Camper Travel Patterns: What Do State-Level Data Tell Us?

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Background

- I work on spatial and temporal aspects of invasions, typically at broad scales
  - Focus on human-mediated pathways
- At last year's Continental Dialogue meeting
  - I presented analyses of National Recreation Reservation Service data (NRRS)
    - Patterns of camper travel (and presumably firewood movement)
  - As a group, we discussed need for additional analyses
- Opportunity arose via TNC to work with North Carolina State Parks data
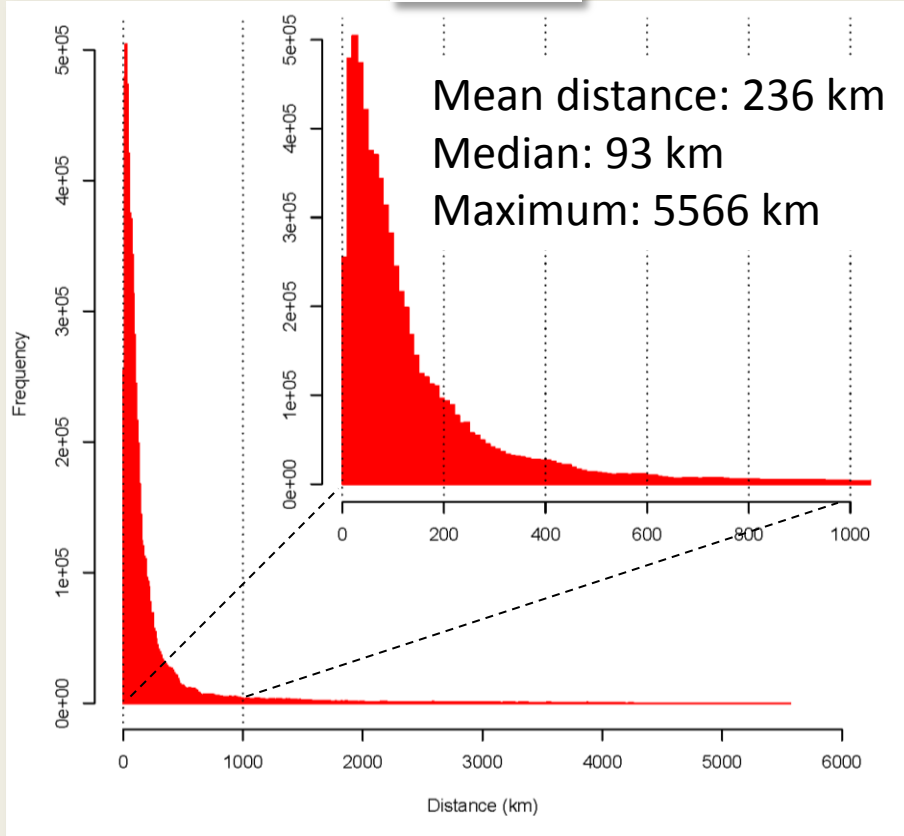 - Margaret Fields and Markus Le deserve lots of credit!
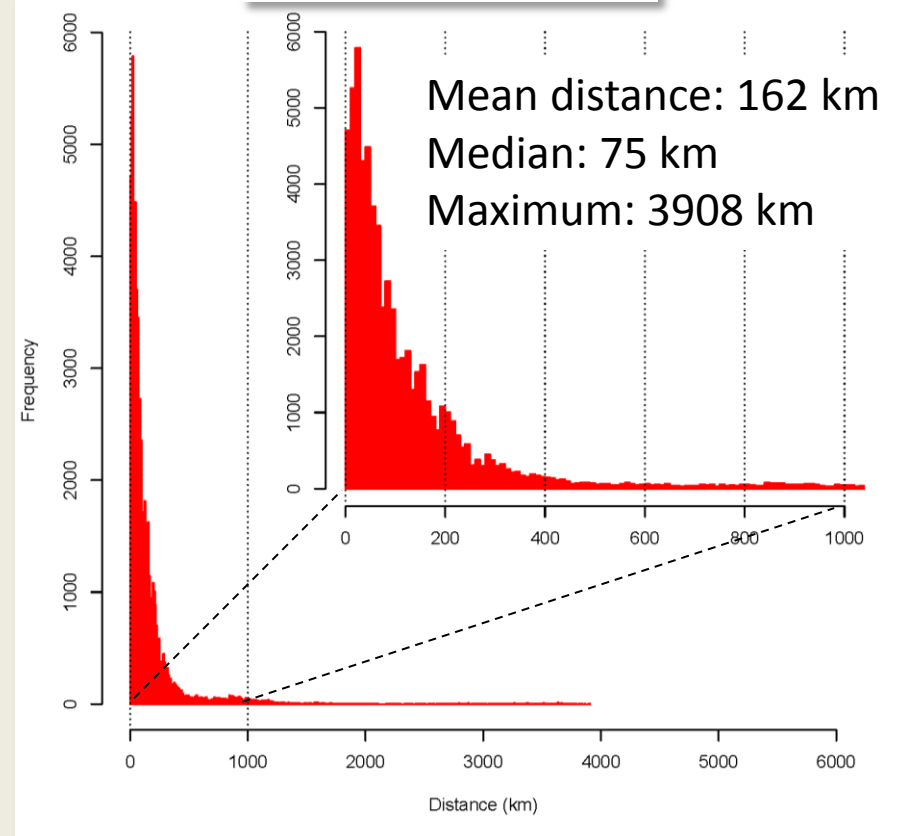
NRRS data vs. NC State Parks data

