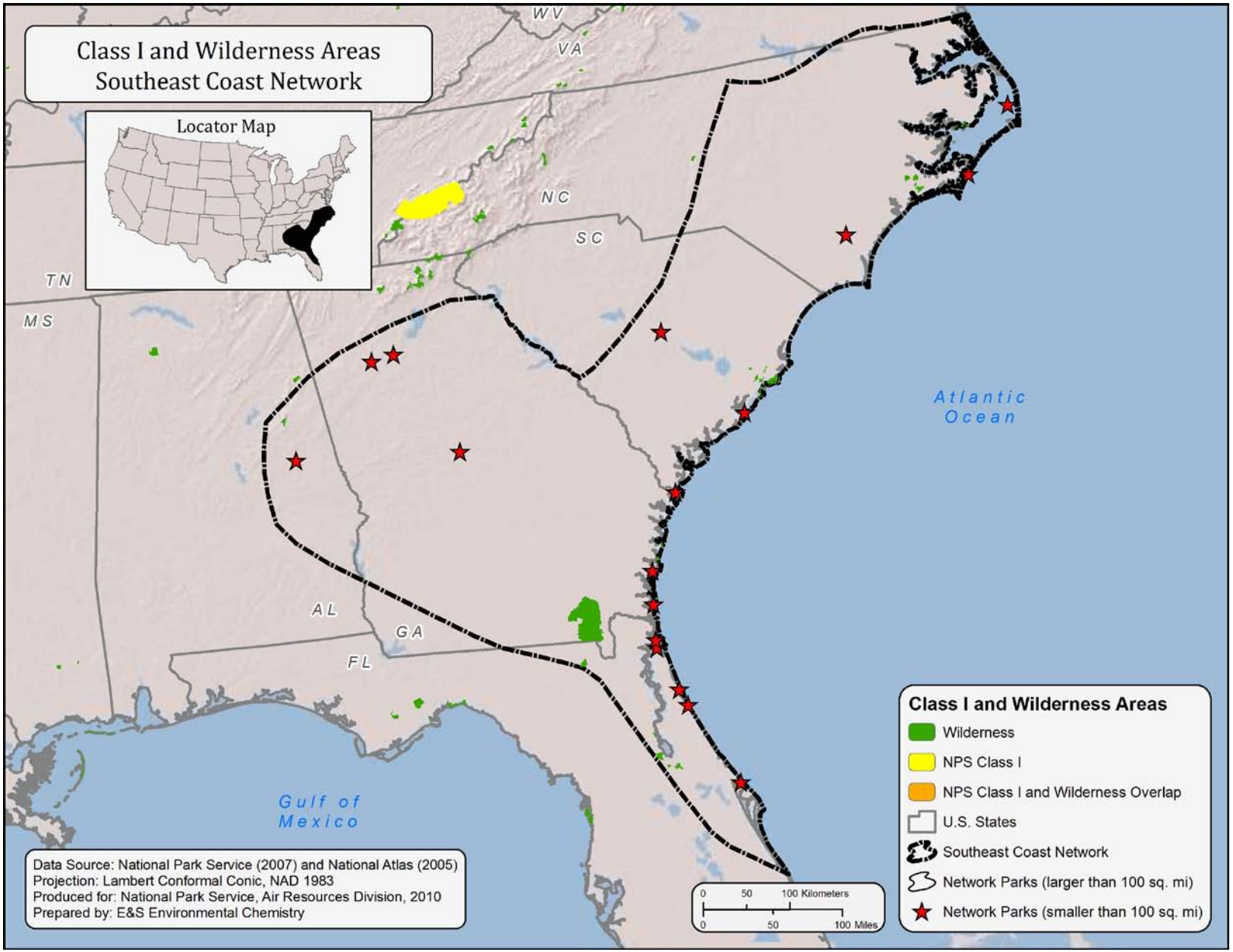
Map K


2001 Land Cover
Southeast Coast Network
(National Land Cover Data)
Locator Map
KY
WV
VA
NC
SC
TN
MS
AL
GA
FL
Atlantic Ocean
Gulf of Mexico
Open Water
Perennial Ice/Snow
Developed
Barren Land
Forest
Shrub/Scrub
Grassland/Herbaceous
Pasture/Hay
Row Crops
Wetlands
U.S. States
Southeast Coast Network
Network Parks (larger than 100 sq. mi)
Network Parks (smaller than 100 sq. mi)
0 50 100 Kilometers
0 50 100 Miles
Data Source: National Land Cover Data (NLCD, 2001)
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry

