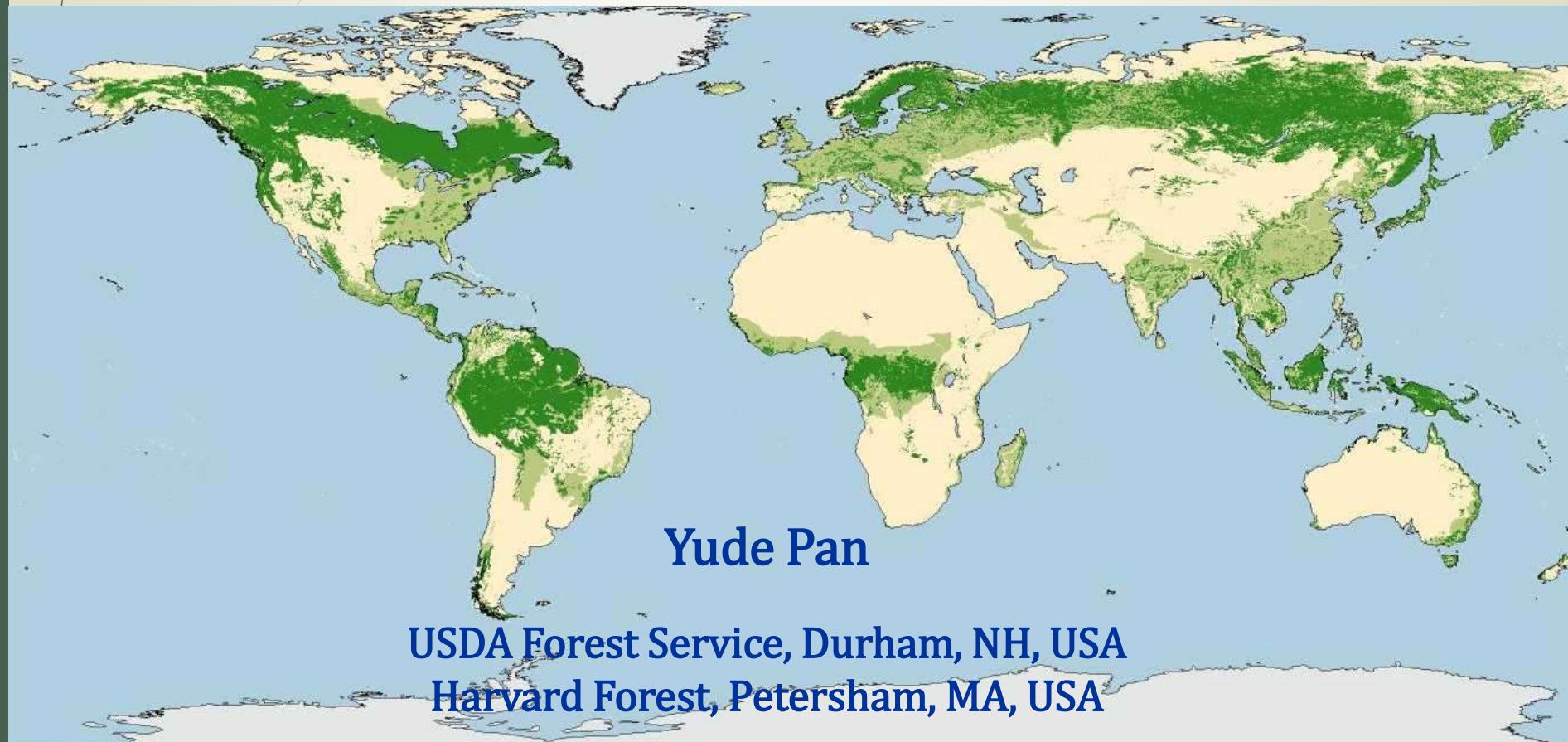


Forest Biodiversity, Structure Complexity and Resilience



Yude Pan

USDA Forest Service, Durham, NH, USA
Harvard Forest, Petersham, MA, USA

Trends of forest structure, complexity, diversity and attributes

