Geospatial Analysis of Strengths, Weaknesses, Opportunities, and Threats for Biomass Feedstock Production in the NE Sun Grant Region.

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Northeast Sun Grant Initiative Feedstock Summit
Nov. 11-13, 2007, Cornell University, Ithaca, NY

Topics for Today

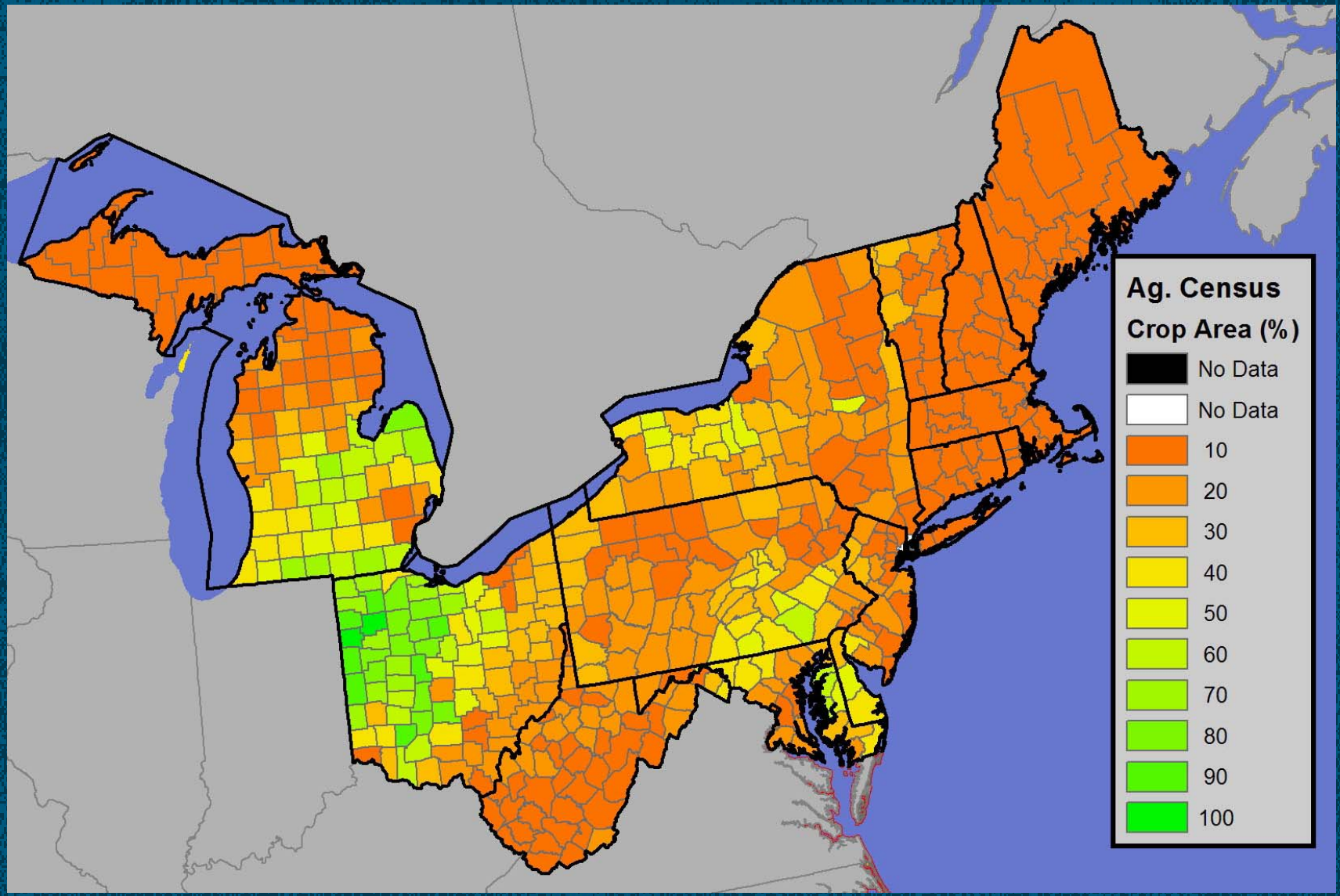
PART 1

Current land use and prospects for biomass feedstock production in the Northeast Sun Grant region

