



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

South Florida/Caribbean Network (SFCN)

Natural Resource Report NPS/NRPC/ARD/NRR—2011/332



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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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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South Florida/Caribbean Network (SFCN)

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 four parks in the South Florida/Caribbean Network that are larger than 100 square miles: Big Cypress (BICY), Biscayne (BISC), Dry Tortugas (DRTO), and Everglades (EVER). In addition, there are two smaller parks: Buck Island Reef (BUIS) and Virgin Islands (VIIS).

Total annual N emissions, by county, are shown in Map C for lands in and surrounding the South Florida/Caribbean 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 between 1 and 20 tons per square mile throughout most of the network, with higher values in a few areas. Point source emissions of oxidized (nitrogen oxides, NO_x) and reduced (ammonia, NH_3) N are shown in Map D. There are many relative large (larger than 2,000 tons per year) point sources scattered throughout the portion of the network in Florida. The largest point sources are sources of oxidized N, although there are also some moderate size sources of reduced N. Urban centers within the network and within a 300 mile buffer around the network are shown in Map E. There are many population centers in the range of 50,000 to 500,000 people, scattered around the south Florida coastline.

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 as low as 5 to 10 kg N/ha/yr to as high as 10 to 15 kg N/ha/yr across broad areas of the network. Smaller areas receiving both lower (2 to 5 kg/ha/yr) and higher (more than 15 kg/ha/yr) estimated atmospheric deposition also occur in limited areas.

Land cover in and around the network is shown in Map G. The predominant cover types within this network are highly varied, and include in particular forest, wetland, pasture/hay, row crop, developed land, and shrubland cover types.

Map H shows 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). The largest parks in this network are EVER, BICY, and BISC. The predominant sensitive vegetation types within these parks is wetland.

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. The only Class I area and the only designated wilderness in this network are in EVER. Most of this park is designated wilderness.

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 South Florida/Caribbean Network ranks at the bottom of the highest quintile, among networks, in N Pollutant Exposure (Figure A). Nitrogen emissions and N deposition within the network are both high. The network Ecosystem Sensitivity ranking is also relatively high, within the second highest quintile among networks (Figure B). This is mainly because there is substantial coverage of vegetation types in this network that are among those expected to be especially sensitive to nutrient enrichment effects from N deposition. This network ranks at the bottom of the second highest quintile in Park Protection, having moderately high amounts of protected lands (Figure C).

In combination, the network rankings for Pollutant Exposure, Ecosystem Sensitivity, and Park Protection yield an overall Network Risk ranking that is in the highest 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 High.

Similarly, park rankings are given in Figures E through H for the same metrics. In the case of the park rankings, we only show in the figures the parks that are larger than 100 square miles. Relative ranks for all parks, including the smaller parks, are given in Table A and Appendix B. As for the network ranking figures, the park ranking figures highlight those parks that occur in this network to show their relative position compared with parks in the other 31 networks. Note that the rankings shown in Figures E through H reflect the rank of a given park compared with all other parks, irrespective of size.

Five of the six parks in this network (all except DRTO) are ranked in the highest (BUIS, EVER, VIIS) or second highest quintile in Pollutant Exposure (Figure E, Table A). Two of the parks (BICY and EVER) rank Very High (i.e., in the highest quintile among parks) or High (in the second highest quintile) in Ecosystem Sensitivity (Figure F). Ecosystem Sensitivity in the other parks is ranked much lower (Table A). Two parks (EVER and VIIS) rank at the top among parks in Park Protection, and BICY is ranked in the second highest quintile in that theme (Figure G). The overall Summary Park Risk ranking places BICY, EVER, and VIIS in the highest quintile among all parks. BISC and BUIS rank in the middle quintile and DRTO in the lowest quintile for Summary Risk (Figure H, Table A).

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.

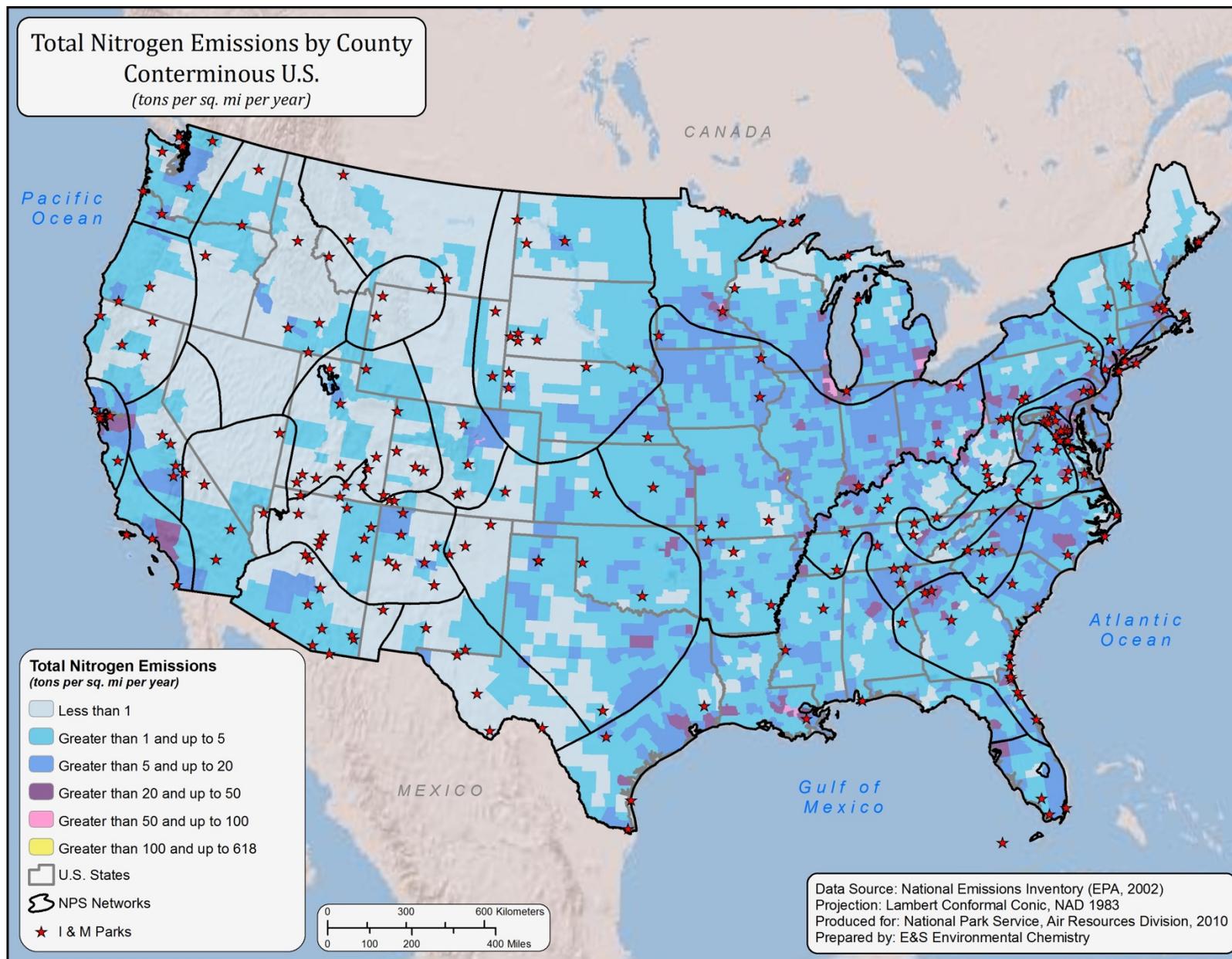
I&M Parks ² in Network	Relative Ranking of Individual Parks ¹			
	Pollutant Exposure	Ecosystem Sensitivity	Park Protection	Summary Risk
<i>Big Cypress</i>	High	Very High	High	Very High
<i>Biscayne</i>	High	Low	Moderate	Moderate
Buck Island Reef	Very High	Very Low	Moderate	Moderate
<i>Dry Tortugas</i>	Moderate	Very Low	Moderate	Very Low
<i>Everglades</i>	Very High	High	Very High	Very High
Virgin Islands	Very High	Very Low	Very High	Very 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)