Boreal forest

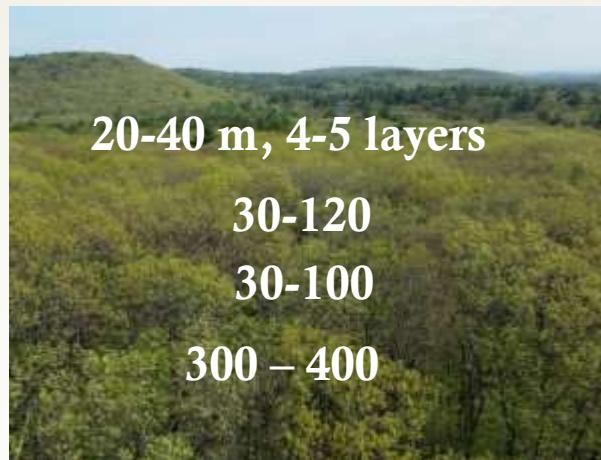


< 15 m, 1-3 layers
< 30
20-70
~100



50-100 m, 3-4 layers
13-35
70-330
500 - 2000

Temperate forest



20-40 m, 4-5 layers
30-120
30-100
300 – 400

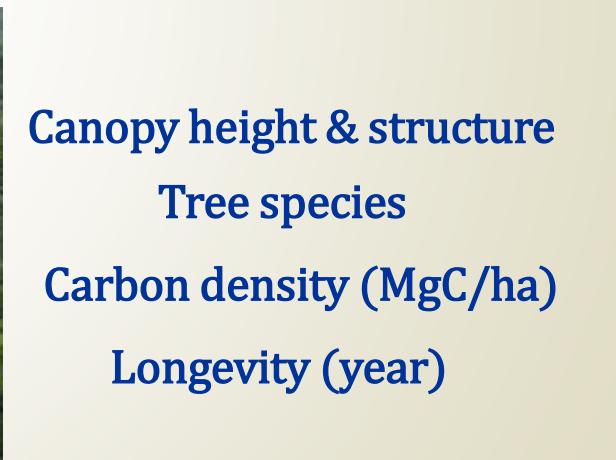