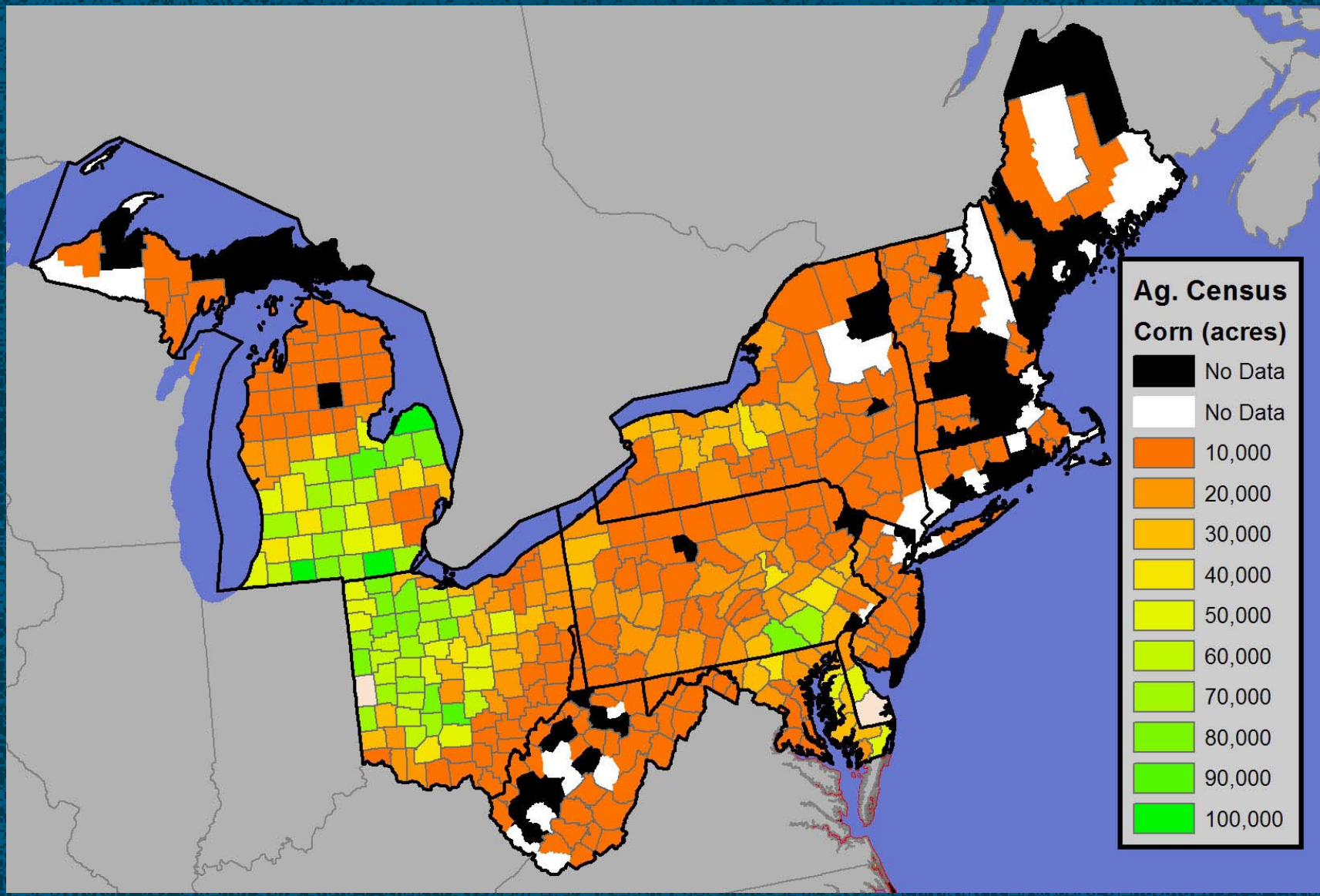
PART 2

Sustainable bioenergy strategies: New York State as an example

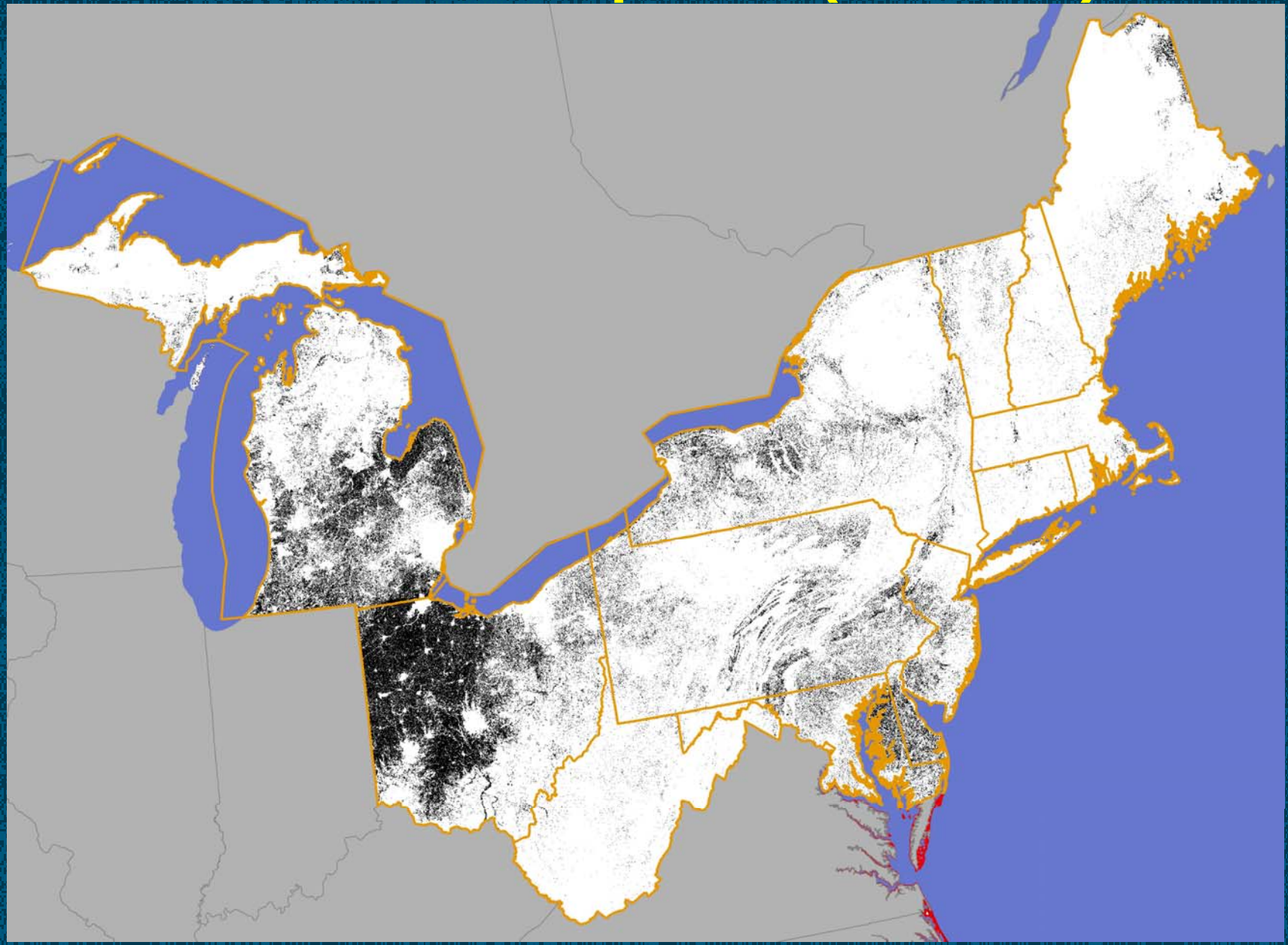
Crop area, percent of county



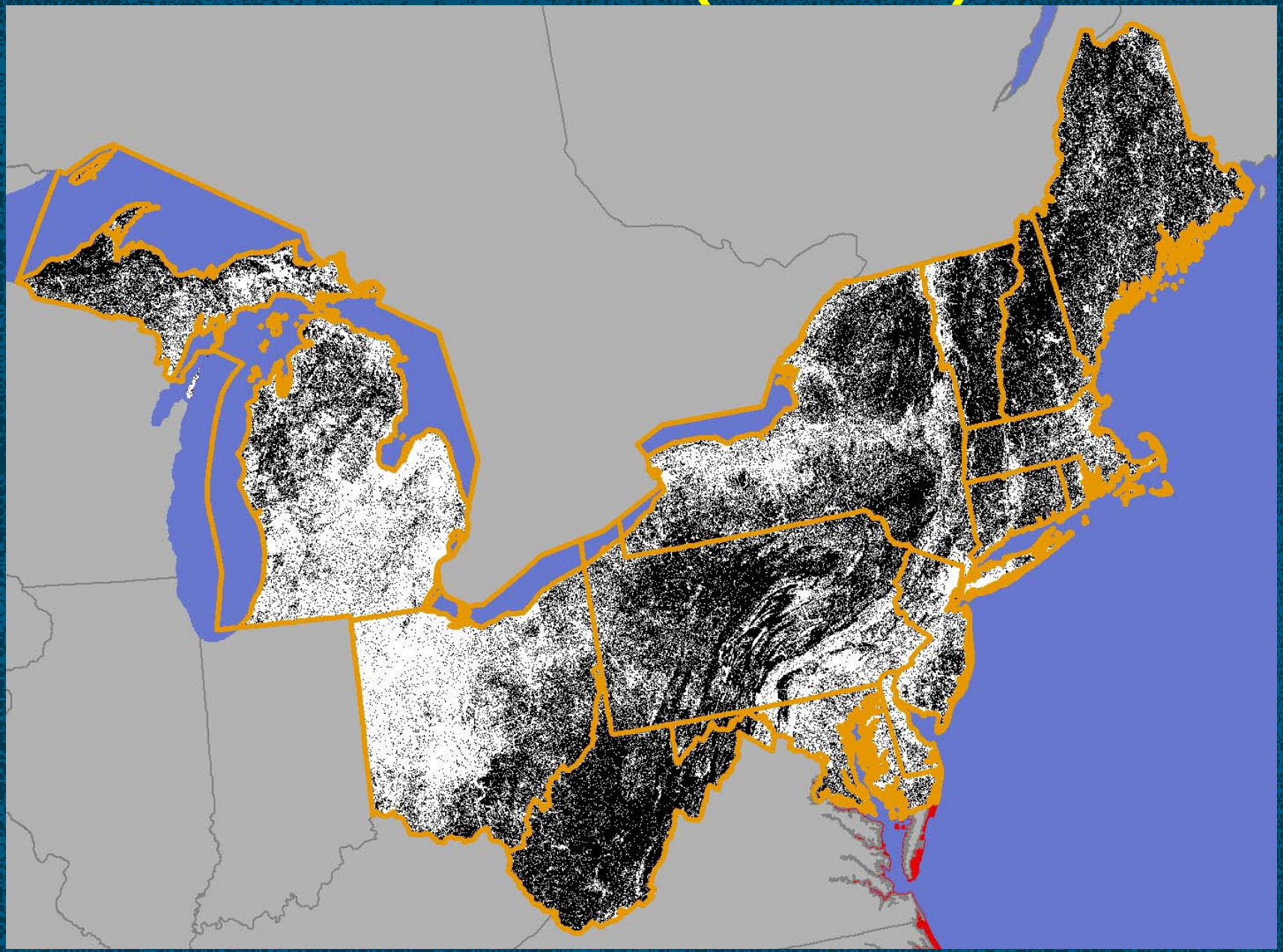
Corn acreage for grain



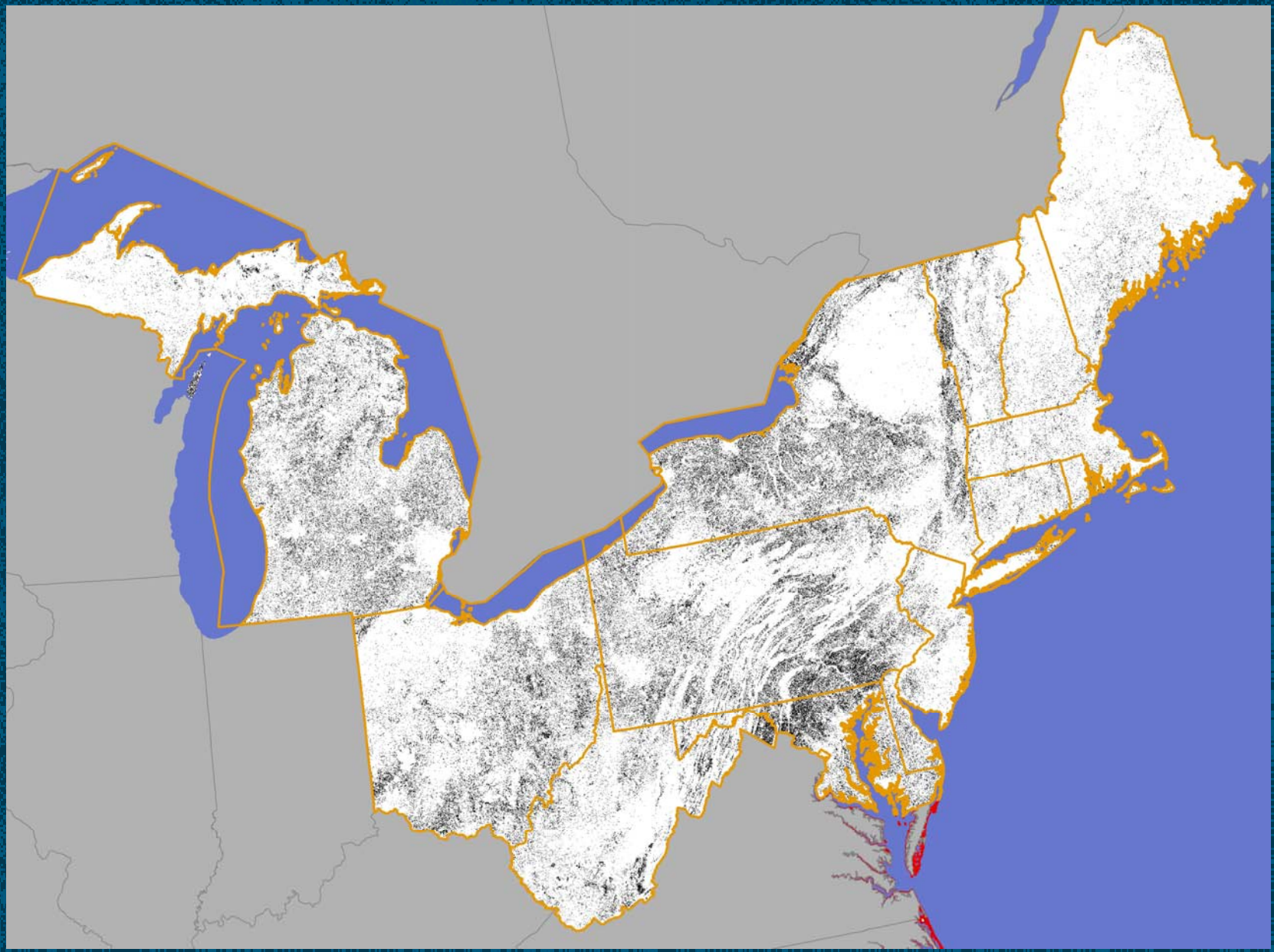
Cultivated crop area (detailed)