Map L


Watershed Slope by Network
Southeast Coast Network
Coded by 10-Digit HUC Boundary
Locator Map
VA
TN
NC
SC
MS
AL
GA
FL
Atlantic Ocean
Gulf of Mexico
Data Source: National Elevation Dataset (2006)
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry
0 50 100 Kilometers
0 50 100 Miles
Watershed Slope (degrees)
Less than 10
10 - 20
20 - 30
30 - 40
40 - 50
Greater than 50
U.S. States
Southeast Coast Network
Network Parks (larger than 100 sq. mi)
I & M Parks (smaller than 100 sq. mi)

Map M


Class I and Wilderness Areas
Southeast Coast Network
Locator Map
WV
VA
NC
SC
TN
MS
AL
GA
FL
Atlantic Ocean
Gulf of Mexico
Data Source: National Park Service (2007) and National Atlas (2005)
Projection: Lambert Conformal Conic, NAD 1983
Produced for: National Park Service, Air Resources Division, 2010
Prepared by: E&S Environmental Chemistry
0 50 100 Kilometers
0 50 100 Miles
Class I and Wilderness Areas
Wilderness
NPS Class I
NPS Class I and Wilderness Overlap
U.S. States
Southeast Coast Network
Network Parks (larger than 100 sq. mi)
Network Parks (smaller than 100 sq. mi)