50-100 m, 4-5 layers
15-50
100-500
500 - 3500

Tropical rainforest



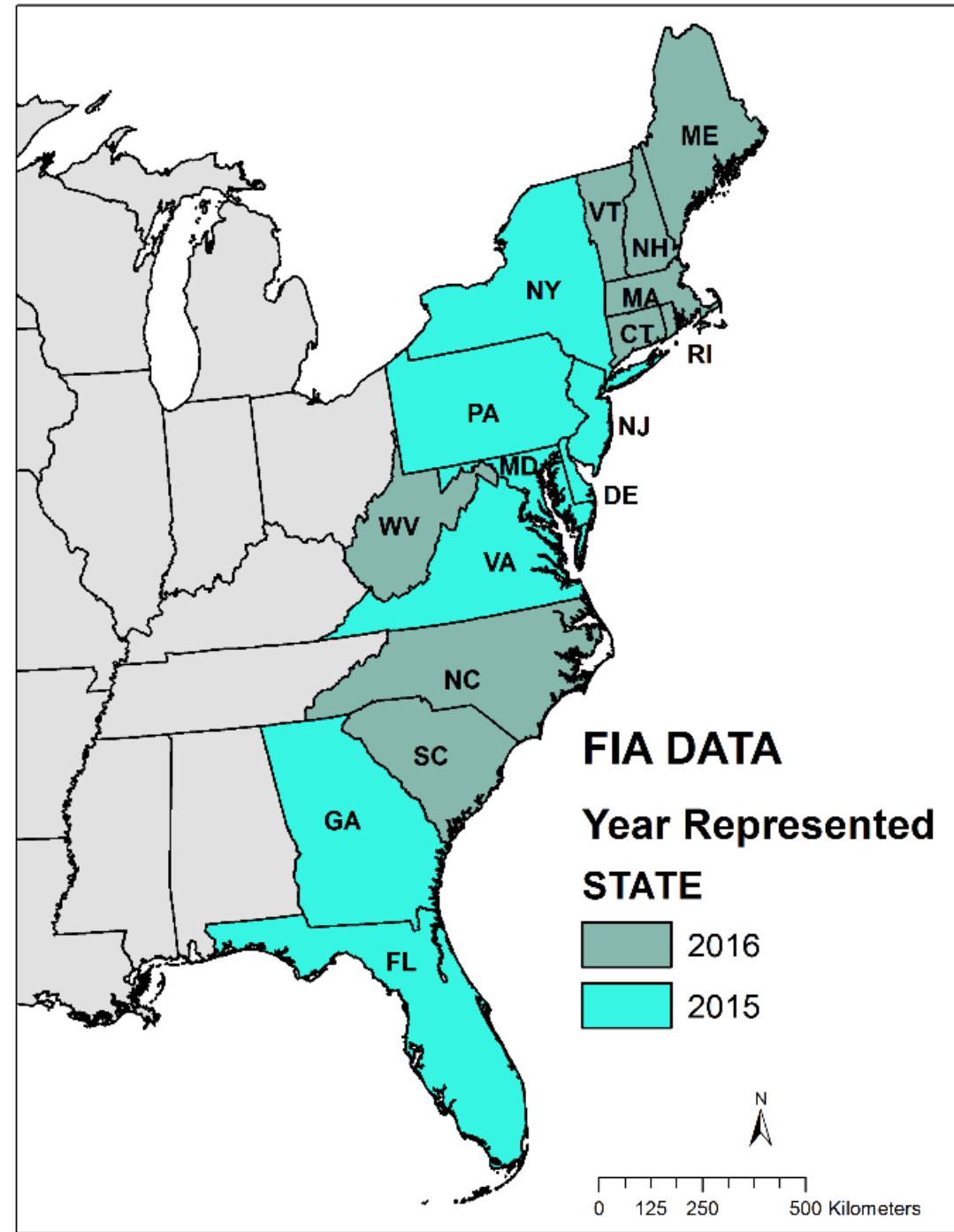
25-60 m, 5-6 layers
90-300
100-200
400 – 1000



Canopy height & structure
Tree species
Carbon density (MgC/ha)
Longevity (year)