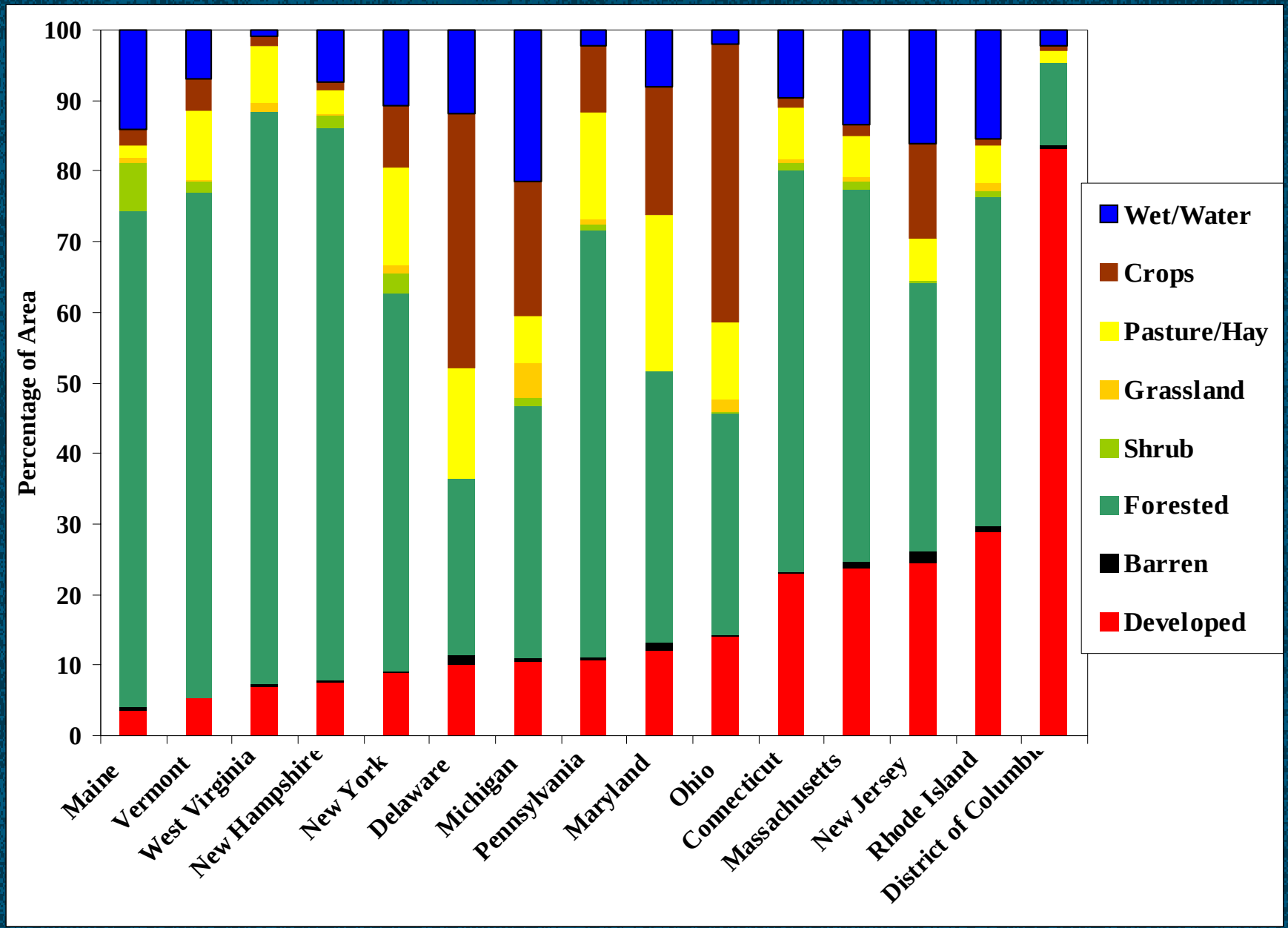
Forest area (detailed)