Map N

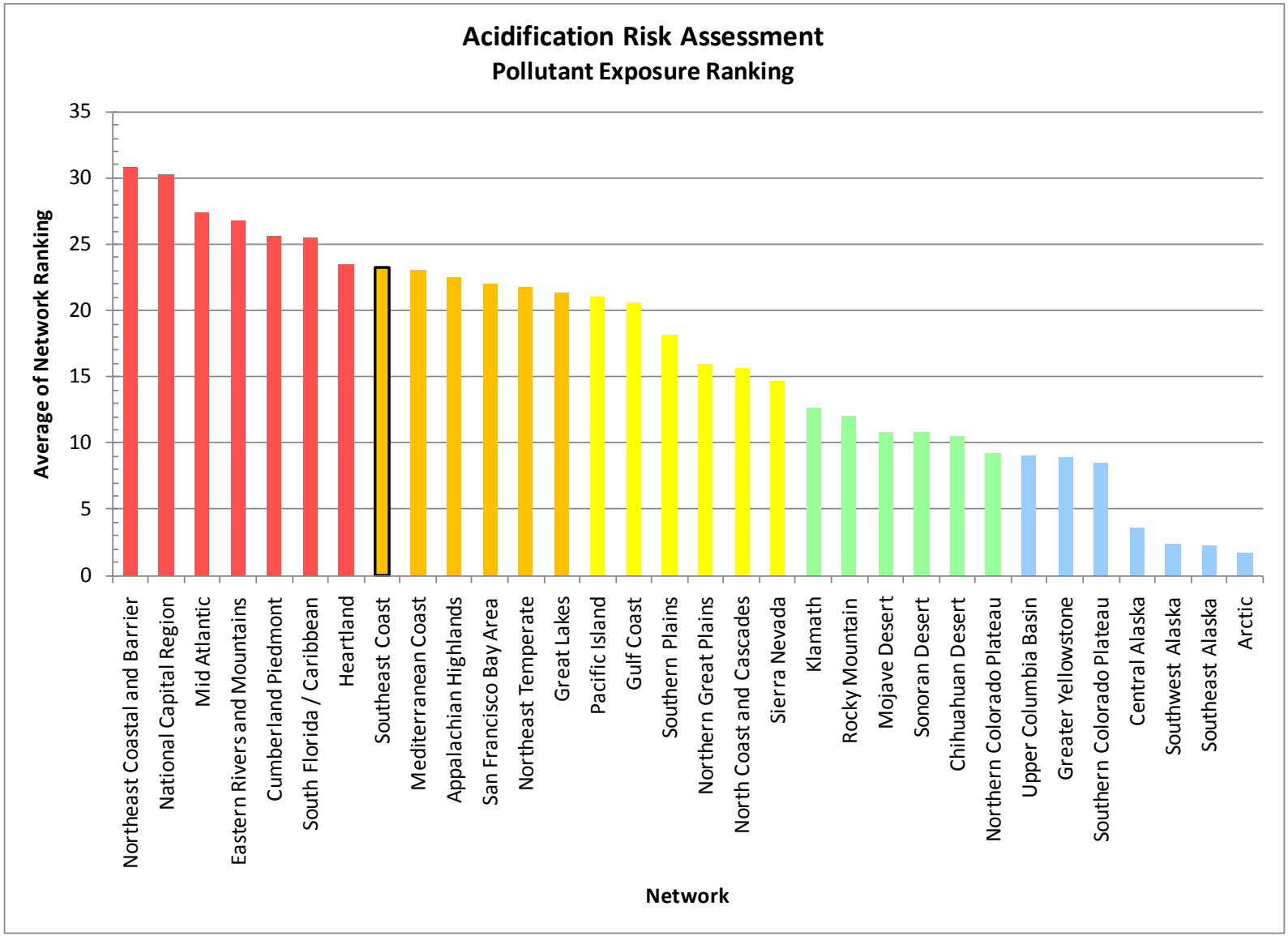

Acidification Risk Assessment
Pollutant Exposure Ranking
Average of Network Ranking
35
30
25
20
15
10
5
0
Northeast Coastal and Barrier
National Capital Region
Mid Atlantic
Eastern Rivers and Mountains
Cumberland Piedmont
South Florida / Caribbean
Heartland
Southeast Coast
Mediterranean Coast
Appalachian Highlands
San Francisco Bay Area
Northeast Temperate
Great Lakes
Pacific Island
Gulf Coast
Southern Plains
Northern Great Plains
North Coast and Cascades
Sierra Nevada
Klamath
Rocky Mountain
Mojave Desert
Sonoran Desert
Chihuahuan Desert
Northern Colorado Plateau
Upper Columbia Basin
Greater Yellowstone
Southern Colorado Plateau
Central Alaska
Southwest Alaska
Southeast Alaska
Arctic
Network