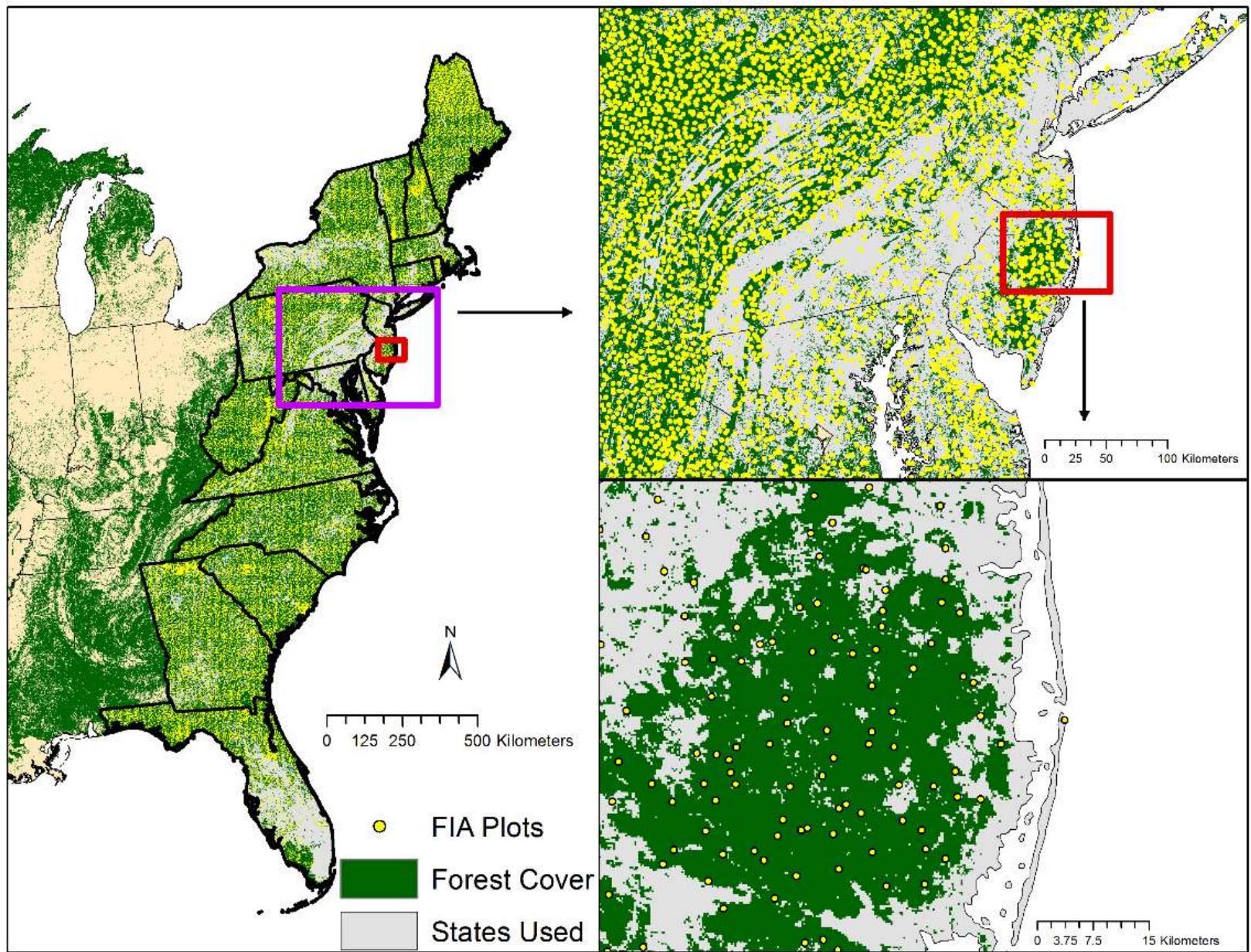
N. temperate rainforest

S. temperate rainforest

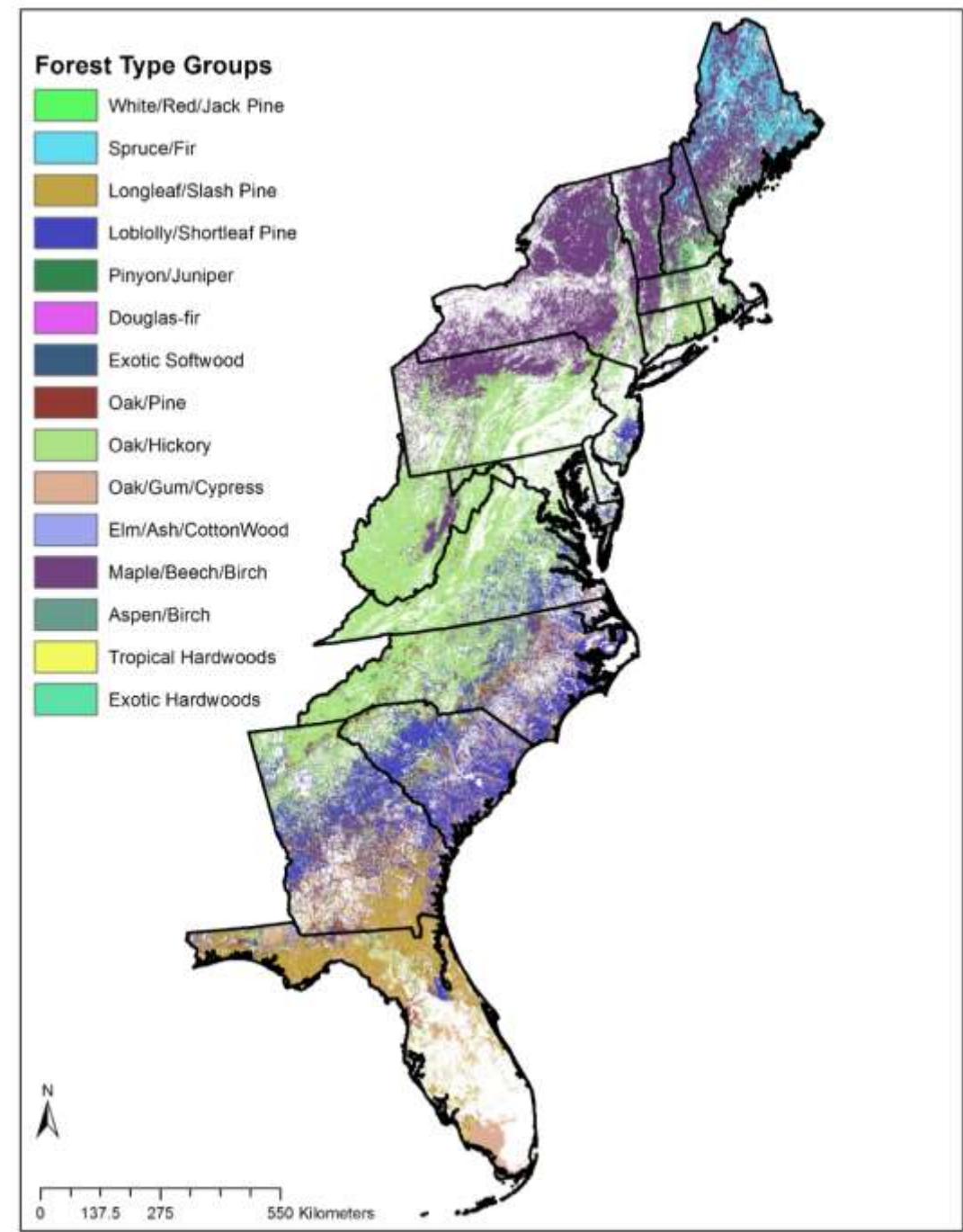