- NRRS
  - 7.2 million reservations over ≈5-year period
  - > 2500 campgrounds
- NC State Parks
  - 65,520 reservations over 1 year (Oct 2013-Sept 2014)
  - 29 parks
  - Fields: park location, camper origin ZIP code, date of reservation, number of people, number of days
  - Calculated (straight-line) travel distance between origin and park
  - Unlike NRRS, information on how reservation was made: **Web**, **Telephone**, or **On-Site** ("Field Manager")
- Neither provides information on camper firewood usage
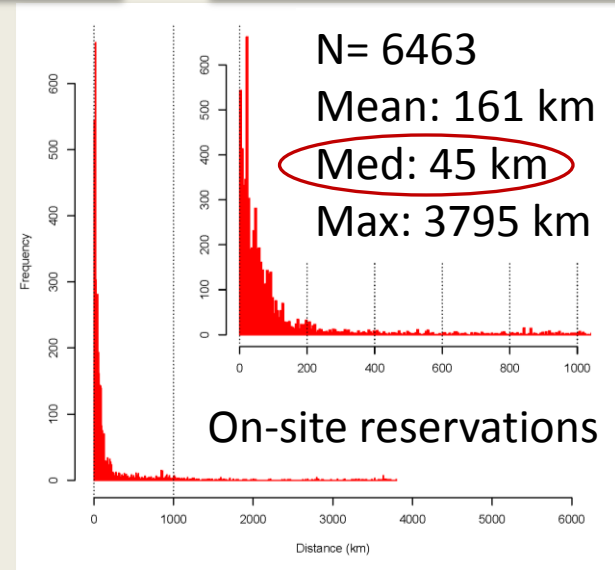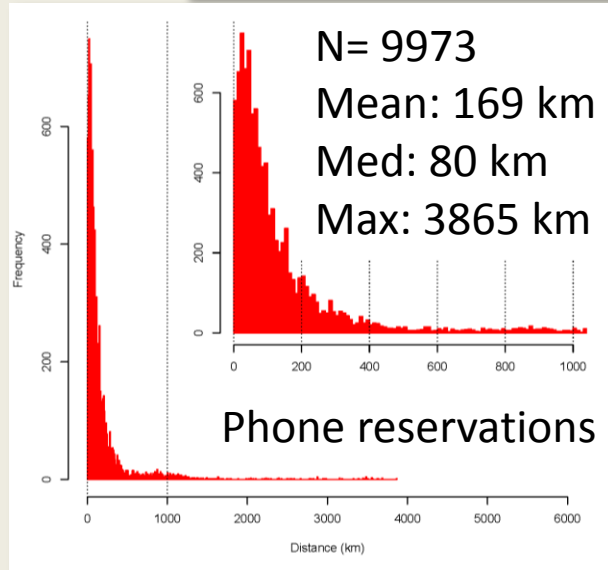
Histograms of camper travel distances