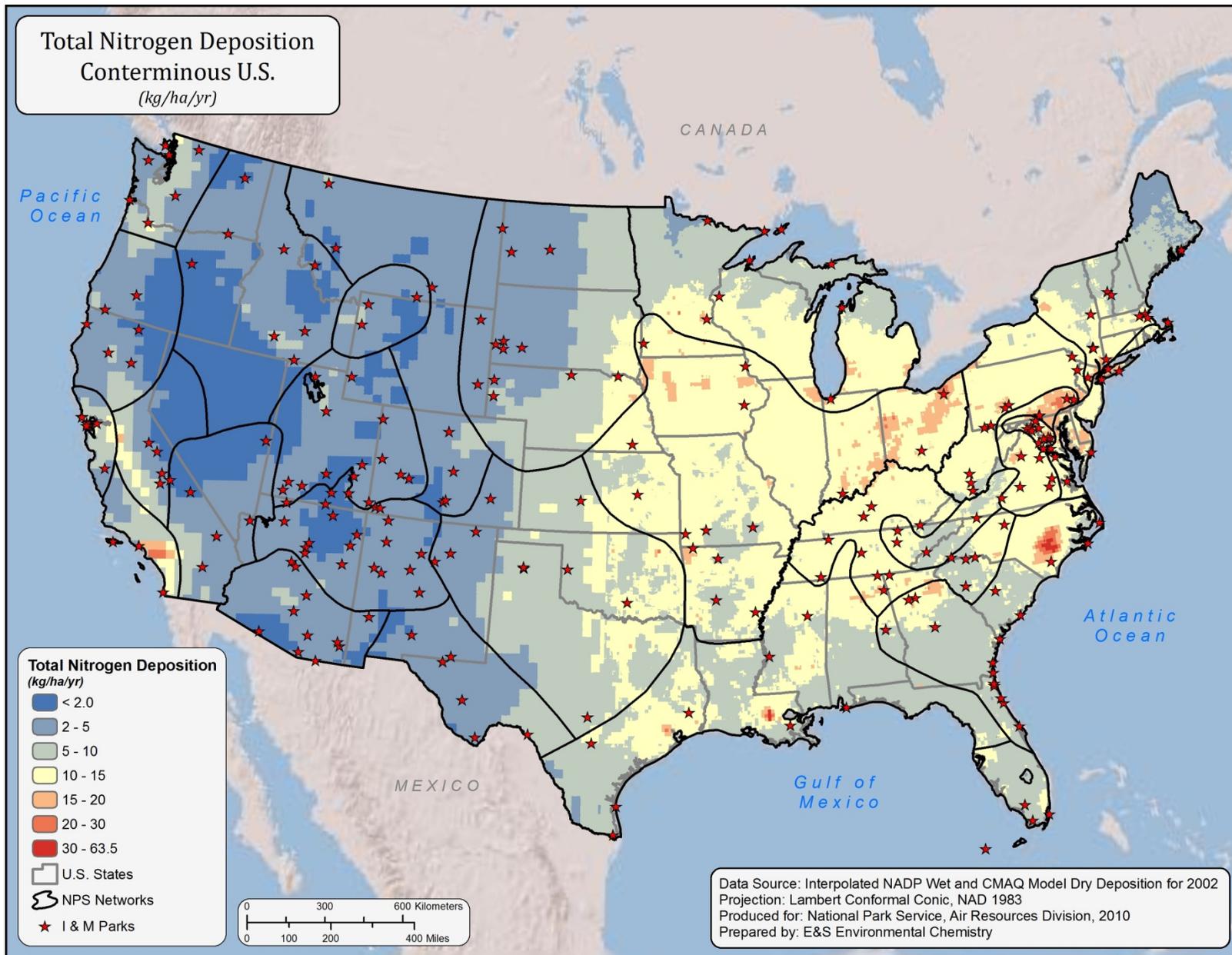
- Map F. Total N deposition in and around the network. Included in the total are wet plus dry forms of both oxidized (nitrogen oxides, NO_x) and reduced (ammonia, NH₃) N. Values are expressed as kilograms of N deposited per hectare per year. (Source of data: Interpolated NADP wet and CMAQ Model dry deposition 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 H. Distribution within the larger parks that occur in this network of the five terrestrial vegetation types thought to be most sensitive to N-nutrient enrichment effects: arctic, alpine, meadow, wetland, and arid and semi-arid. (Source of data: See Appendix A)
- 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.
- Figure E. Park rankings for Pollutant Exposure for all parks larger than 100 square miles. Ranks for each park were calculated relative to all parks, regardless of size, as the average of scores for all Pollutant Exposure variables.
- Figure F. Park rankings for Ecosystem Sensitivity for all parks larger than 100 square miles. Ranks for each park were calculated relative to all parks, regardless of size, as the average of scores for all Ecosystem Sensitivity variables.
- Figure G. Park rankings for Park Protection for all parks larger than 100 square miles. Ranks for each park were calculated relative to all parks, regardless of size, as the average of scores for all Park Protection variables.
- Figure H. Park rankings for Summary Risk for all parks larger than 100 square miles. Ranks for each park were calculated relative to all parks, regardless of size, as the average of scores for all Summary Risk variables.