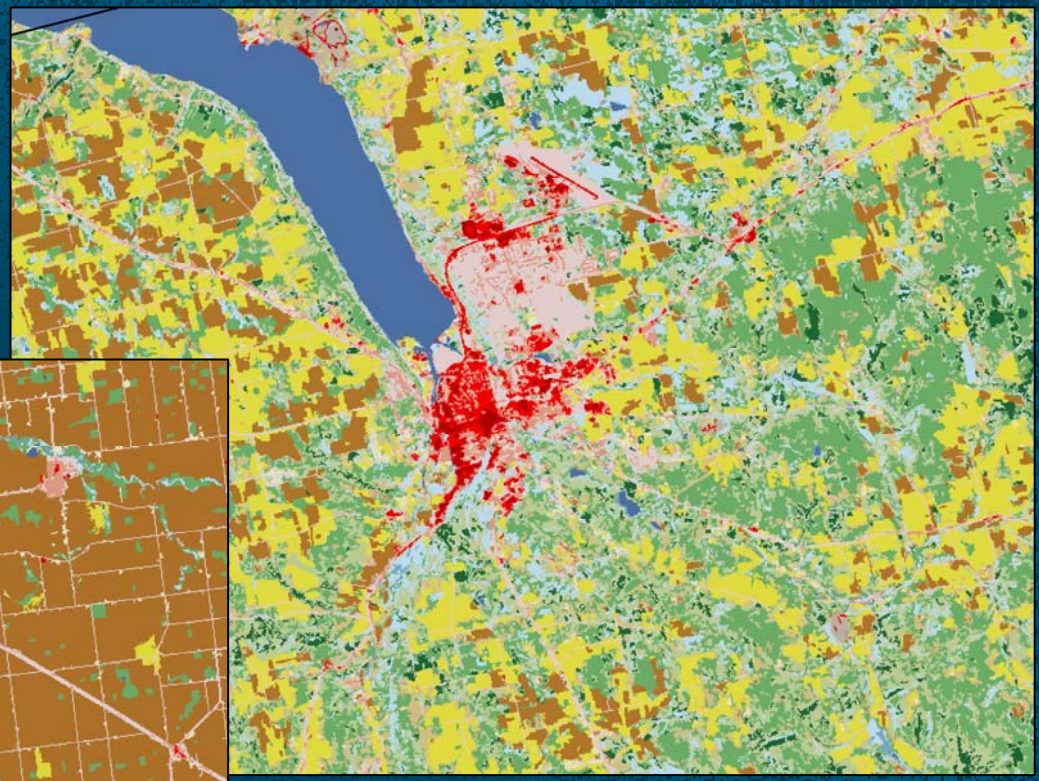
Herbaceous, hay, and pasture area



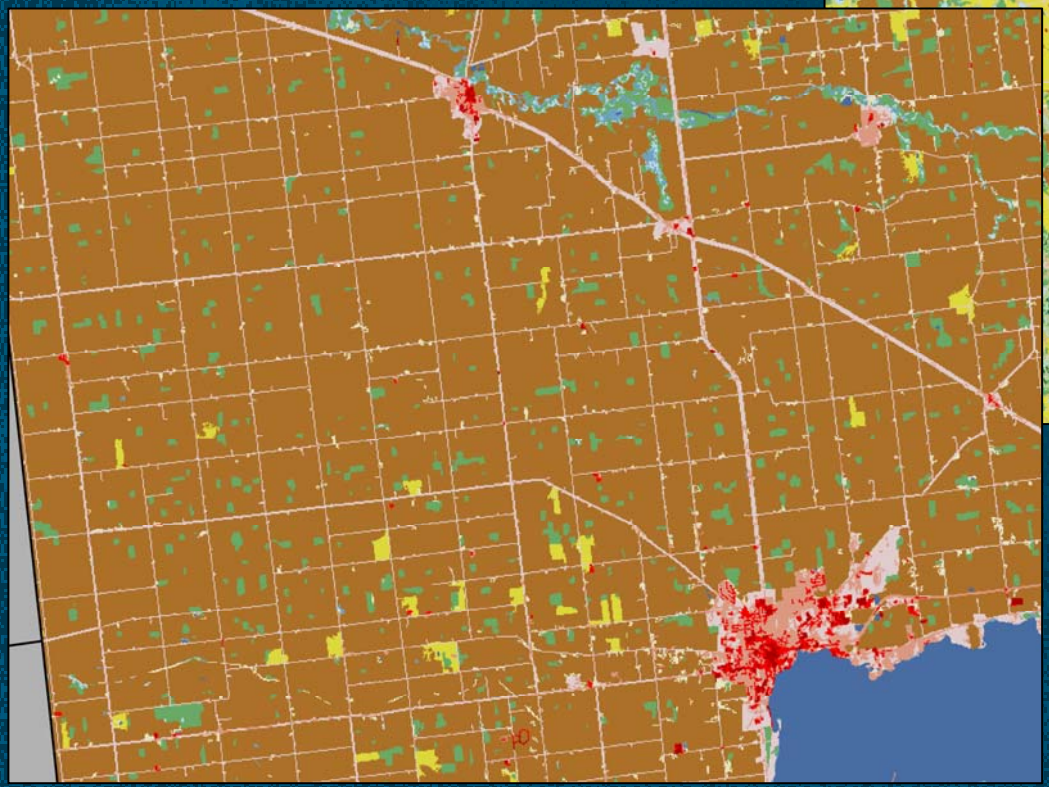
Land Cover by State



Land use is varied in much of the Northeast

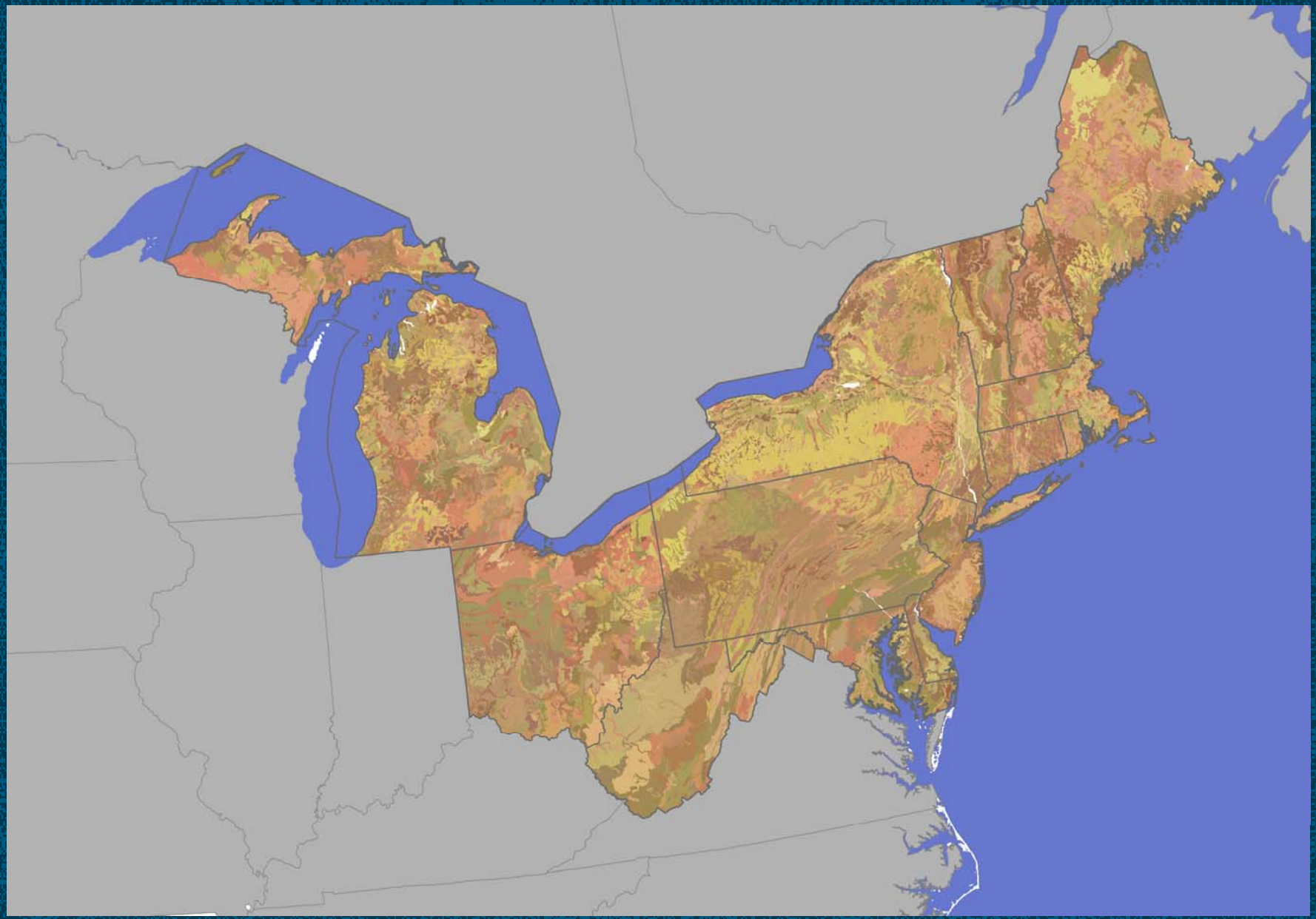


Tompkins County, NY

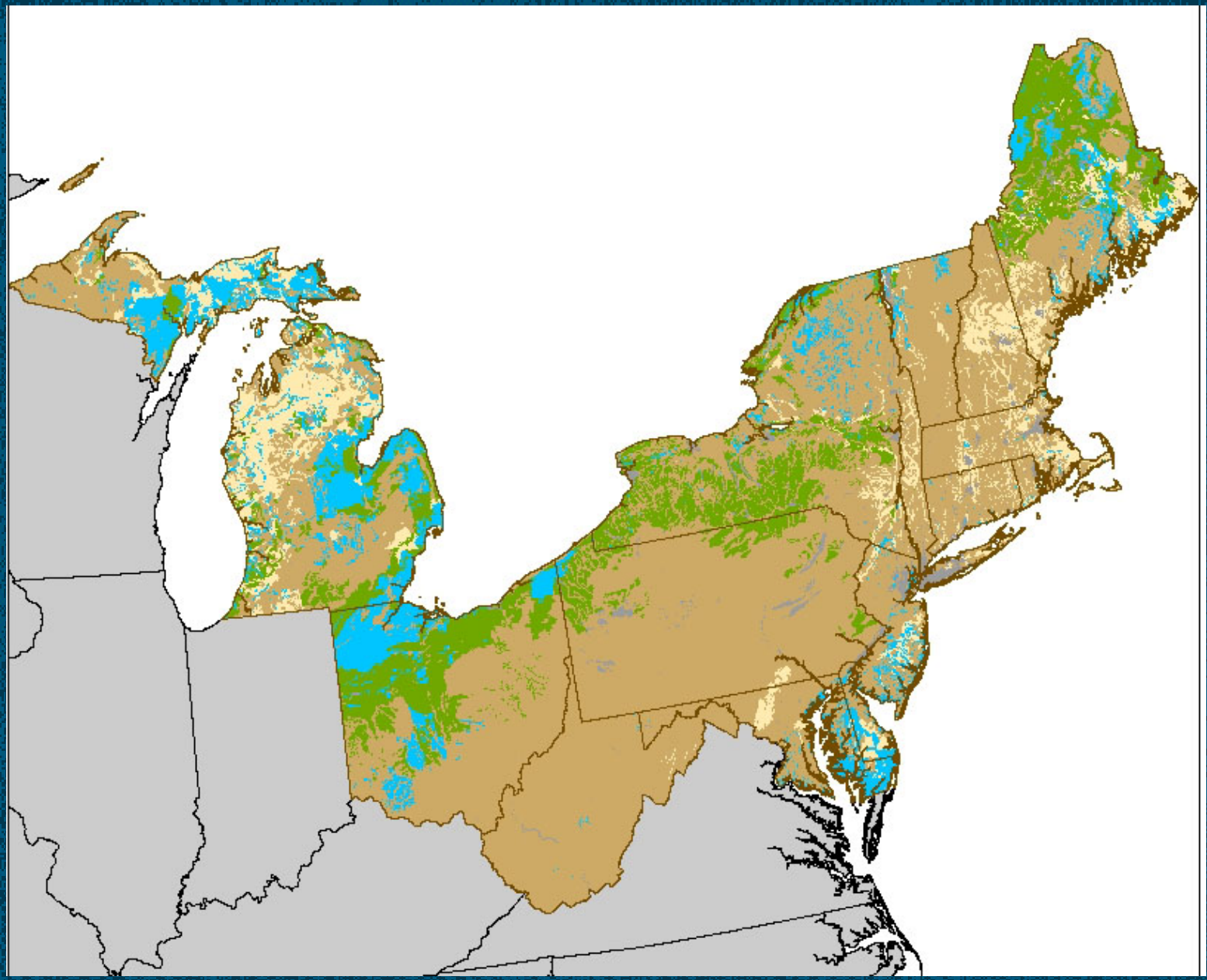


Mercer County, Ohio

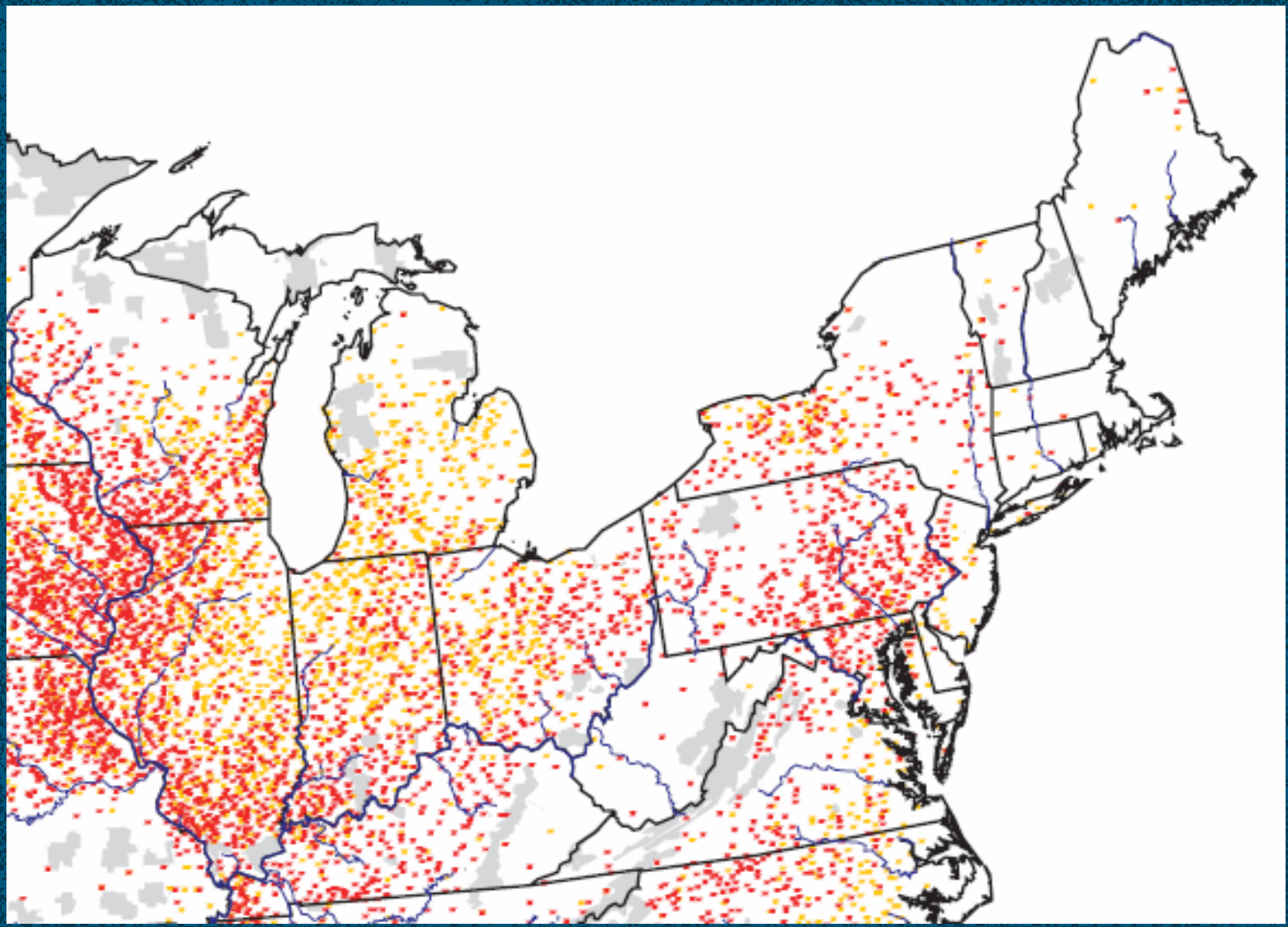
How will soil type affect biomass production?