NRRS

NC State Parks

Mean distance: 236 km
Median: 93 km
Maximum: 5566 km

Mean distance: 162 km
Median: 75 km
Maximum: 3908 km

NC State Parks, histograms by reservation type

Mean: 162 km
Med: 75 km
Max: 3908 km

All reservations

N= 49264
Mean: 161 km
Med: 80 km
Max: 3908 km

Web reservations

N= 9973
Mean: 169 km
Med: 80 km
Max: 3865 km

Phone reservations

N= 6463
Mean: 161 km
Med: 45 km
Max: 3795 km

On-site reservations
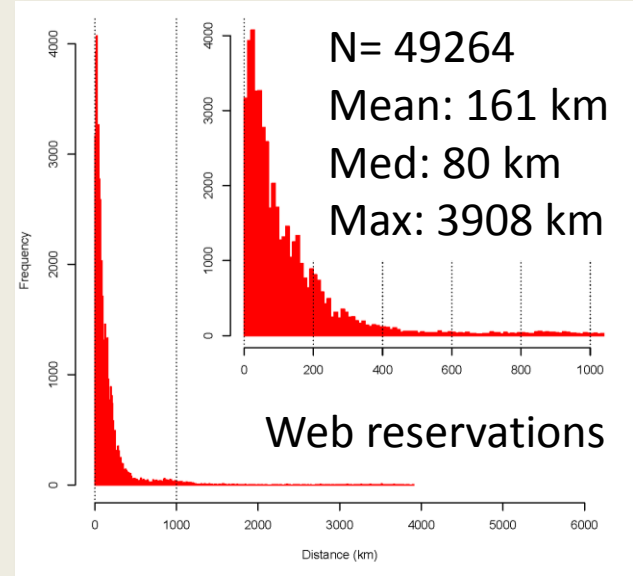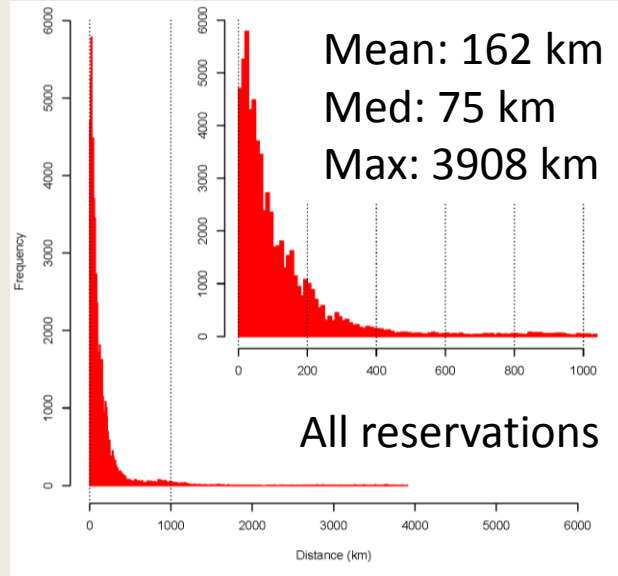
Number of camper reservations broken down by type
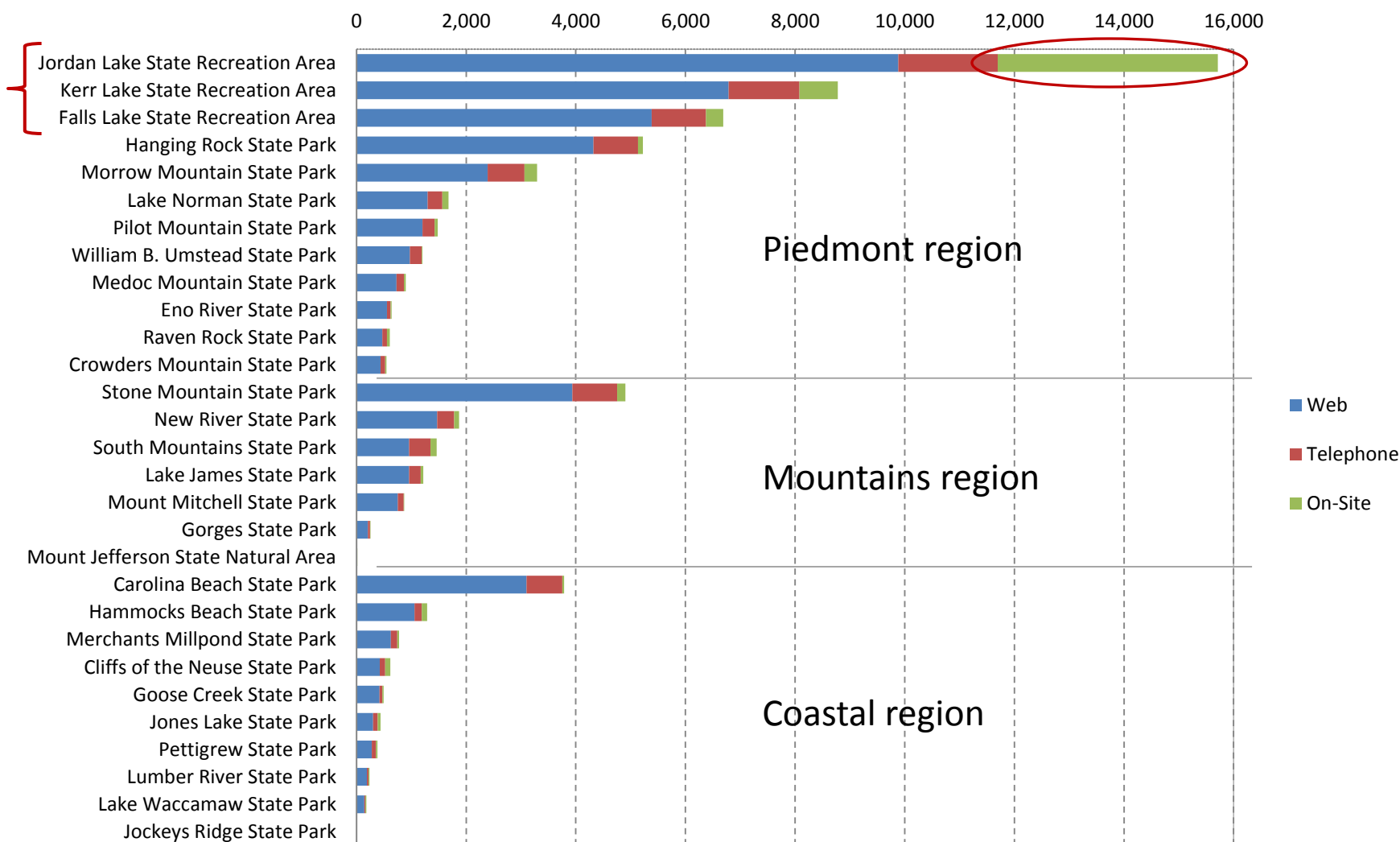
In-state vs. out-of-state camper origin