SFCN-5

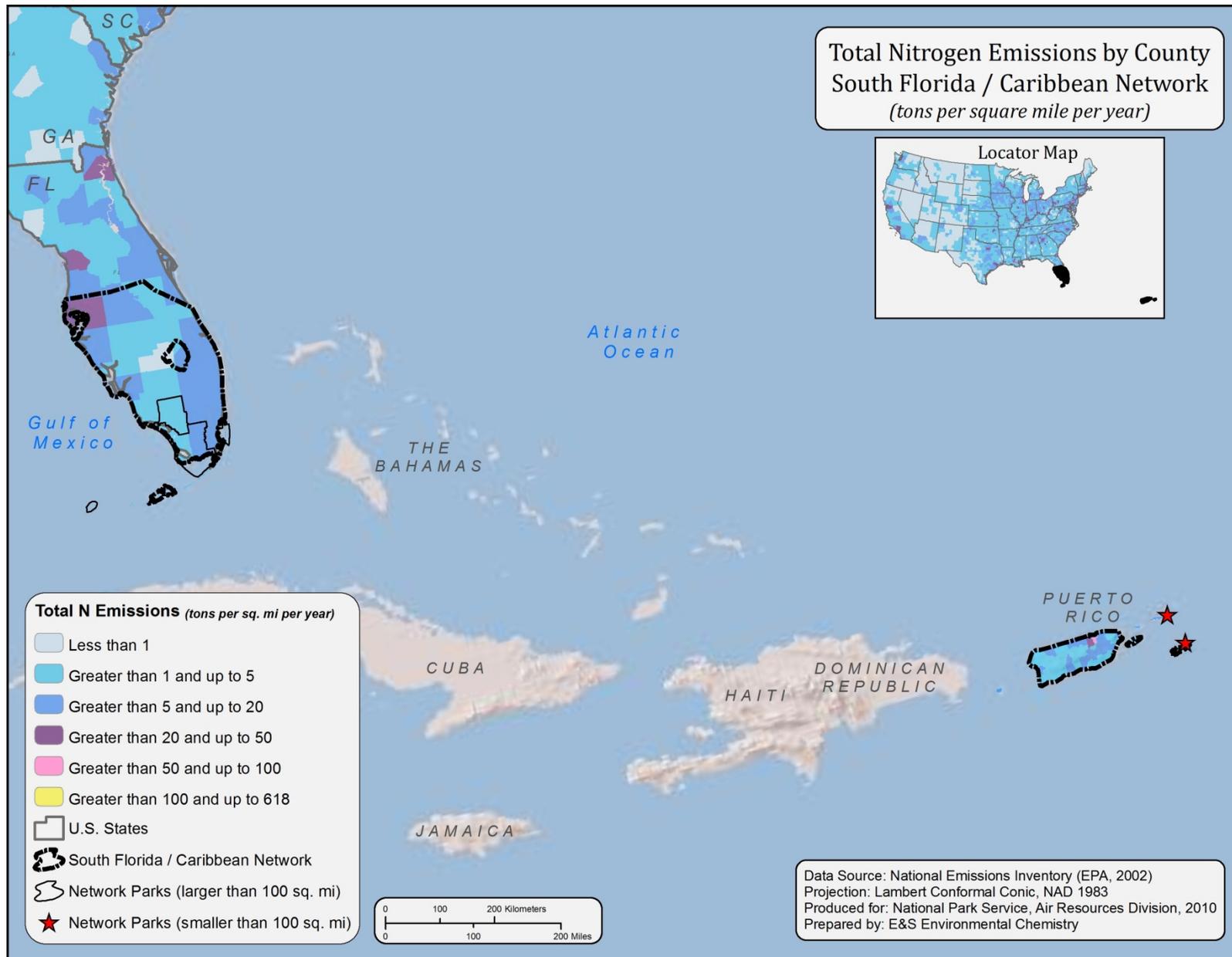


Map A

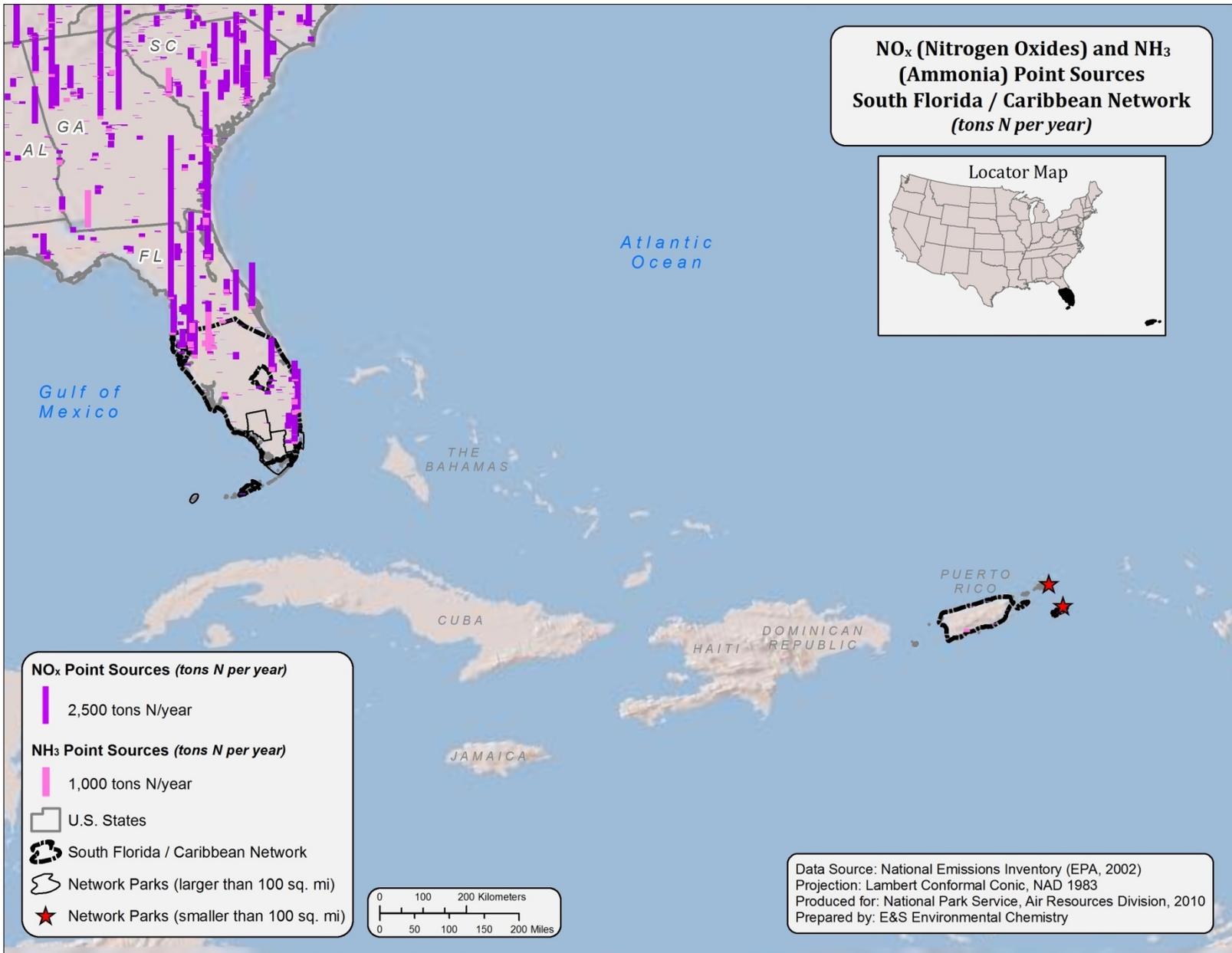
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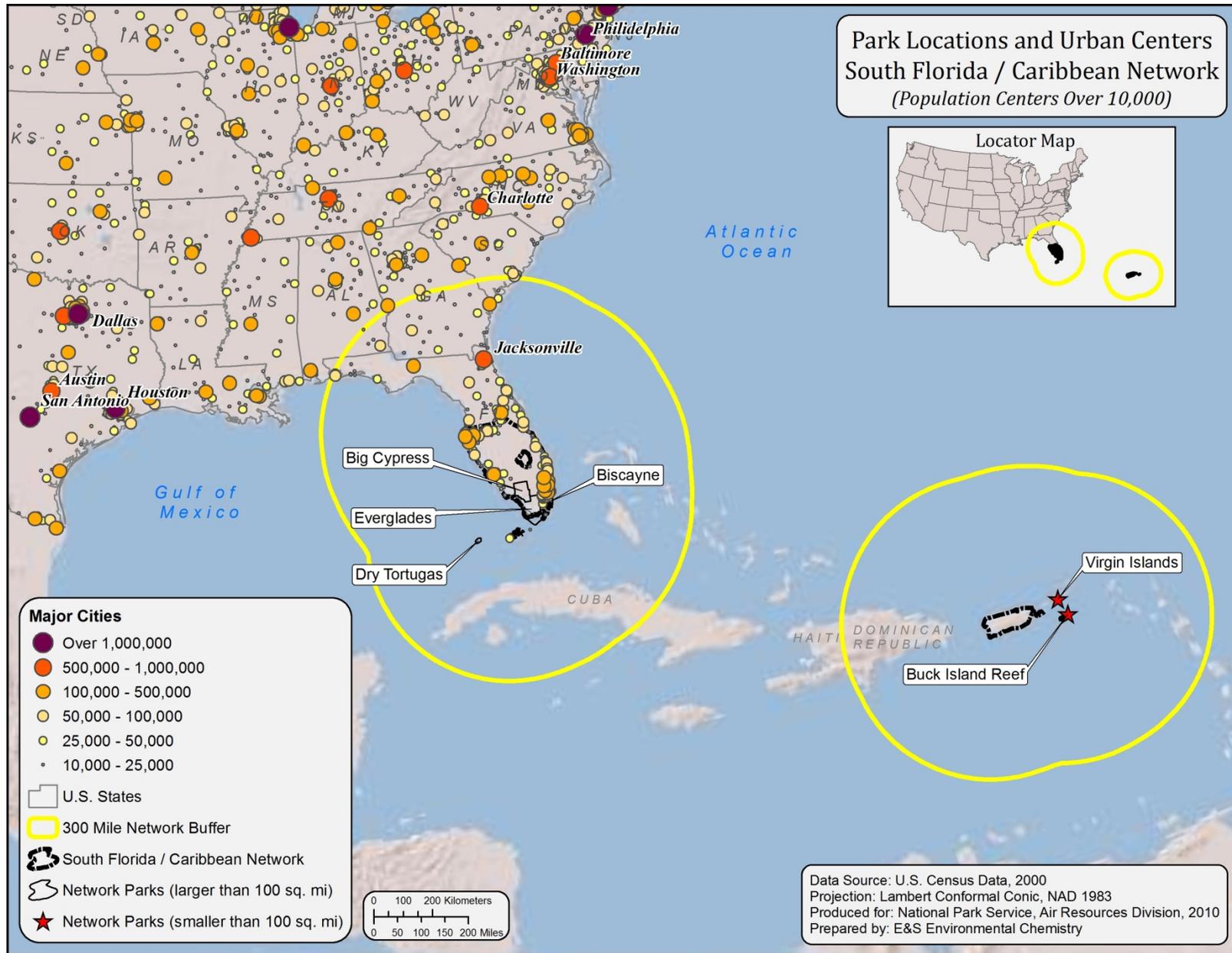
Map B