Perennial grasses are viable on poorly drained soils

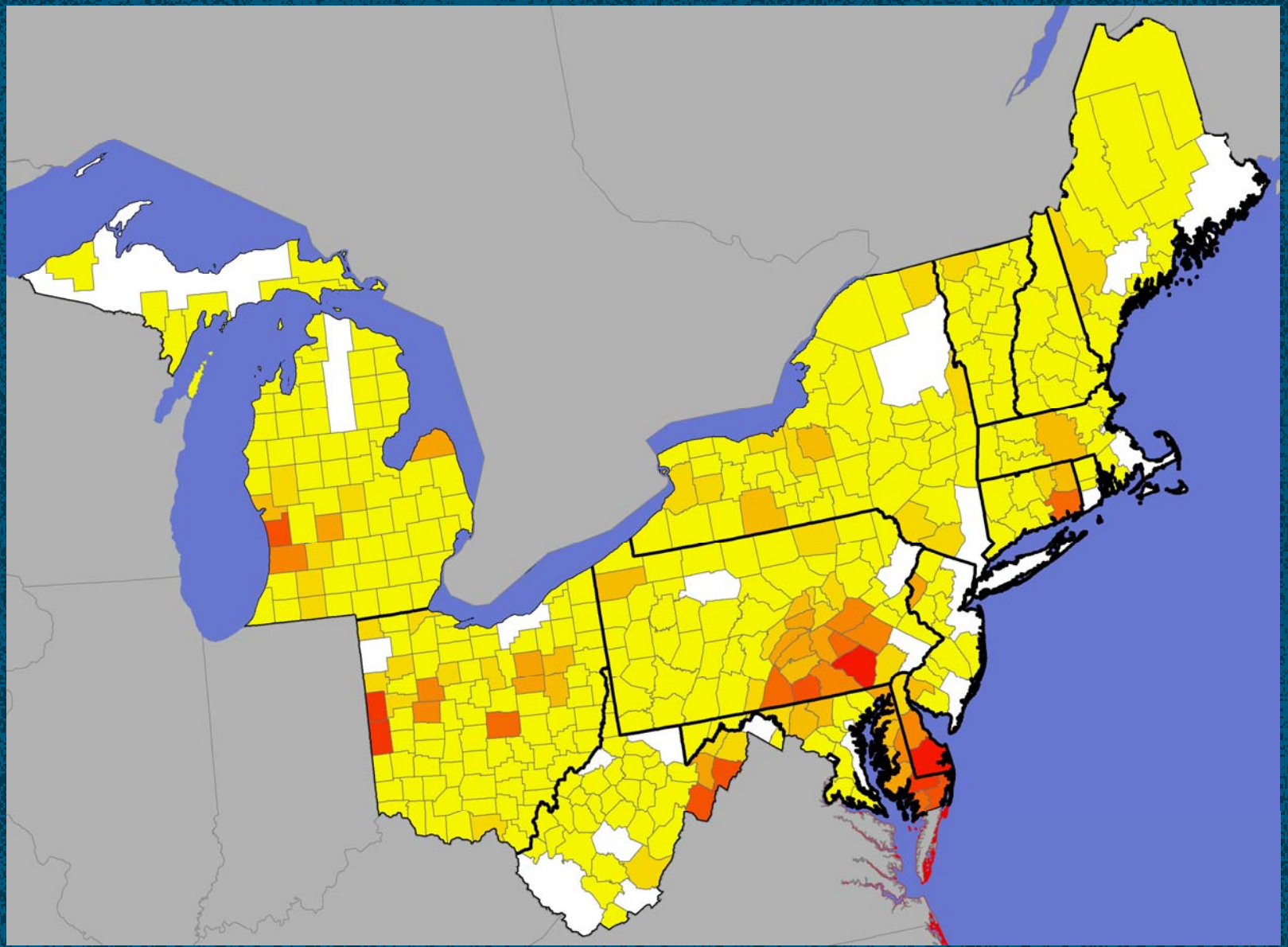


Excessive Erosion on Cropland



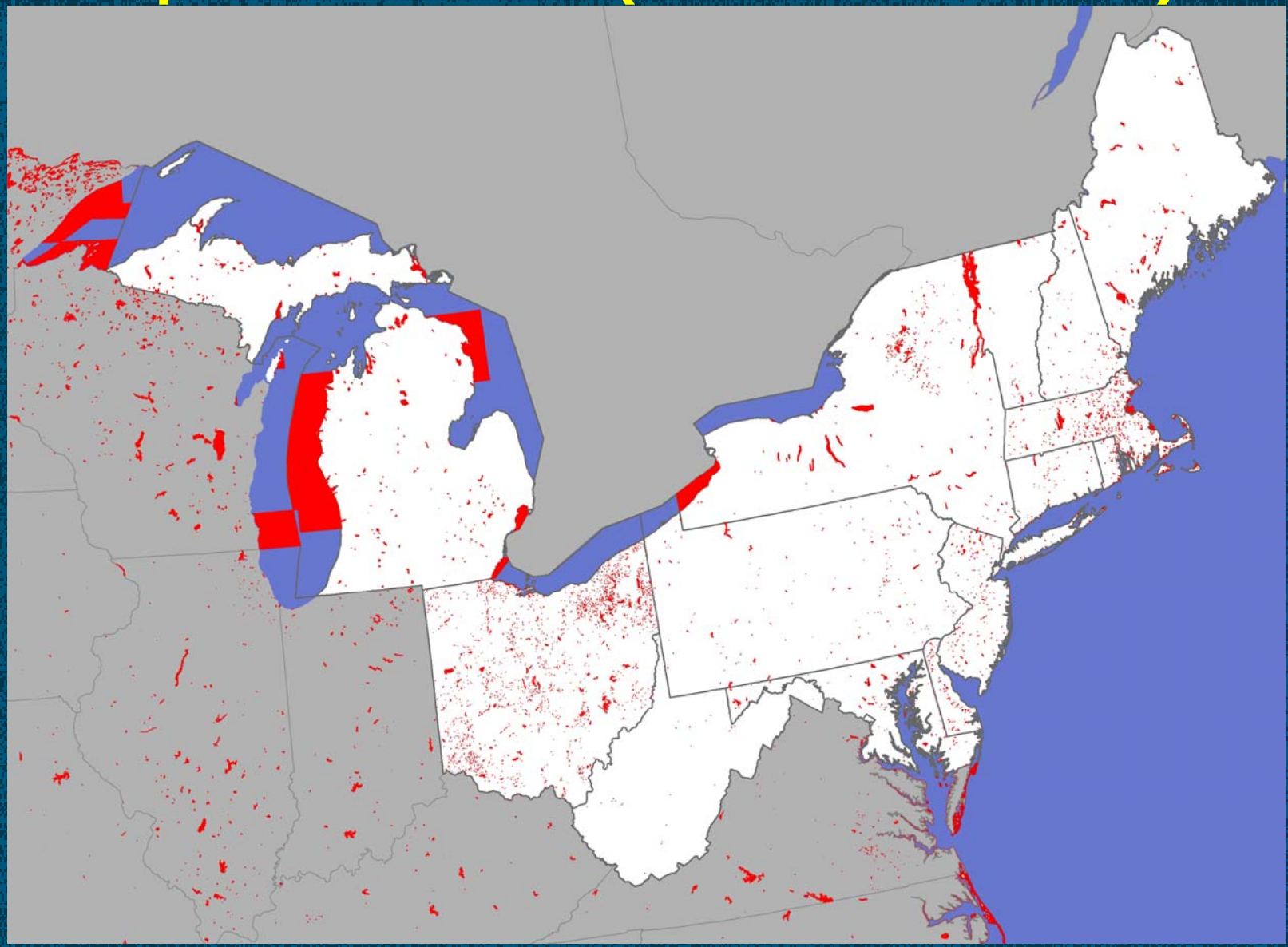
Source: USDA-NRCS 2000 (based on NRI)