Region / Park		# Res	In State (%)	Out of State (%)
				Visitor Origin
Coastal	Carolina Beach State Park	3788	80.9	19.1
	Cliffs of the Neuse State Park	618	89.6	10.4
	Goose Creek State Park	495	85.5	14.5
	Hammocks Beach State Park	1290	78.4	21.6
	Jockeys Ridge State Park	6	.	100.0
	Jones Lake State Park	436	81.0	19.0
	Lake Waccamaw State Park	181	89.5	10.5
	Lumber River State Park	235	87.7	12.3
	Merchants Millpond State Park	774	53.9	46.1
	Pettigrew State Park	380	73.2	26.8
Mountains	Gorges State Park	253	45.5	54.5
	Lake James State Park	1218	84.7	15.3
	Mount Jefferson State Natural Area	11	90.9	9.1
	Mount Mitchell State Park	868	49.1	50.9
	New River State Park	1868	84.0	16.0
	South Mountains State Park	1460	85.1	14.9
	Stone Mountain State Park	4903	88.3	11.7
Piedmont	Crowders Mountain State Park	544	73.2	26.8
	Eno River State Park	641	93.3	6.7
	Falls Lake State Recreation Area	6687	88.6	11.4
	Hanging Rock State Park	5222	88.4	11.6
	Jordan Lake State Recreation Area	15711	92.7	7.3
	Kerr Lake State Recreation Area	8777	80.8	19.2
	Lake Norman State Park	1676	83.5	16.5
	Medoc Mountain State Park	899	63.7	36.3
	Morrow Mountain State Park	3292	90.7	9.3
	Pilot Mountain State Park	1479	87.6	12.4
	Raven Rock State Park	606	92.6	7.4
	William B. Umstead State Park	1202	87.3	12.7

Regional differences in travel distances

Median visitor travel distance by park

Carolina Beach State Park
Cliffs of the Neuse State Park
Goose Creek State Park
Hammocks Beach State Park
Jones Lake State Park
Lake Waccamaw State Park
Lumber River State Park
Merchants Millpond State Park
Pettigrew State Park
Crowders Mountain State Park
Eno River State Park
Falls Lake State Recreation Area
Hanging Rock State Park
Jordan Lake State Recreation Area
Kerr Lake State Recreation Area
Lake Norman State Park
Medoc Mountain State Park
Morrow Mountain State Park
Pilot Mountain State Park
Raven Rock State Park
William B. Umstead State Park
Gorges State Park
Lake James State Park
Mount Mitchell State Park
New River State Park
South Mountains State Park
Stone Mountain State Park

Coastal

Piedmont

Mountains

Median Distance (km)

Network Modeling

- At last year's meeting, presented results of analyses completed with network model using NRRS data

- Similar network model built for NC State Parks data

  - Programmed in R (by Markus)