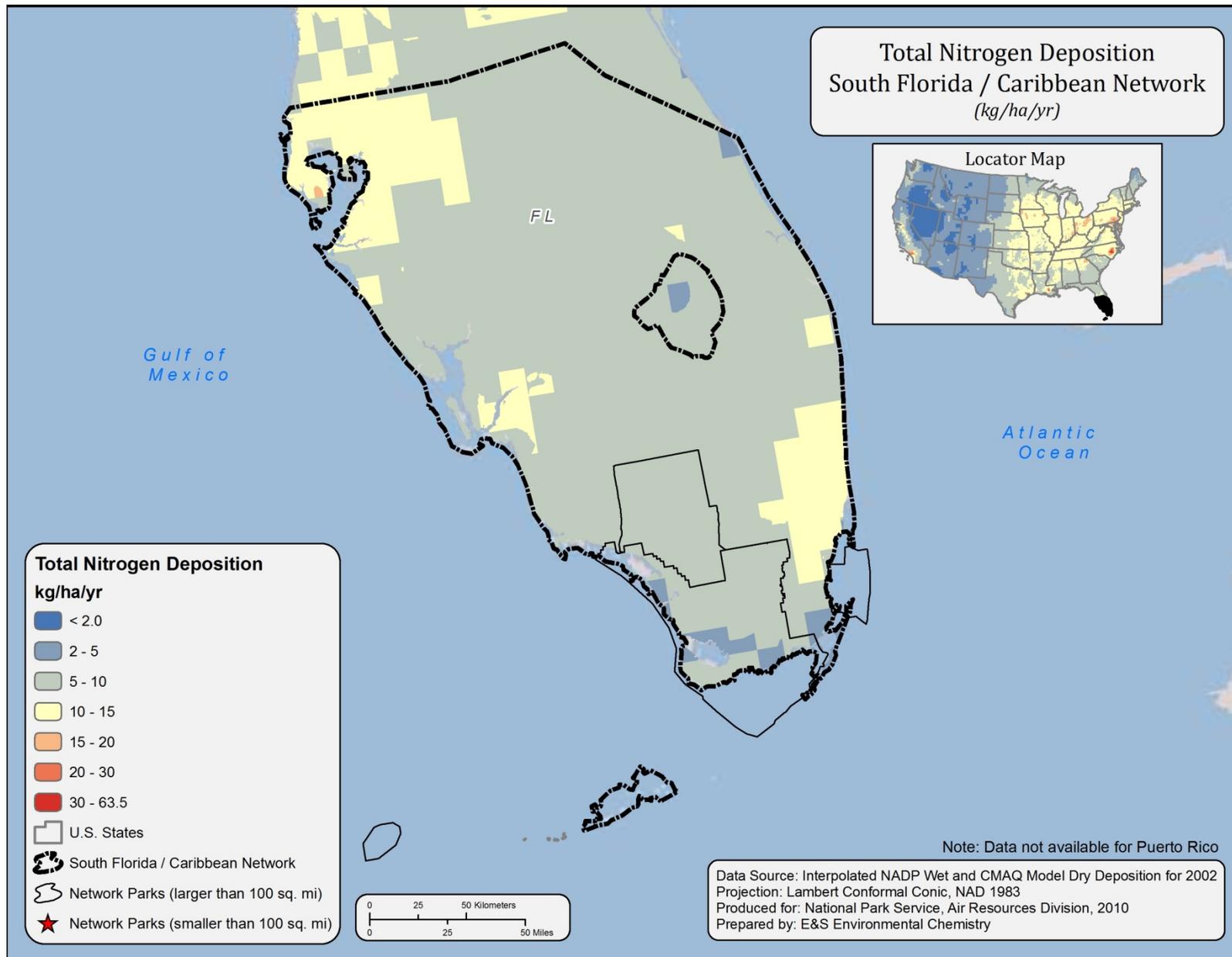
Map C



Map D

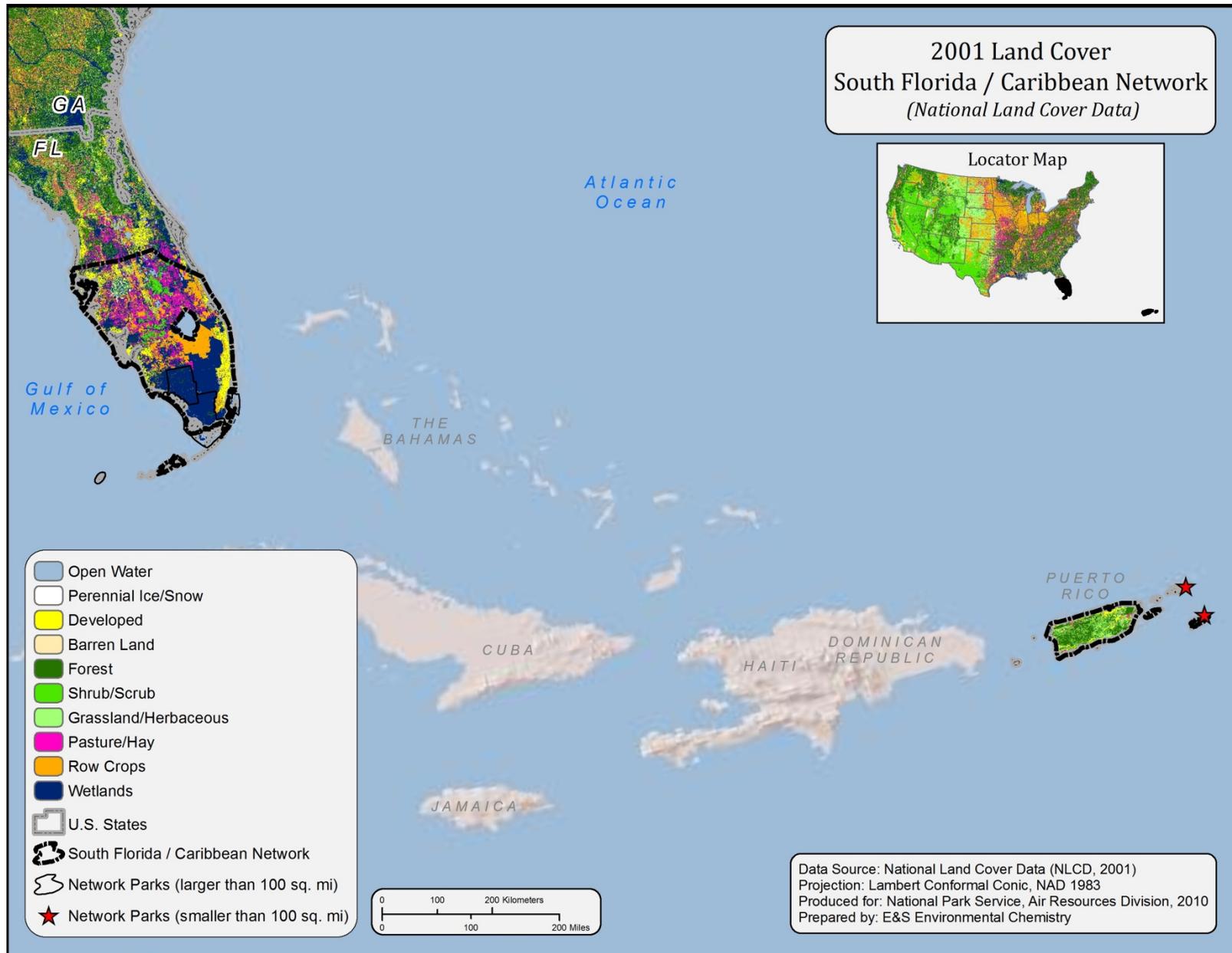


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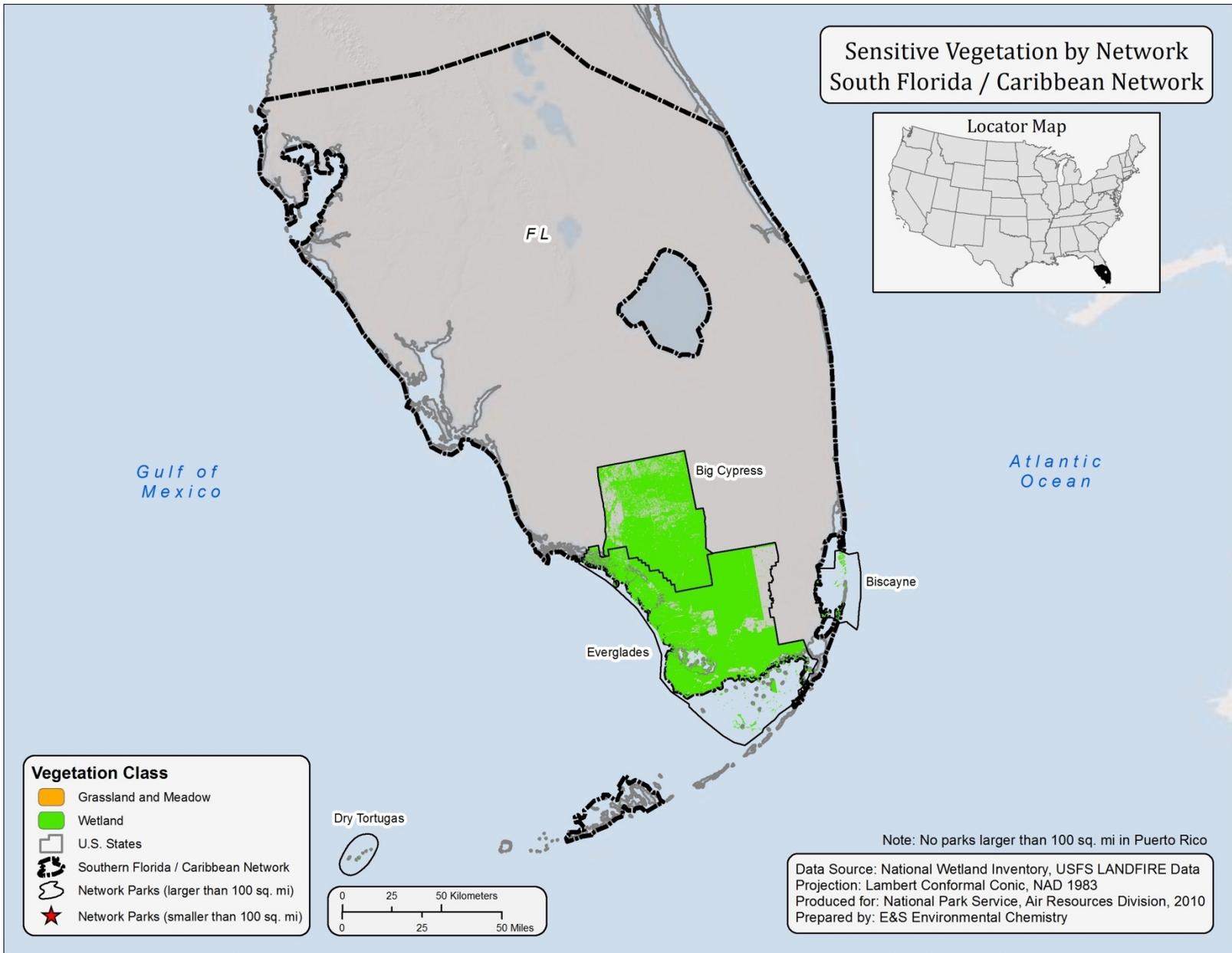