Eastern Coastal States of the US

USDA Forest Service inventory plots in the eastern coastal states



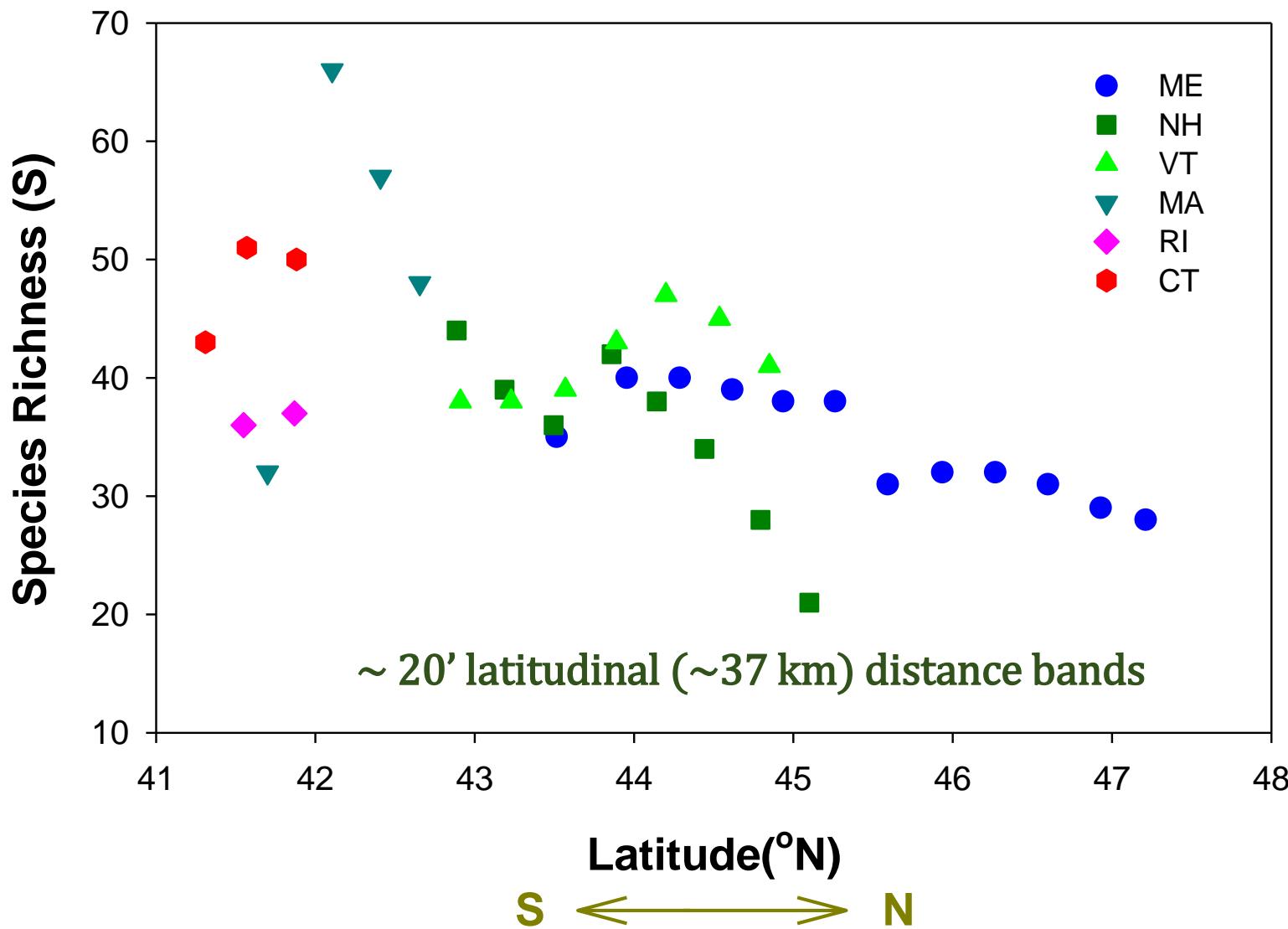
Forest type groups of eastern coastal states of the US