  - Bidirectional network

  - Key assumption: 15% of campers bring firewood home with them

Movement of a pest through the network with recreational travel

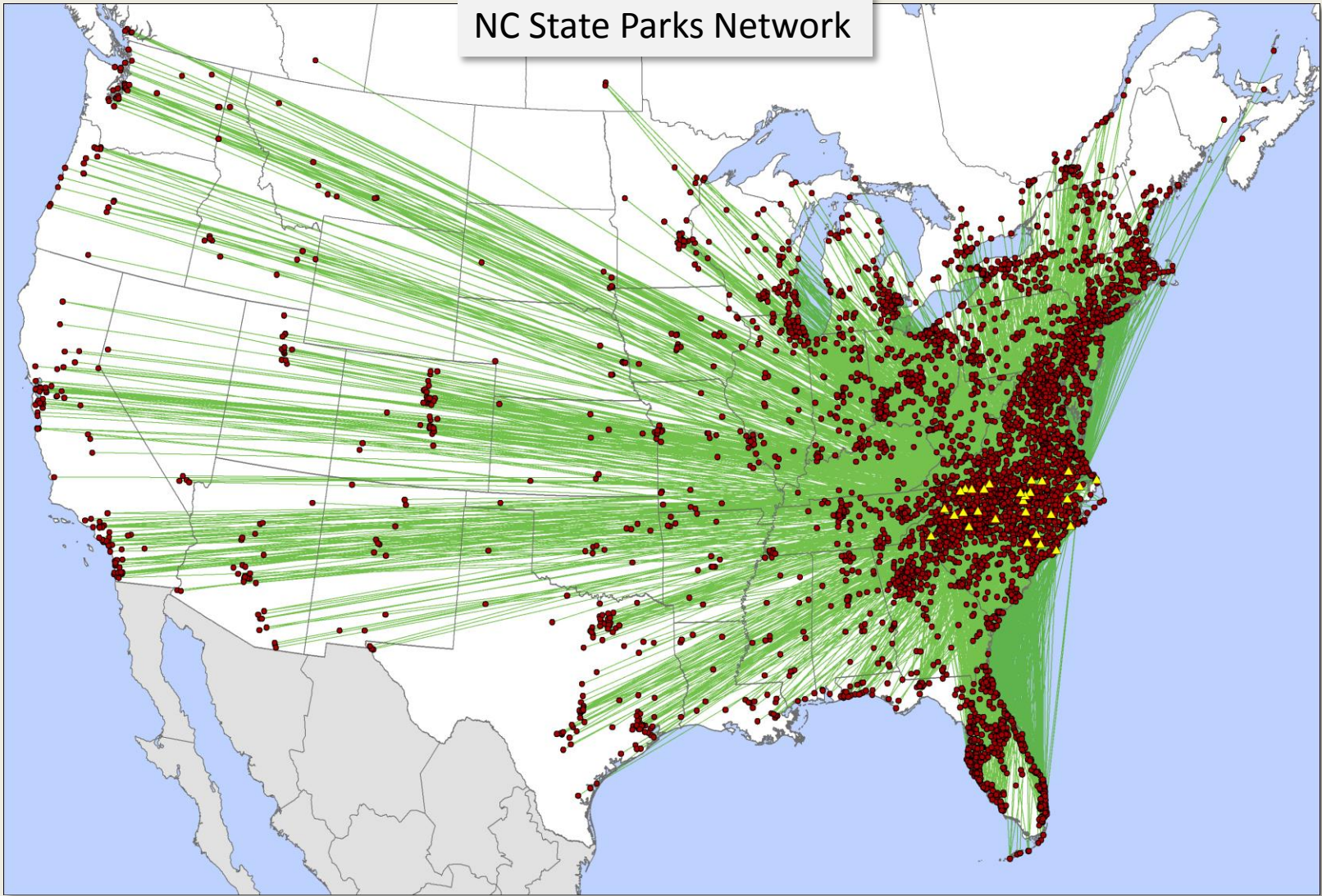⟵ - Pathways in the network

⬤ - Campgrounds

◯ - Visitors' home locations
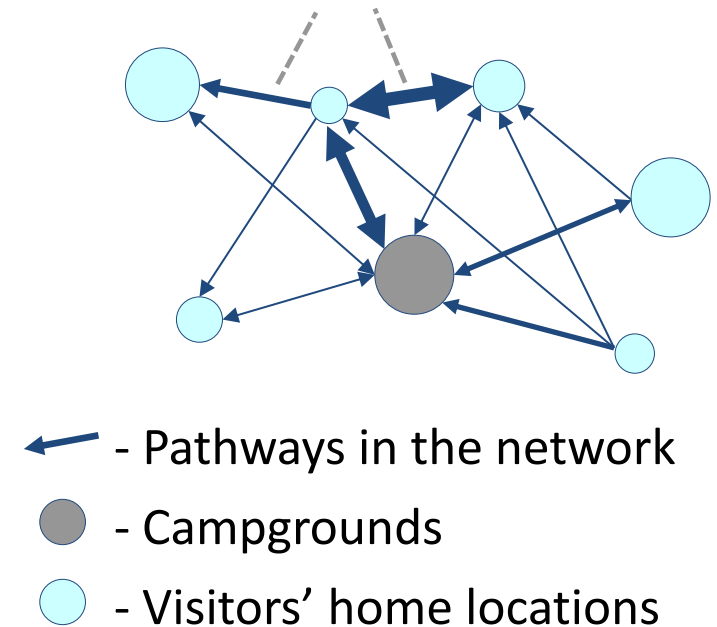
Network Modeling