Map F

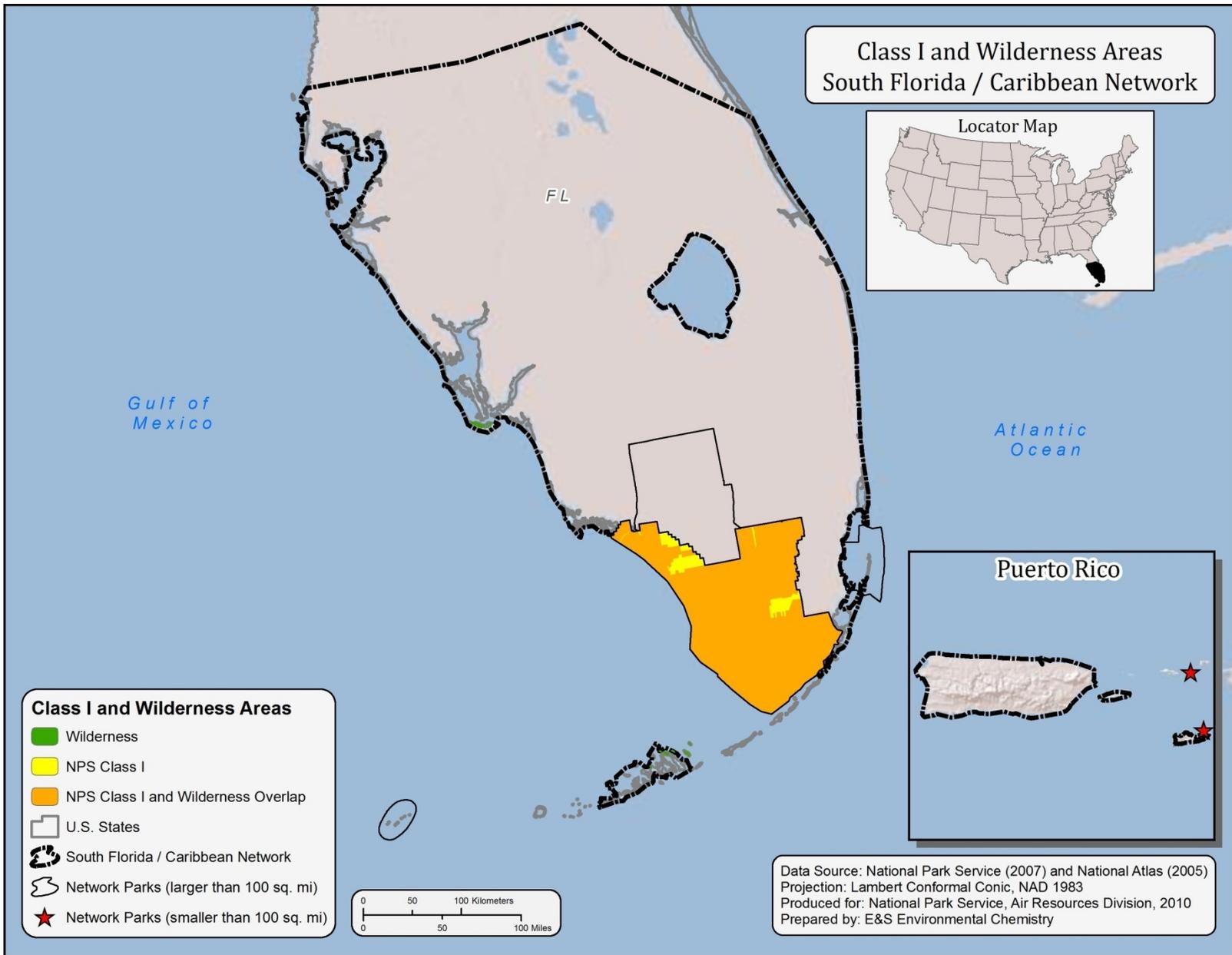
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Map G