Figure A

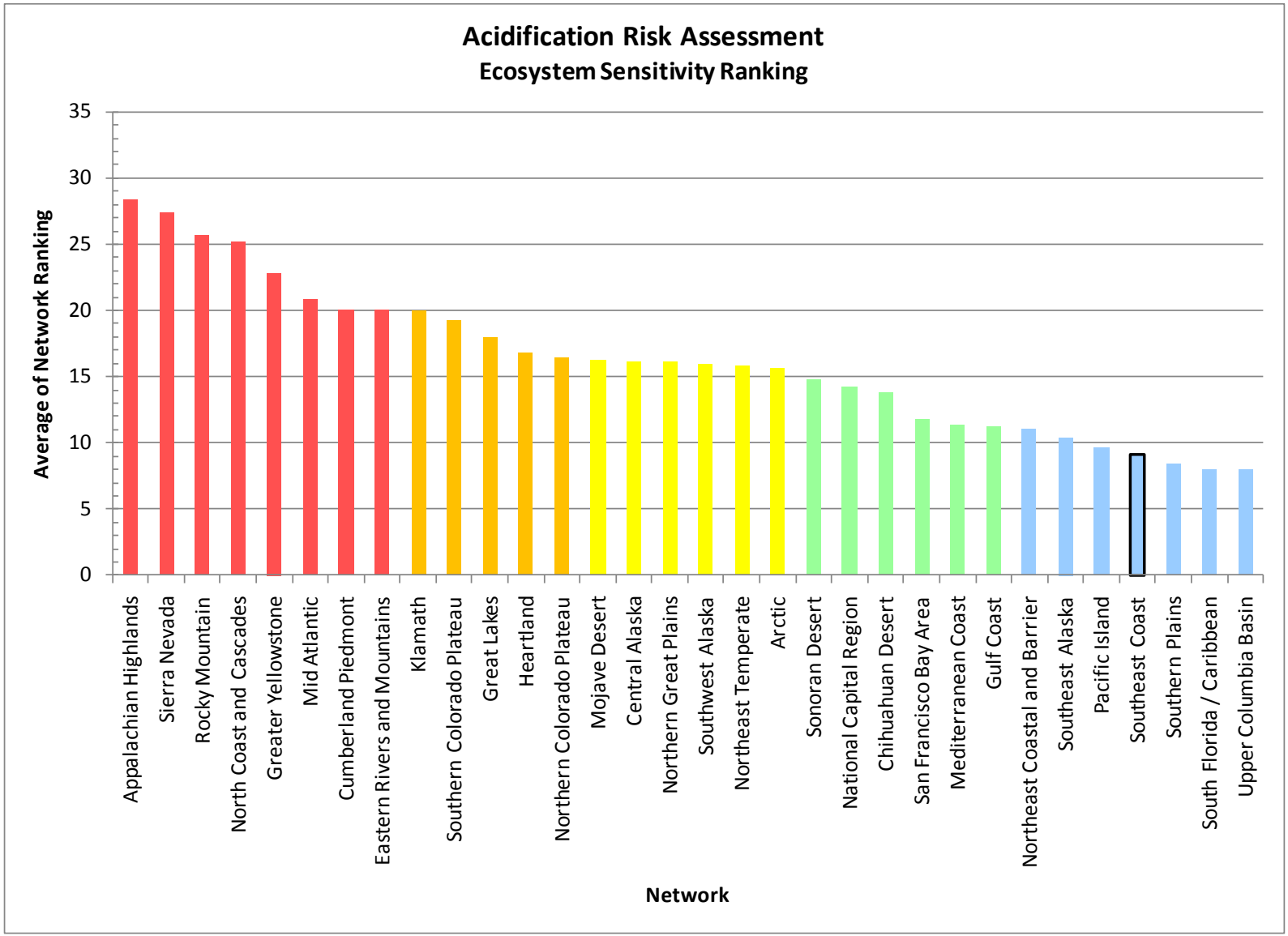

Acidification Risk Assessment
Ecosystem Sensitivity Ranking
Average of Network Ranking
35
30
25
20
15
10
5
0
Appalachian Highlands
Sierra Nevada
Rocky Mountain
North Coast and Cascades
Greater Yellowstone
Mid Atlantic
Cumberland Piedmont
Eastern Rivers and Mountains
Klamath
Southern Colorado Plateau
Great Lakes
Heartland
Northern Colorado Plateau
Mojave Desert
Central Alaska
Northern Great Plains
Southwest Alaska
Northeast Temperate
Arctic
Sonoran Desert
National Capital Region
Chihuahuan Desert
San Francisco Bay Area
Mediterranean Coast
Gulf Coast
Northeast Coastal and Barrier
Southeast Alaska
Pacific Island
Southeast Coast
Southern Plains
South Florida / Caribbean
Upper Columbia Basin
Network