- Two main objectives
  - Origin risk
    - Focusing on out-of-state origins
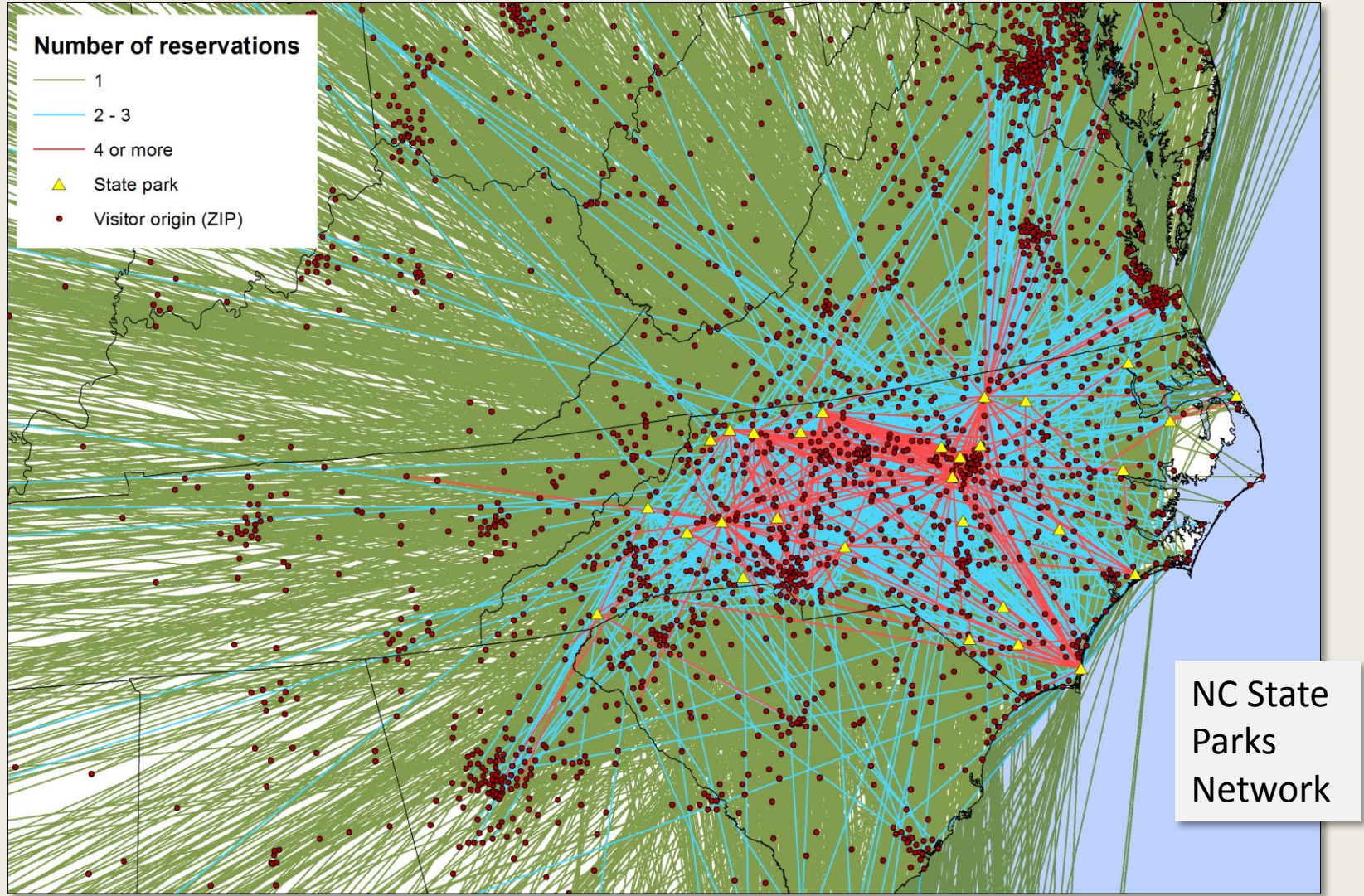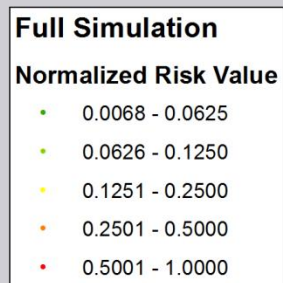 - Park risk
    - Again, out-of-state origins