Map H



Map I

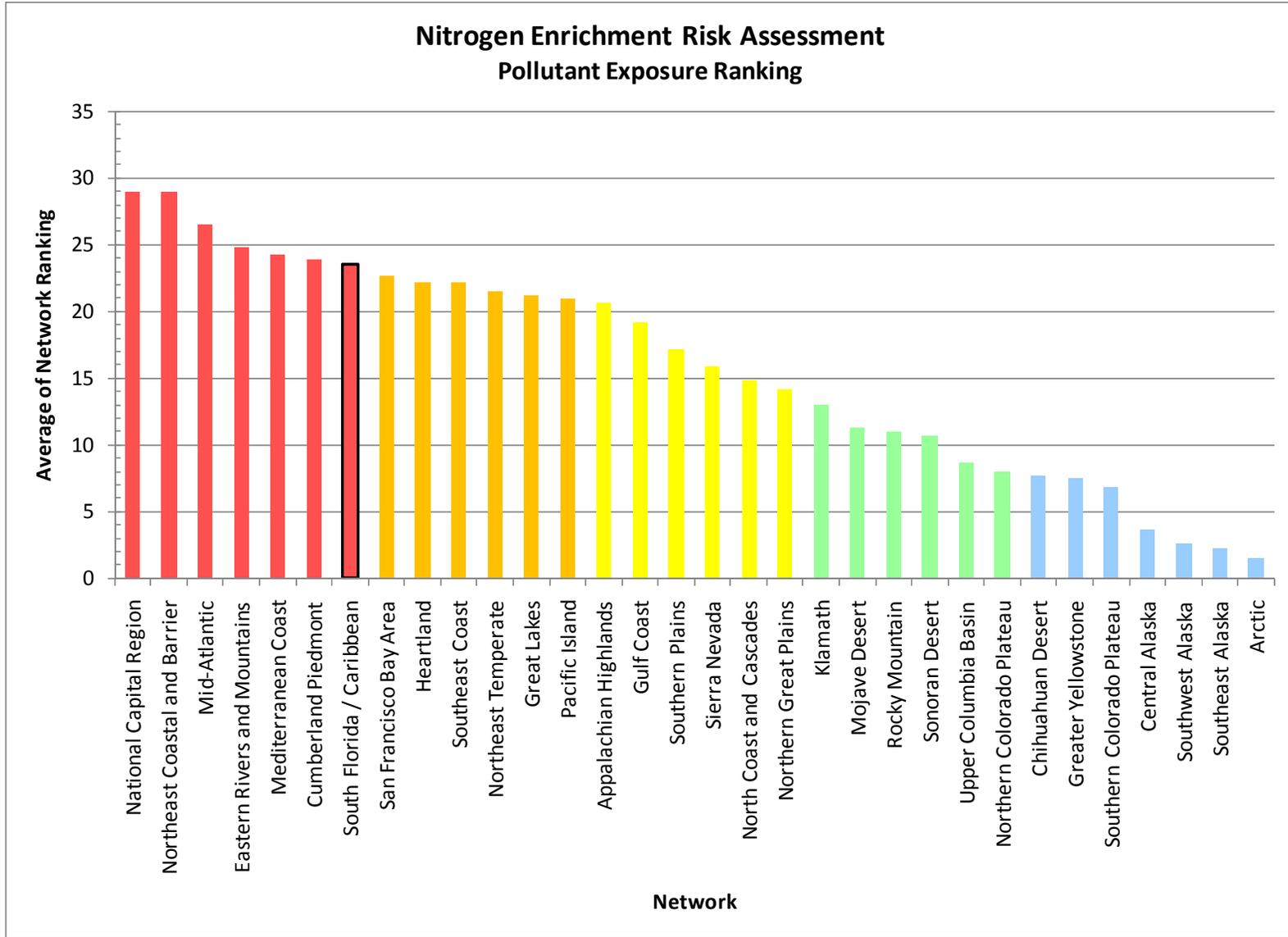


Figure A

SPCN-15

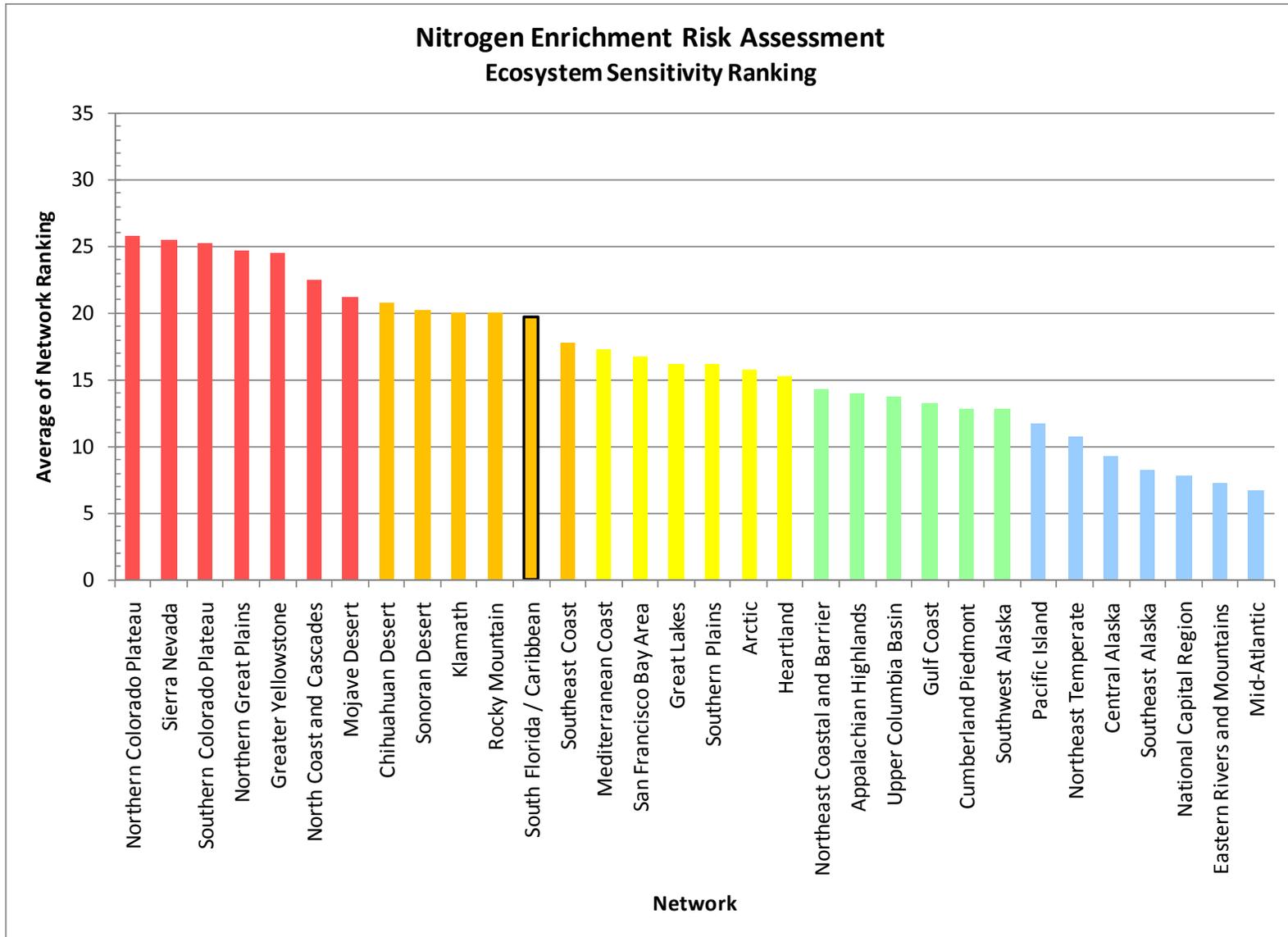


Figure B

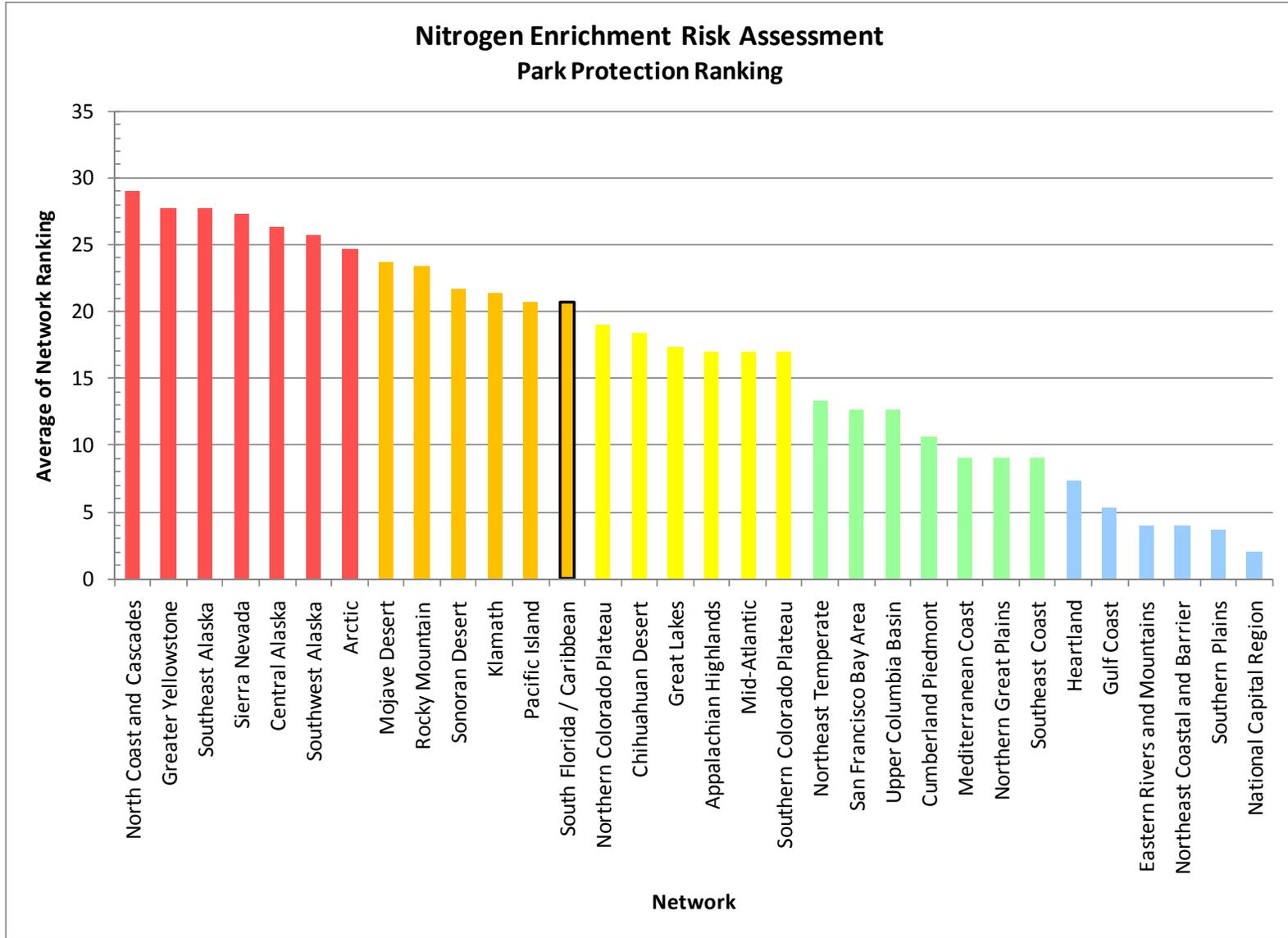


Figure C