Excess manure beyond crop needs

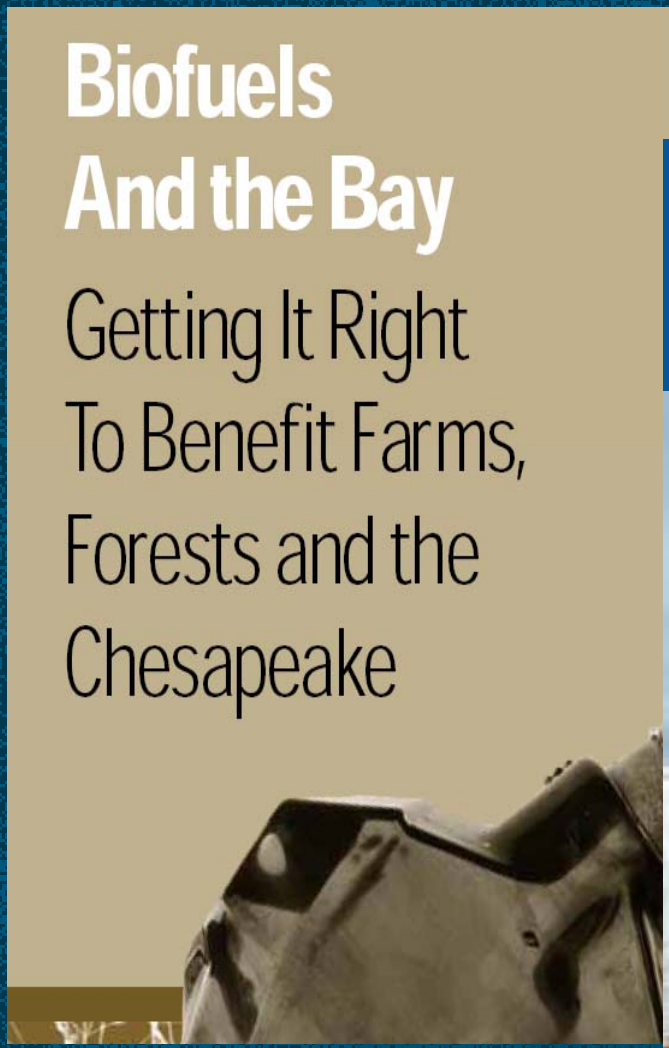


Source: Kellogg et al. 2000

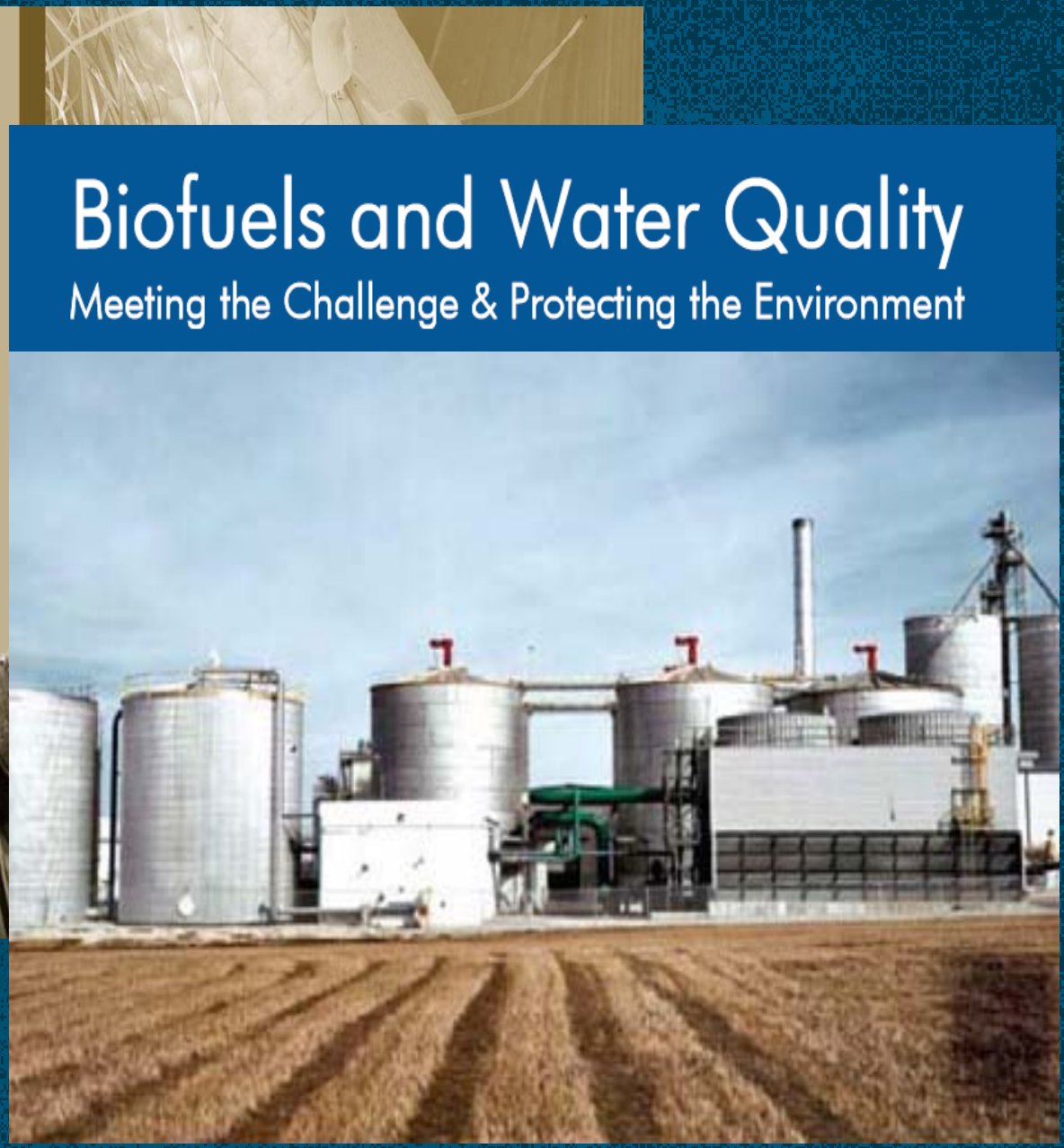
Impaired waters (Clean Water Act)



Source: USEPA 2002



Chesapeake Bay Commission, September, 2007



Simpson et al., 2007

Summary of Part 1

Sustainable feedstock production systems in the NE must account for high regional and local variability in:

- Soil characteristics (slope, drainage, texture, etc.)
- Land use (agricultural, forest, urban, ex-urban)
- Agricultural systems (field crops, dairy, etc.). For example, dairy farms harvest most corn as silage, thus no stover is available.
- Environmental vulnerability (erosion potential, quality of surface waters, quality of coastal waters, etc.)

PART 2

Sustainable Biomass Energy Strategies: New York State as a Case Study

Peter B. Woodbury, Jerome H. Cherney, Jenifer Wightman, John M. Duxbury, William J. Cox, Charles L. Mohler, Stephen D. DeGloria.

Steps in Analysis

Determine underutilized agricultural and forest area

Predict potential growth corn, soybean, switchgrass, and reed-canary grass based on:

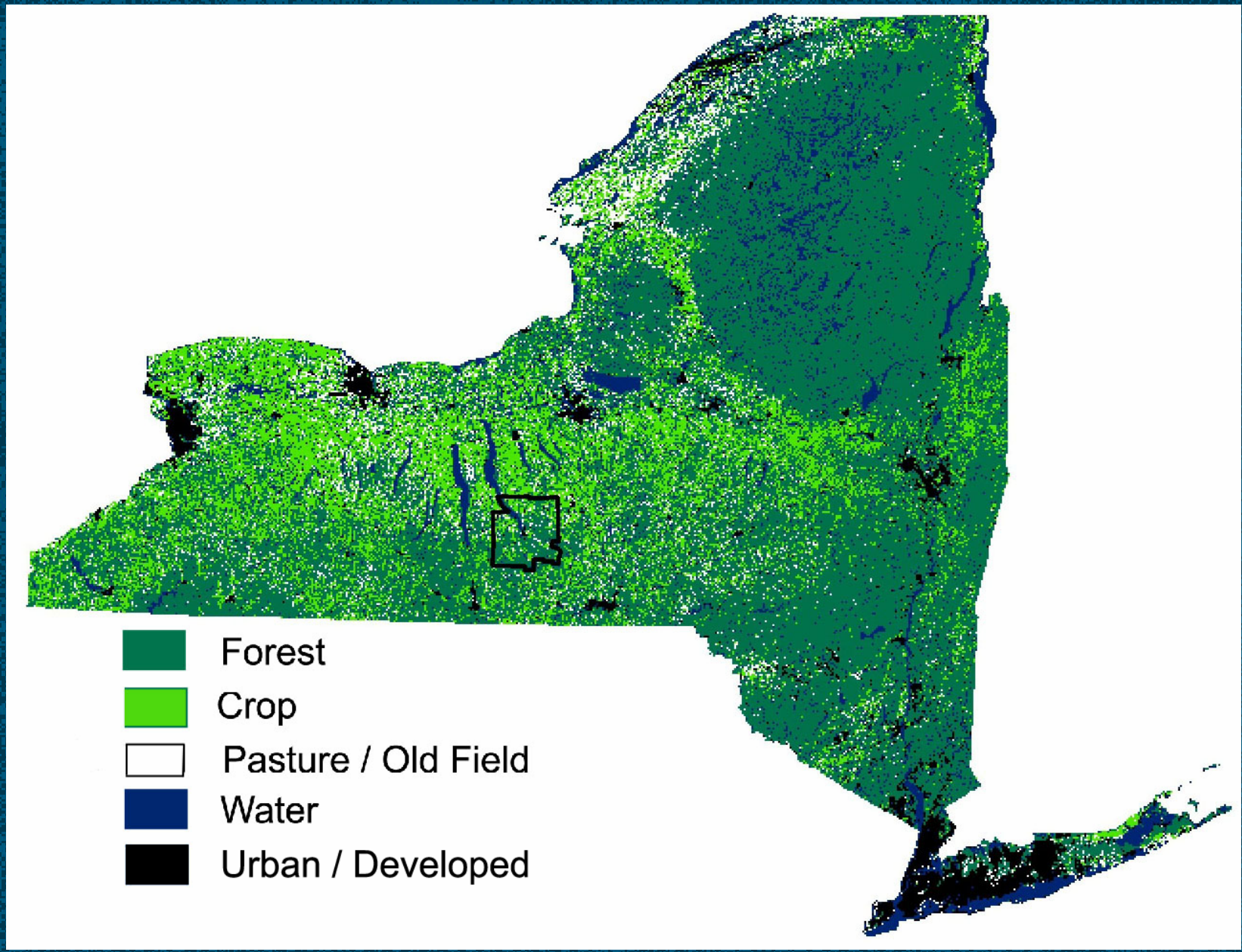
- Soil type, soil drainage, slope,
- Data from yield trials interpolated with expert opinion.

Predict mixed forest species growth based on:

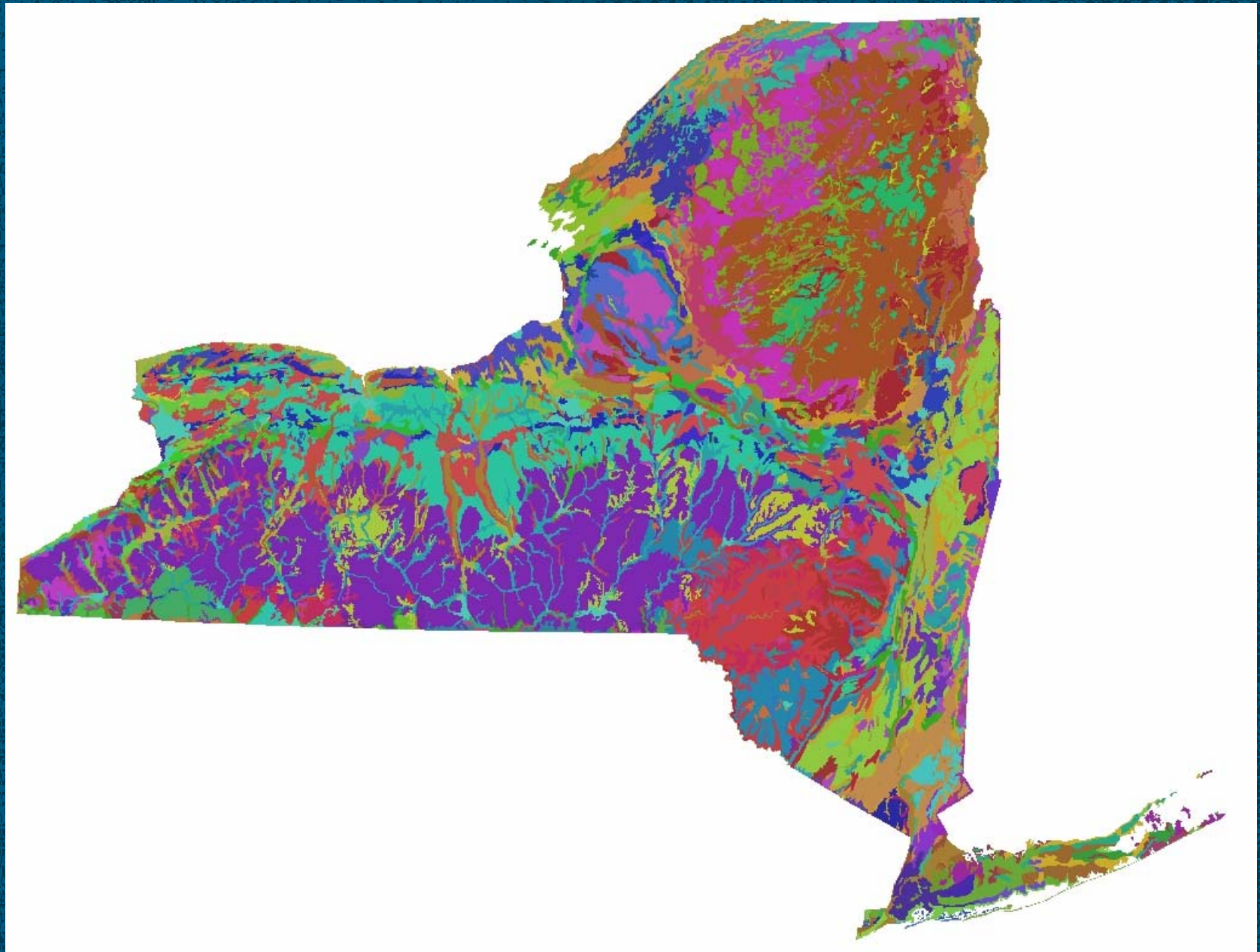
- USDA FIA data,
- Data from paired plots with and without timber stand improvement cuts (C. Mohler, unpublished data).