Figure B

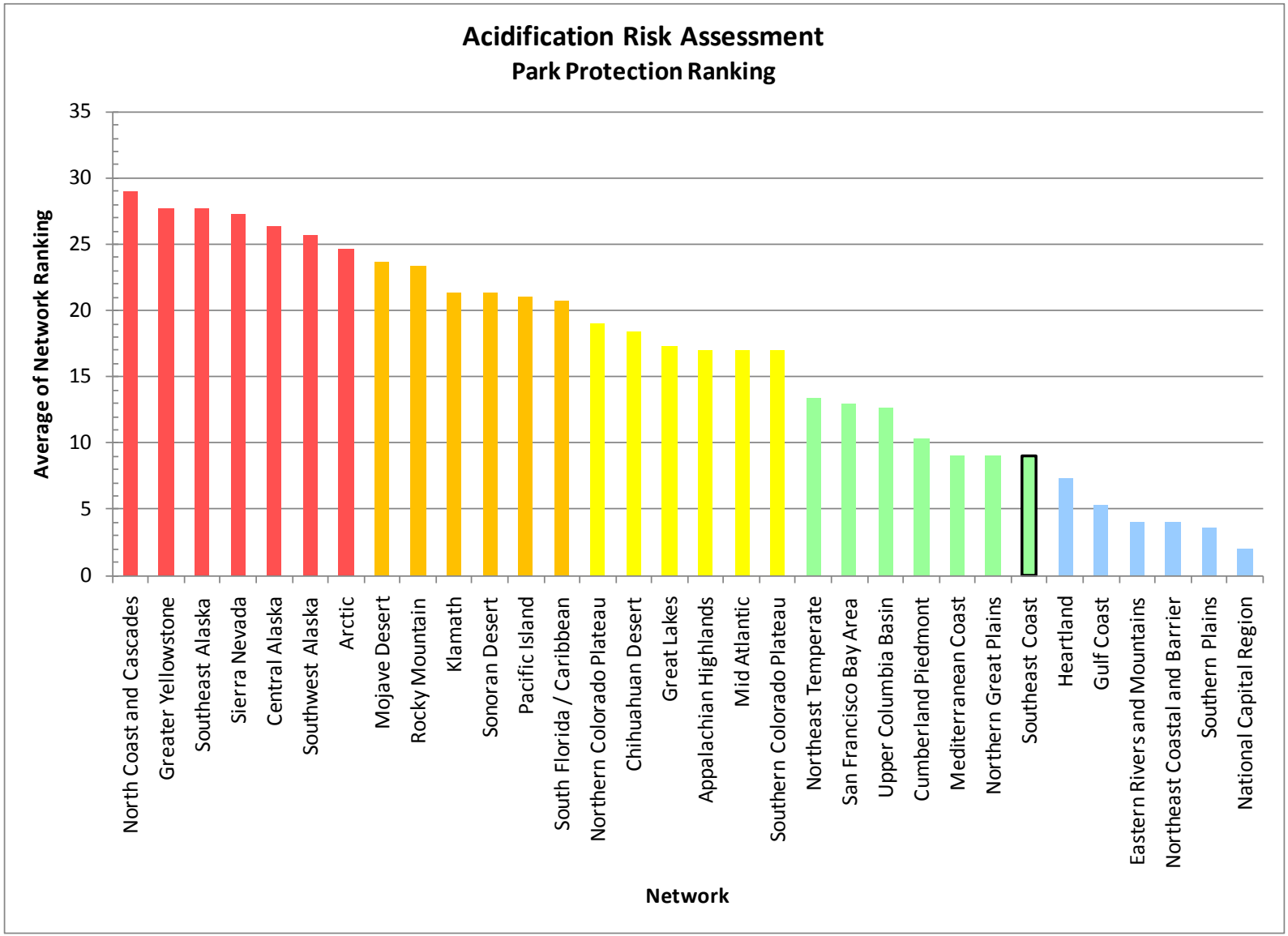

Acidification Risk Assessment
Park Protection Ranking
Average of Network Ranking
35
30
25
20
15
10
5
0
North Coast and Cascades
Greater Yellowstone
Southeast Alaska
Sierra Nevada
Central Alaska
Southwest Alaska
Arctic
Mojave Desert
Rocky Mountain
Klamath
Sonoran Desert
Pacific Island
South Florida / Caribbean
Northern Colorado Plateau
Chihuahuan Desert
Great Lakes
Appalachian Highlands
Mid Atlantic
Southern Colorado Plateau
Northeast Temperate
San Francisco Bay Area
Upper Columbia Basin
Cumberland Piedmont
Mediterranean Coast
Northern Great Plains
Southeast Coast
Heartland
Gulf Coast
Eastern Rivers and Mountains
Northeast Coastal and Barrier
Southern Plains
National Capital Region
Network