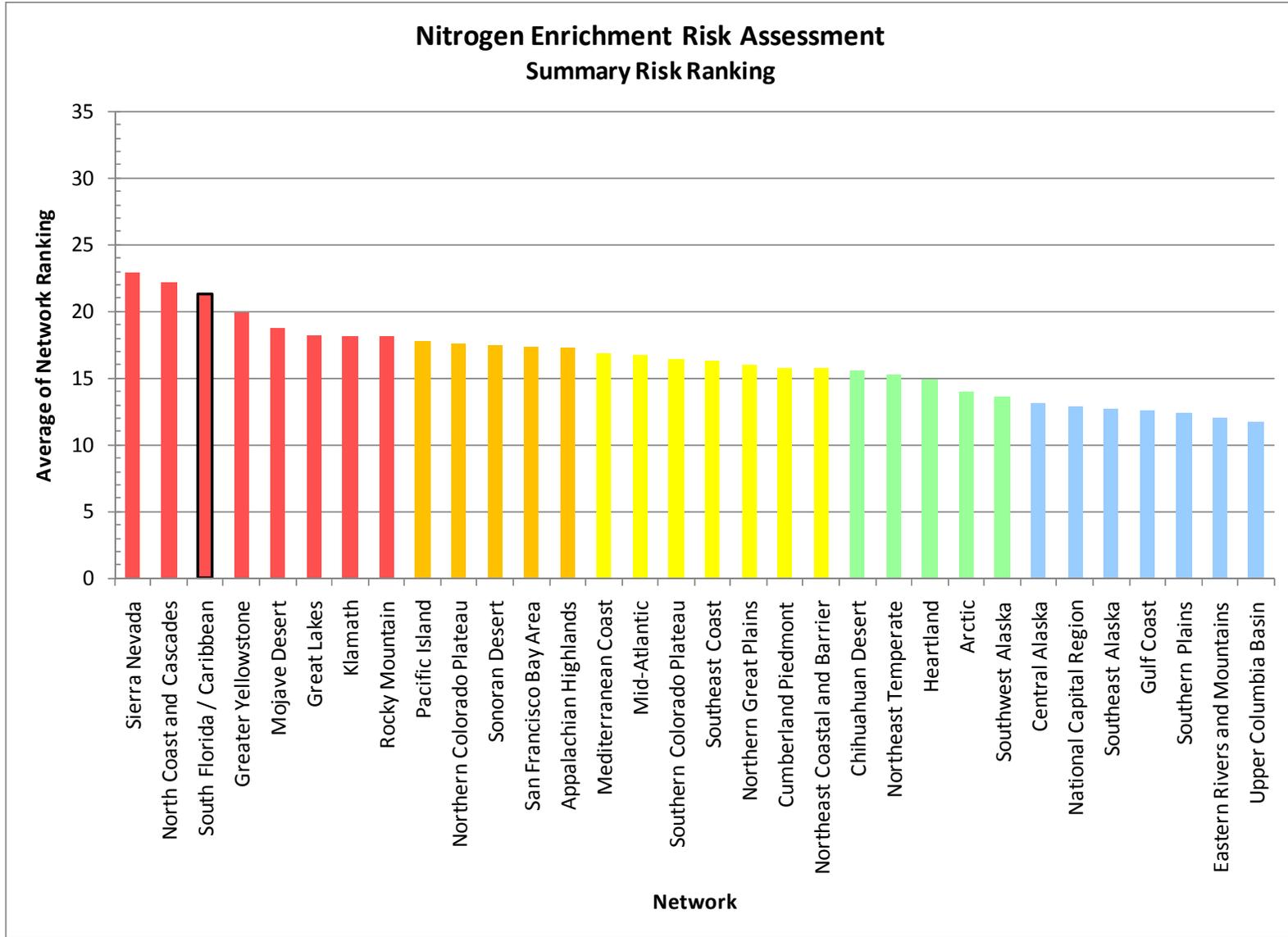


Figure D

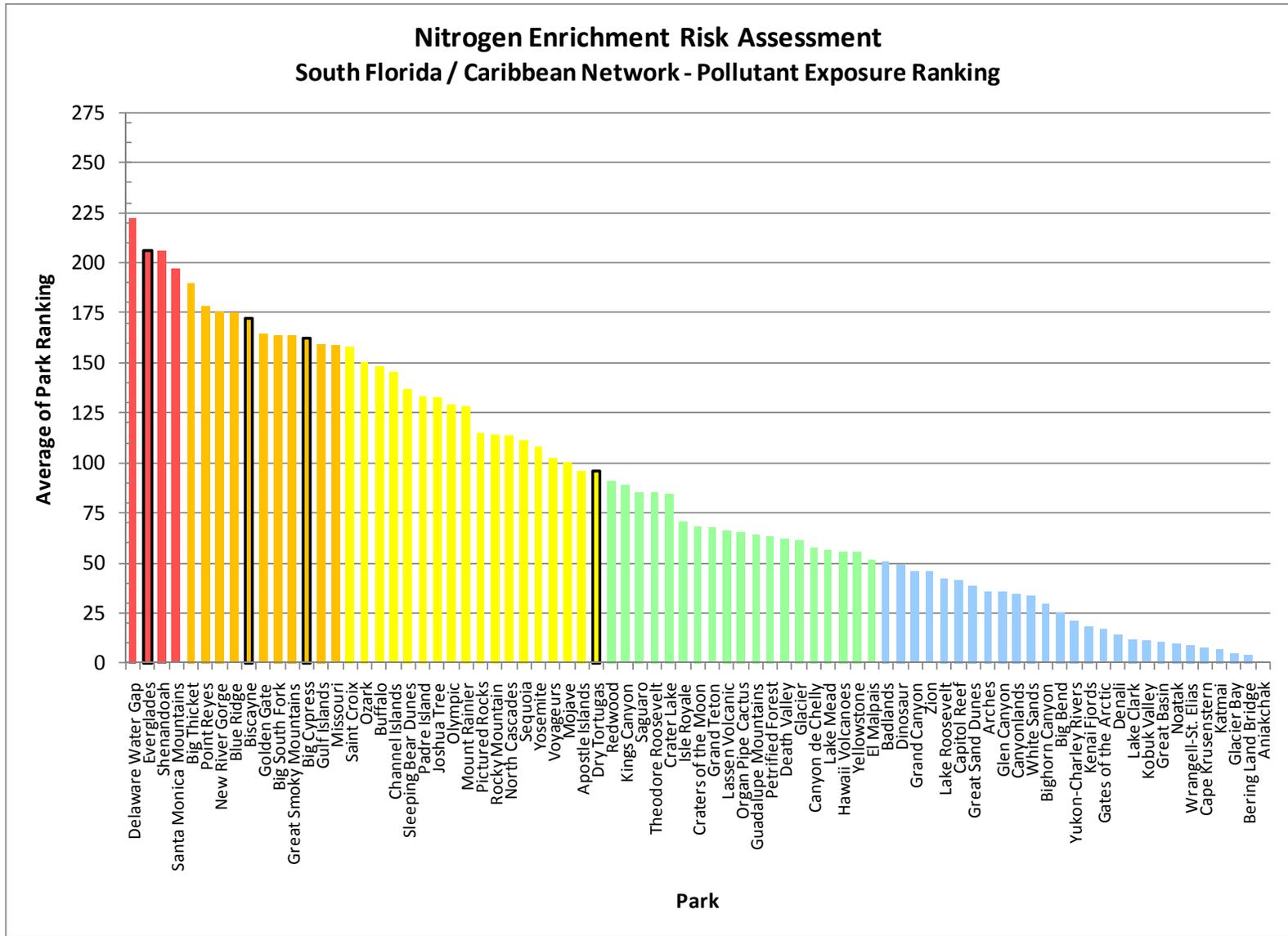


Figure E

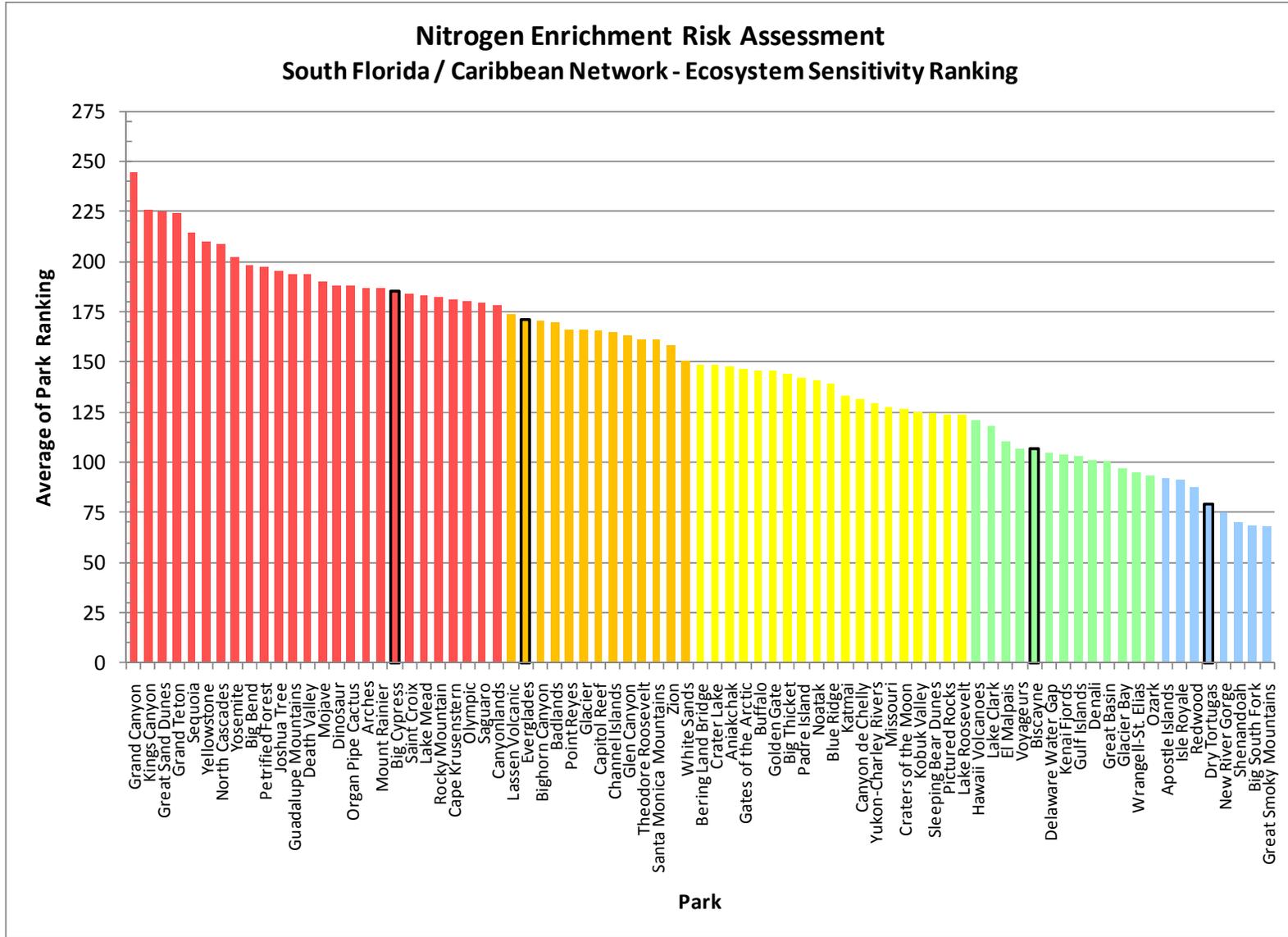


Figure F

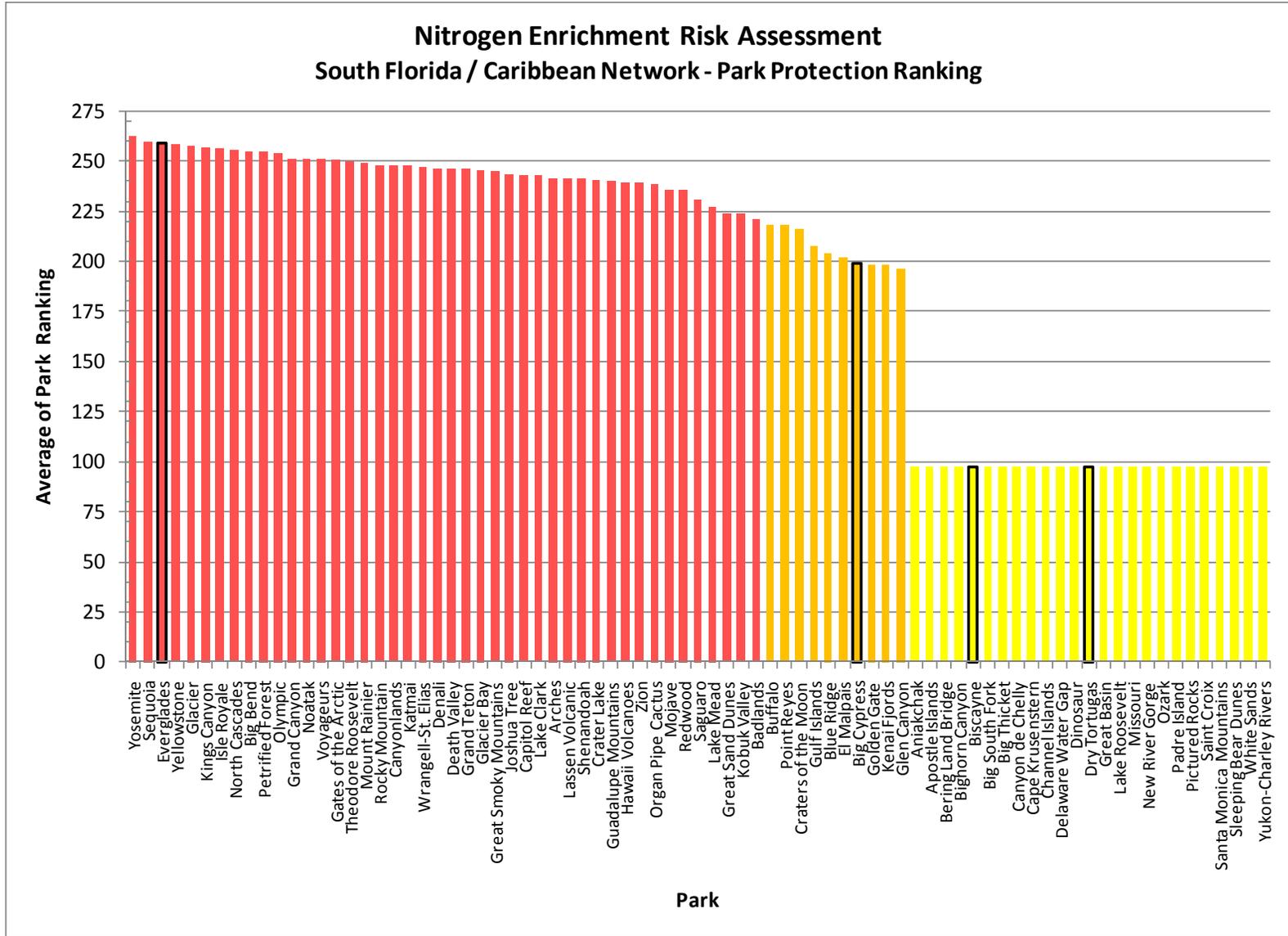