Compare different biomass options, including biofuels and biopower

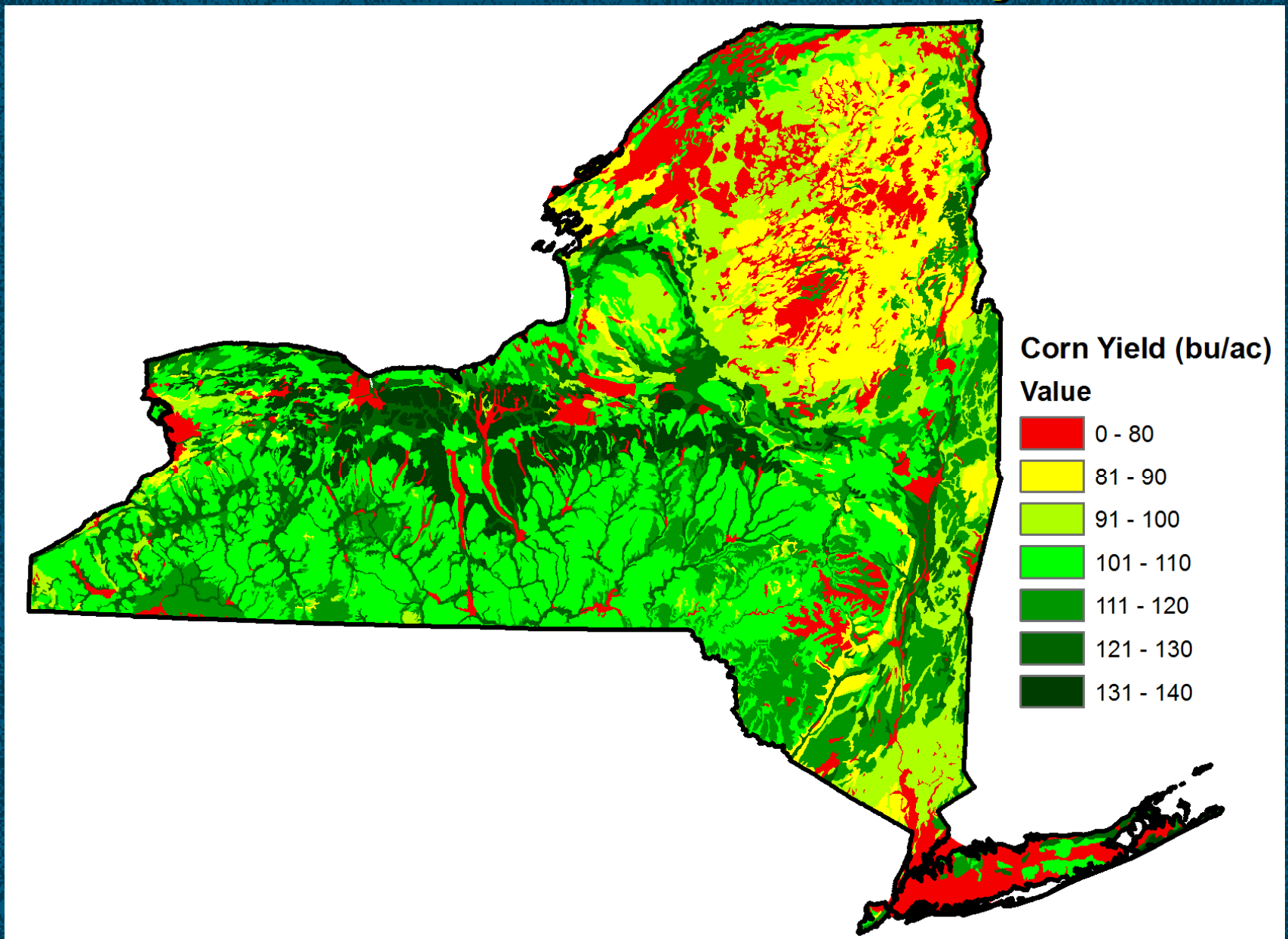
What is the current land use in New York State?