NC State Parks Network

Number of reservations
— 1
— 2 - 3
— 4 or more
▲ State park
• Visitor origin (ZIP)

NC State Parks Network

Forest Service

Southern Research Station

Out-of-State Origin Risk, NC State Parks

Full Simulation

Normalized Risk Value

- 0.0068 - 0.0625
- 0.0626 - 0.1250
- 0.1251 - 0.2500
- 0.2501 - 0.5000
- 0.5001 - 1.0000

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Out-of-State Origin Risk, NRRS Network Model

Origin Probability, φ_{ij}

- < 0.000001
- 0.000001 - 0.00001
- 0.00001 - 0.0001
- 0.0001 - 0.001
- 0.001 - 0.01
- 0.01 - 0.1
- 0.1 - 1

North Carolina
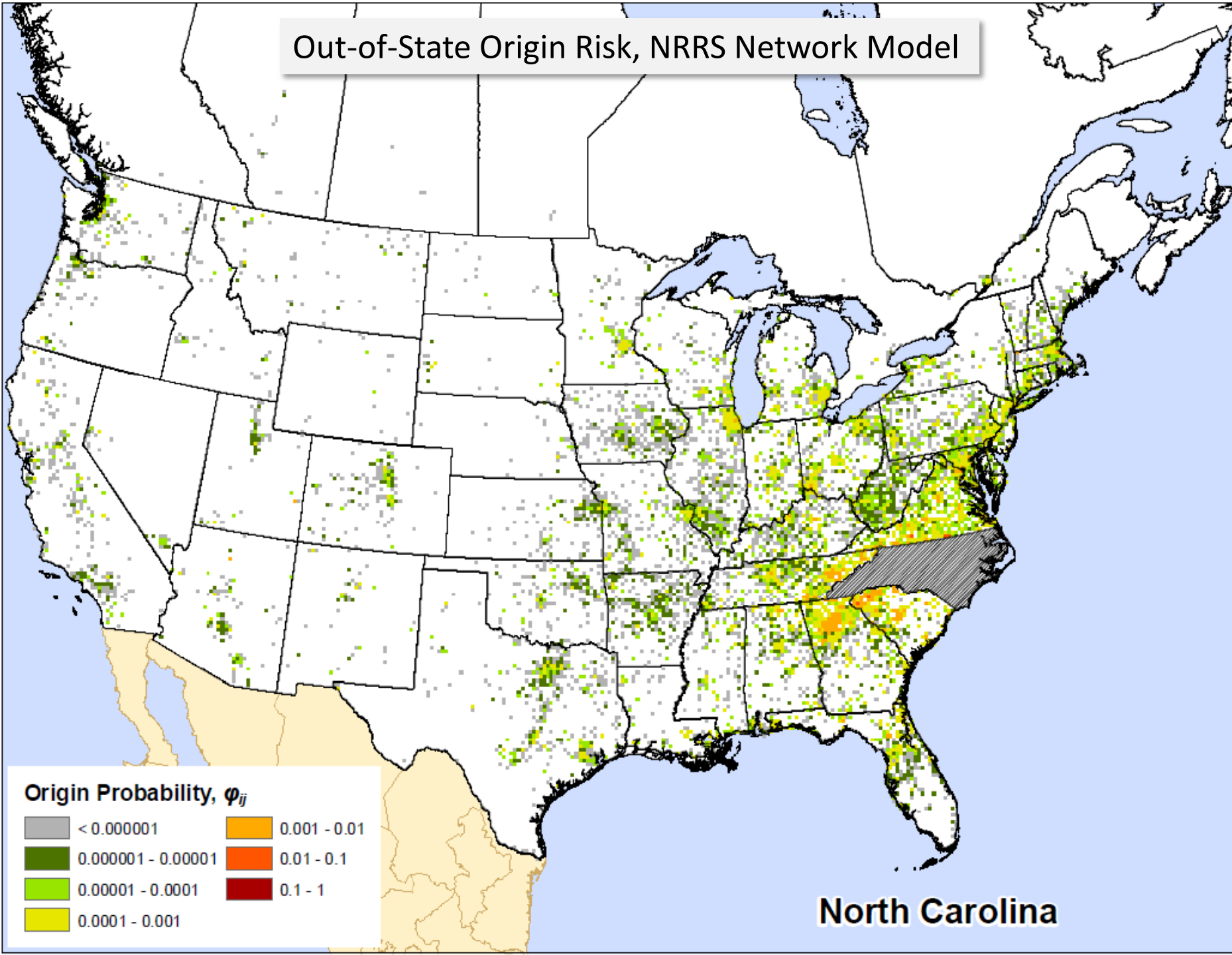
Park Risk (Out-of-State Origins)
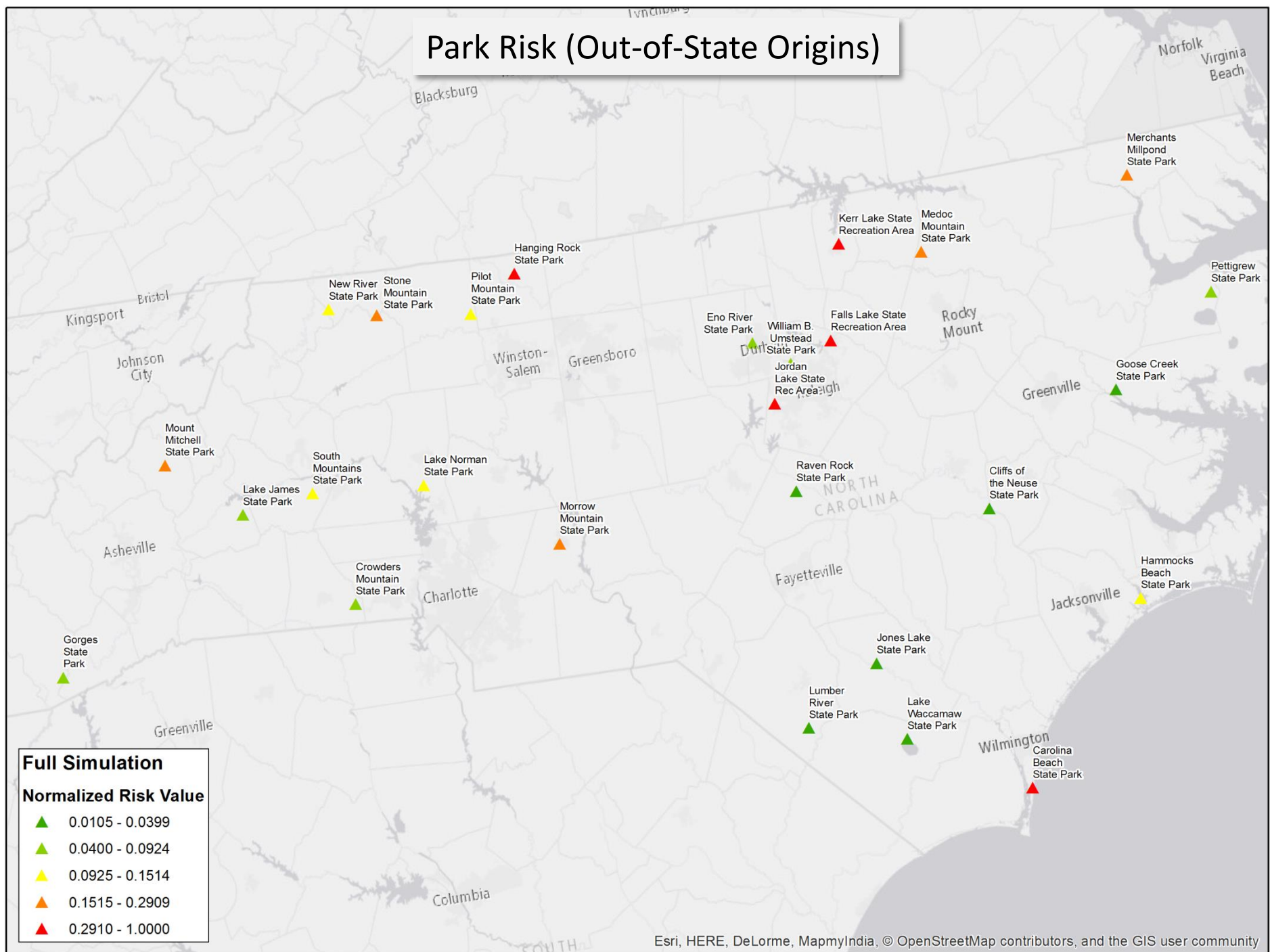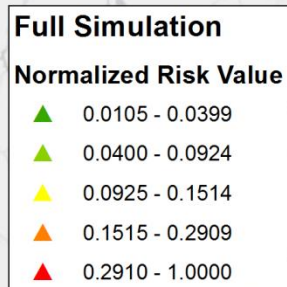
Summary Points

- Similarities and differences between national-level and state-level camper reservations data

- Implications for firewood regulation and management (including messaging)

- State-level network model enables nuanced analyses

- Now analyze data from other states?

Acknowledgements

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