Figure G

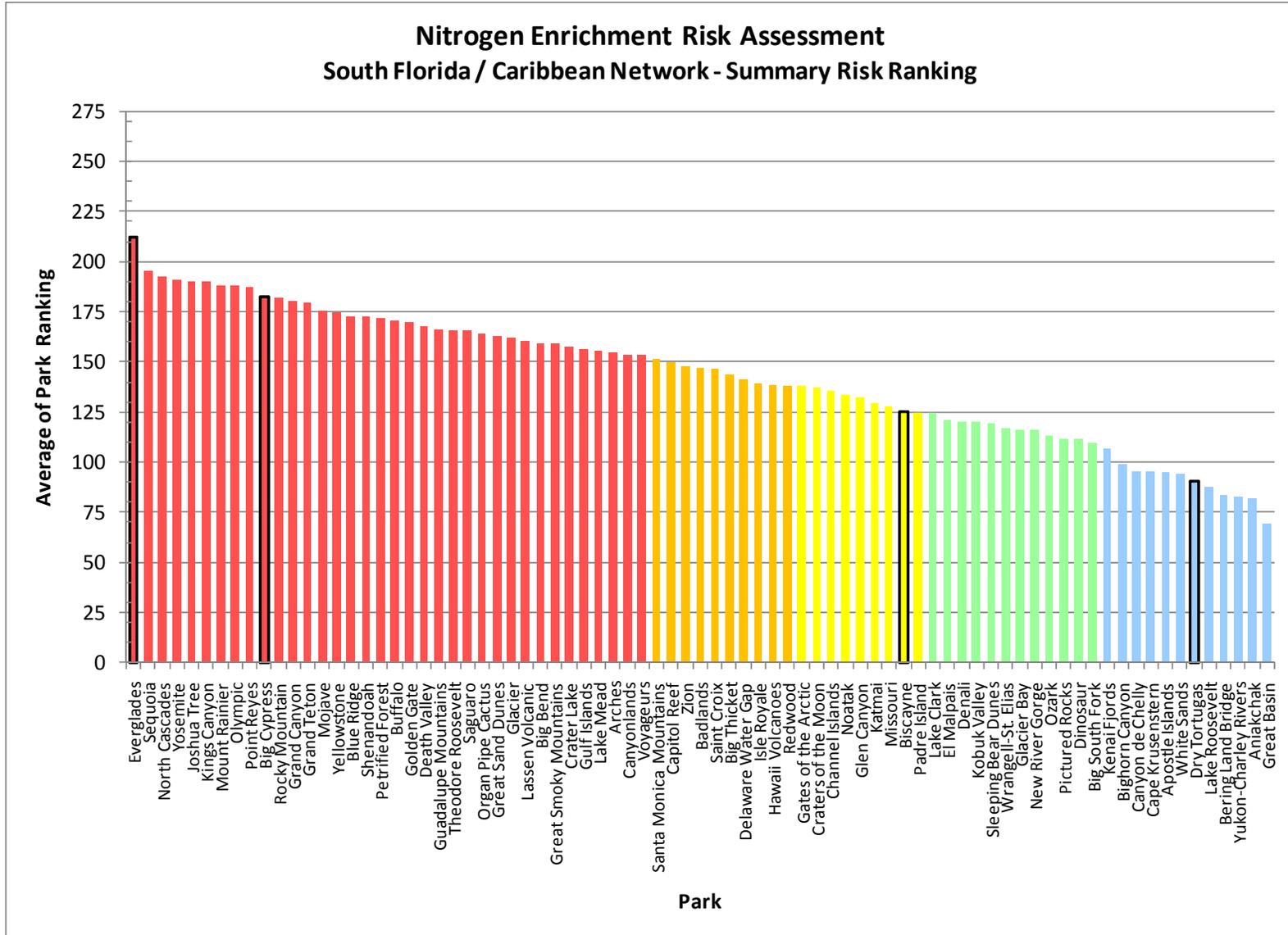


Figure H

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.

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