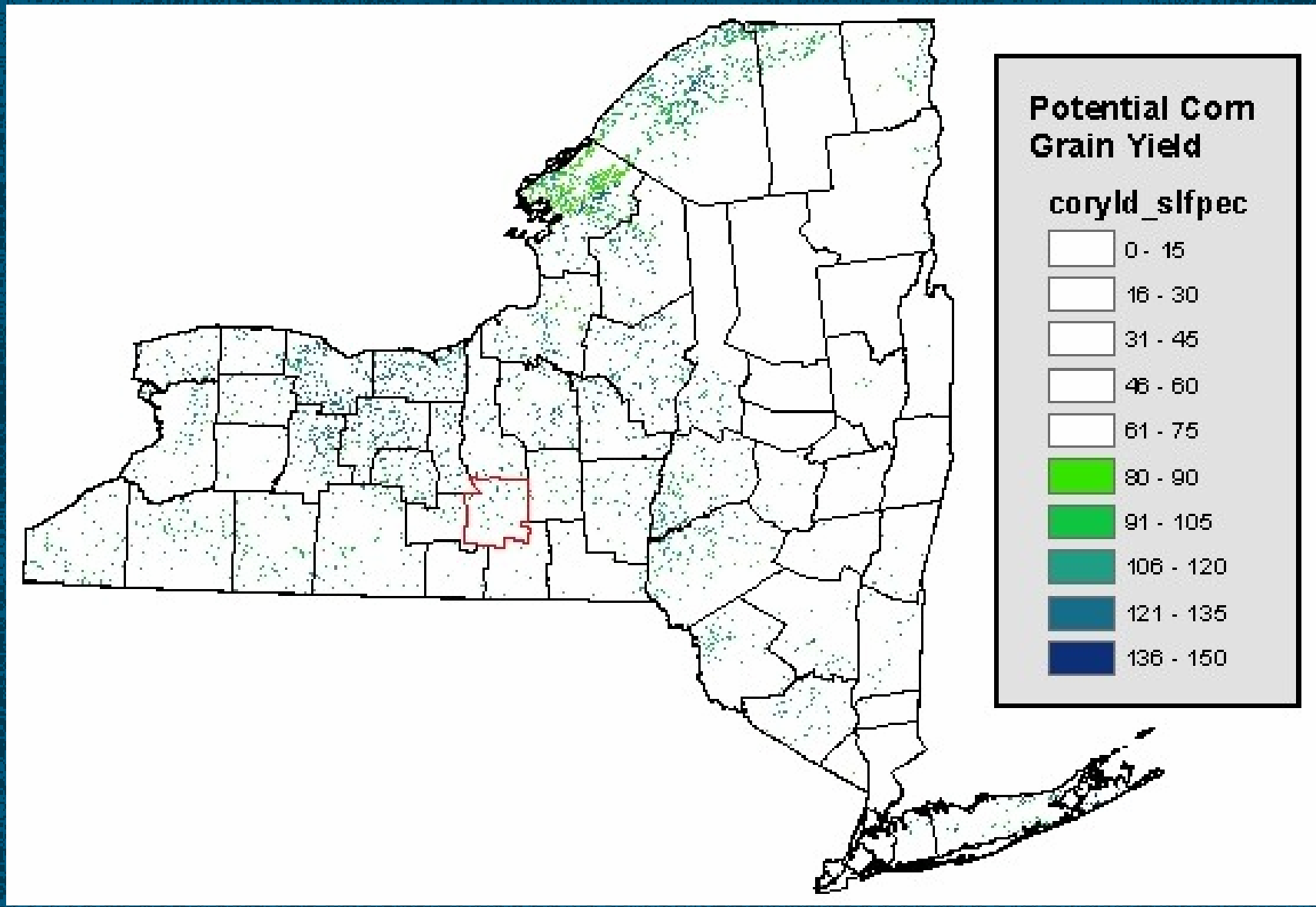
Soils: Predict yield based on soil type



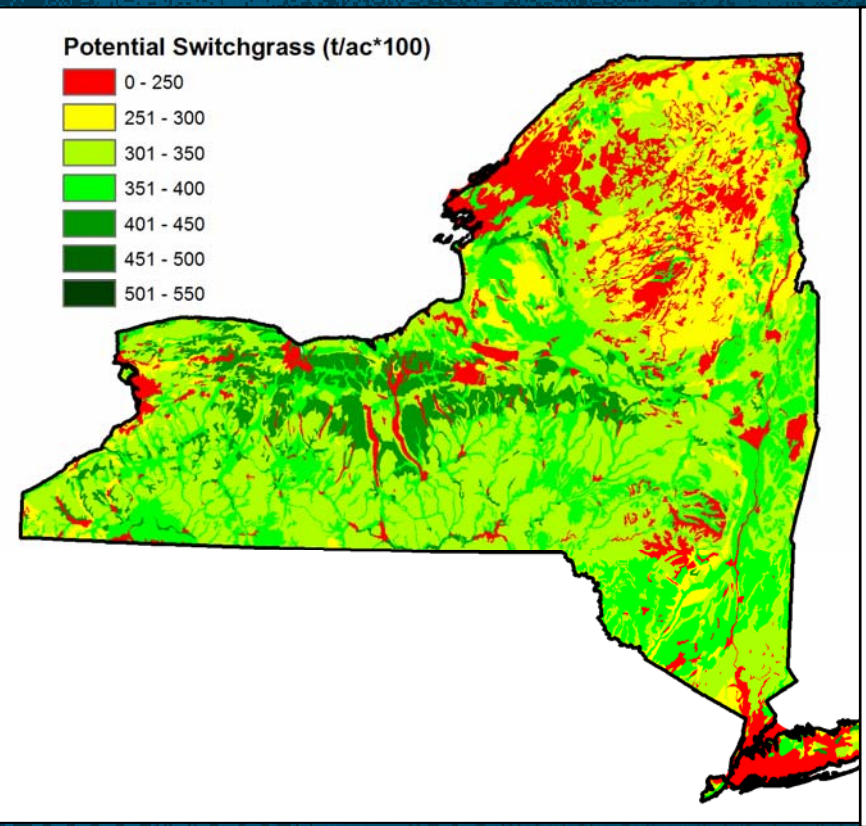
Prediction: Potential corn yield

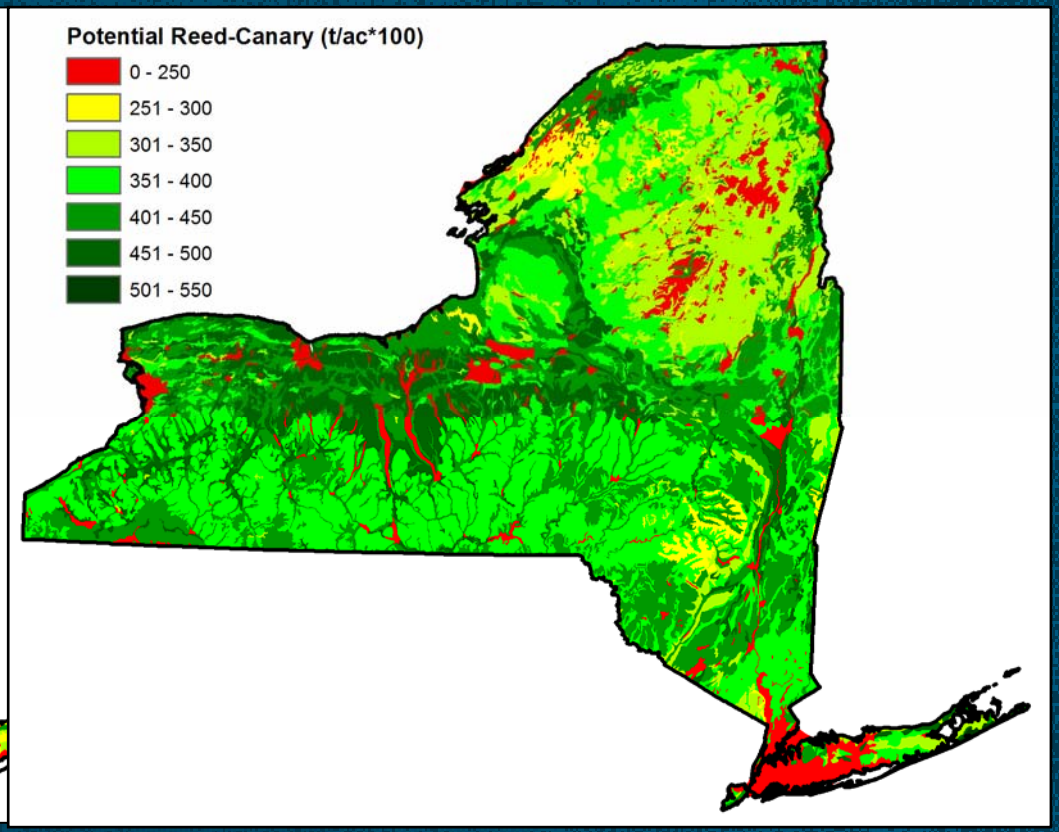


Remove land with incompatible land use or yield below economic cut-off



Also predict potential yield of grasses





Switchgrass

Reed Canarygrass

Compare energy and GHG benefits for different biomass use options

Biomass energy options include:

- Corn for ethanol or heat
- Soybean for biodiesel
- Switchgrass, reed canarygrass, or unimproved meadow for home heating
- Forest biomass for electricity or home/commercial heat

For each option:

1) Determine appropriate energy input:output ratio
2) Calculate net fossil fuel energy saved
3) Use published emissions factors to estimate GHG benefit

Potential biomass area, yield, and production

Type of Biomass	Potential New Area	Potential Yield	Potential Production
NOTE: Herbaceous biomass options are mutually exclusive			
	---- Mil. acre ----	*---- bu/ac ----*	*----1000 t -----*
Potential New Crop Area[1]	**1.5**		
Corn (grain)	1.3	110	4,129
Soybean	1.1	37	1,080
		----- t/ac ----	*---- 1000 t -----*
Reed-Canarygrass	1.5	4.1	5,982
Switchgrass	1.2	3.5	4,270
Unimproved Grasses	1.2	1.9	2,429
Forestry, Current non-harvested	5.0	0.5	2,478
Forestry, timber stand improvement	5.0	0.8	3,787

[1] Area currently in pasture or old field vegetation with slopes less than 15

Crop and Grass Biomass – Greenhouse Gas Benefits

Biomass Fuel	Energy Product	Net Energy Ratio	Net Greenhouse Gas Benefit	Percentage of Total NYS Emissions Offset
NOTE: These herbaceous options are mutually exclusive				
			-- *lb* CO_2 *e/ac.* --	----- *%* ----
Corn grain	**Ethanol**	1.3	497	0.1
Soybean	**Biodiesel**	3.2	791	0.2
Corn grain	**Heat**	7.7	5,026	1.2
Reed-Canarygrass	**Heat**	14.6	7,444	2.0
Switchgrass	**Heat**	14.6	6,845	1.6
Unimproved Grasses	**Heat**	14.6	4,218	1.0

1 Area currently in pasture or old field vegetation with slopes less than 15

2 Fuel comparison is "at the pump", not including fuel production. For ethanol, comparison is to gasoline, for biodiesel, comparison is to diesel.

Forest Biomass – Greenhouse Gas Benefits

Biomass Fuel	Energy Product	Net Energy Ratio	Net Greenhouse Gas Benefit	Percentage of Total NYS Emissions Offset
			-- lb CO2e/ac. --	*----- % ----*
NOTE: Forestry options use half of existing non-industrial privately-owned hardwood timberland				
Forestry: Current non-harvested growth	**Electricity**	3.2	882	0.8
Forestry: Timber Stand Improvement	**Electricity**	3.2	1,348	1.2
Forestry: Current non-harvested growth	**Heat**	10.9	1,159	1.1
Forestry: Timber Stand Improvement	**Heat**	10.9	1,772	1.6

Summary of New York State Biomass Energy Potential

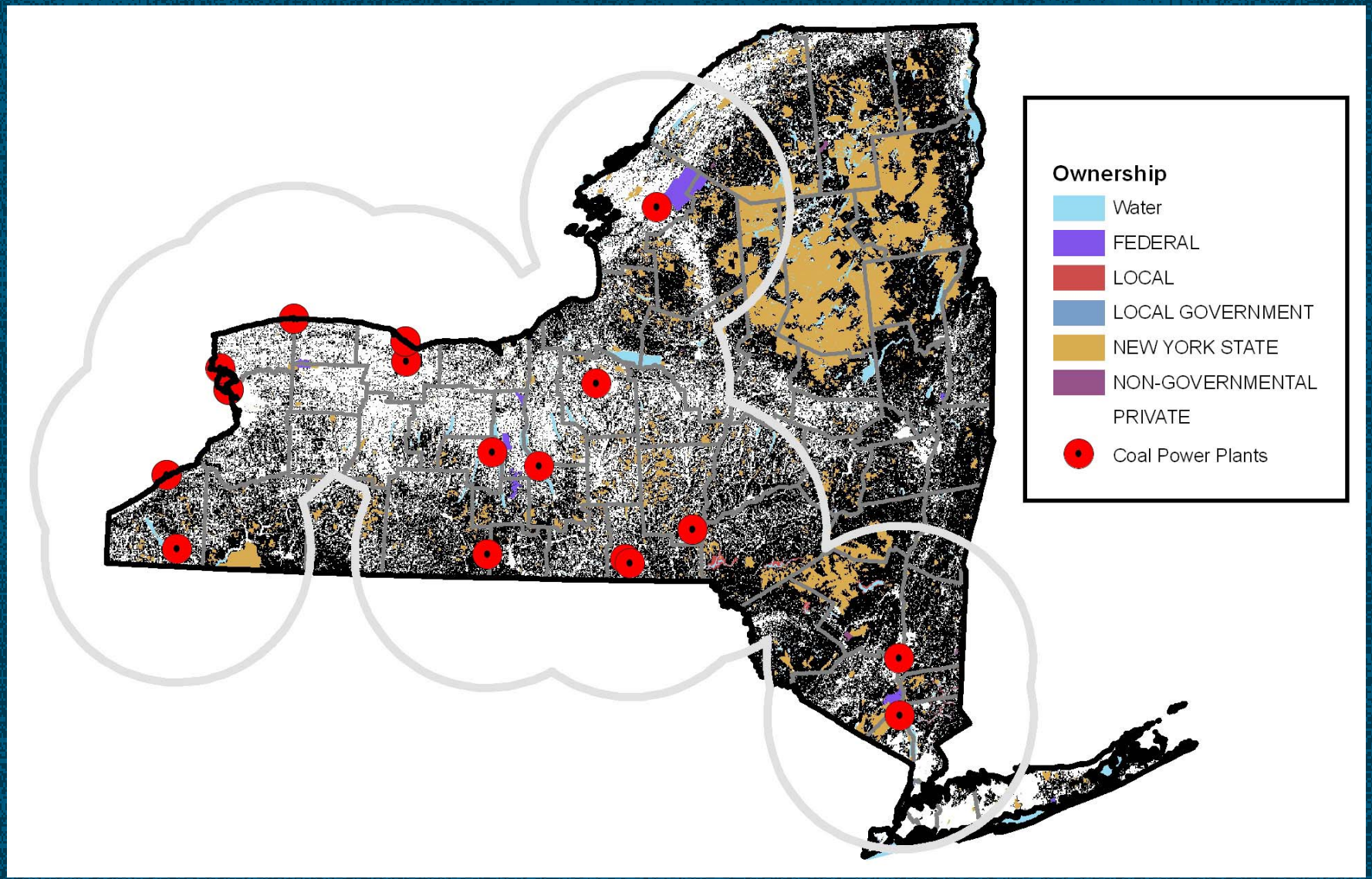
1.5 million acres of underutilized farmland could produce a variety of biomass crops.

5 million acres of forest land could benefit from a timber stand improvement cut, and could produce biomass as a co-product.

The best herbaceous and forest biomass production strategies could reduce NYS greenhouse gas emissions by 3.7 %.

Co-firing biomass with coal to produce electricity could help meet New York State's Renewable Portfolio Standard goal (25% renewable).

Example of Remaining Challenges: Forest within 50 miles of coal-fired power plants



Summary questions and challenges

Much idle agricultural land seems to be on low-income farms (data not shown). Do these farmers have the labor, equipment and other resources needed to grow biomass feedstock?

How will biomass feedstock production integrate into existing agricultural and forestry enterprises?

Which bioenergy options are the most sustainable economically, socially and environmentally?

How can we create feedstock markets, production capacity, and distribution capacity at the same time?

We gratefully acknowledge the following sources of funding for our ongoing research:

USDA Cooperative State Research, Education, and Extension Service

Northeast Sun Grant Institute of Excellence

Hydric soils: NE USA and St. Lawrence County NY