Figure C

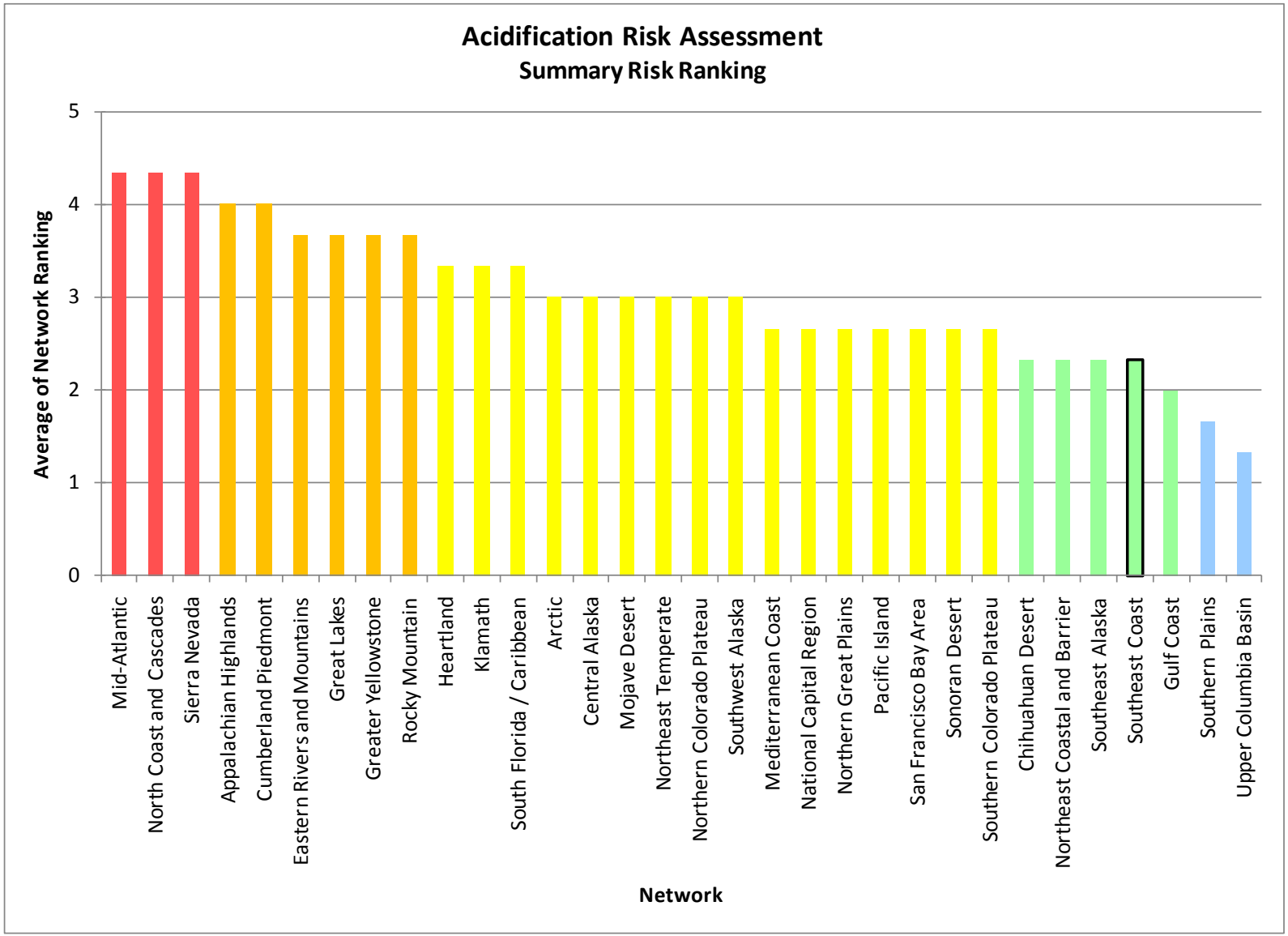

Acidification Risk Assessment
Summary Risk Ranking
Average of Network Ranking
0
1
2
3
4
5
Mid-Atlantic
North Coast and Cascades
Sierra Nevada
Appalachian Highlands
Cumberland Piedmont
Eastern Rivers and Mountains
Great Lakes
Greater Yellowstone
Rocky Mountain
Heartland
Klamath
South Florida / Caribbean
Arctic
Central Alaska
Mojave Desert
Northeast Temperate
Northern Colorado Plateau
Southwest Alaska
Mediterranean Coast
National Capital Region
Northern Great Plains
Pacific Island
San Francisco Bay Area
Sonoran Desert
Southern Colorado Plateau
Chihuahuan Desert
Northeast Coastal and Barrier
Southeast Alaska
Southeast Coast
Gulf Coast
Southern Plains
Upper Columbia Basin
Network

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 910/107413, April 2011

National Park Service
U.S. Department of the Interior

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