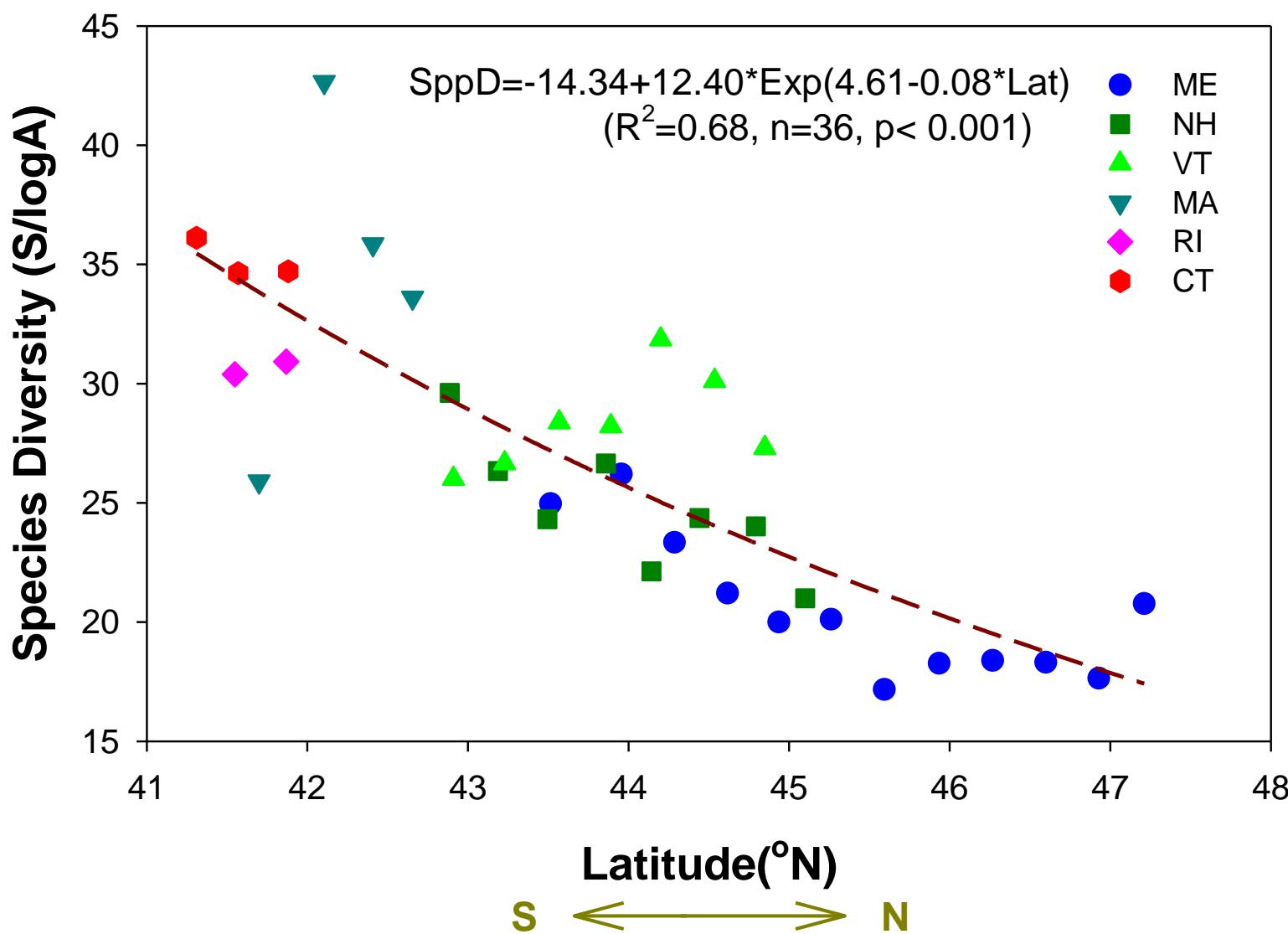
Tree Species (S) in Forests of Eastern Coastal States of the US

States	Plots	Measured trees	Species	Latitude
Maine	3,150	196,536	56	43°06'24" – 47°26'14" N
New Hampshire	1,047	58,813	65	42°42'13" – 45°16'17" N
Vermont	920	43,935	62	42°44'02" – 45°00'46" N
Massachusetts	534	20,329	74	41°14'58" – 42°40'11" N
Rhode Island	124	4,020	48	41°21'07" – 42°00'44" N
Connecticut	317	10,340	62	41°05'22" – 42°02'25" N
New York	3,204	130,326	116	40°34'57" – 45°00'06" N
New Jersey	425	14,927	86	38°56'59" – 43°19'10" N
Pennsylvania	2,997	105,083	116	39°43'16" – 42°11'58" N
Delaware	136	5,298	59	38°27'47" – 39°50'18" N
Maryland	430	15,405	98	37°58'27" – 39°43'07" N
West Virginia	2,080	78,308	117	37°12'59" – 40°37'19" N
Virginia	3,318	43,935	60	42°44'02" – 45°00'46" N
N. Carolina	3,647	187,852	132	33°55'12" – 36°34'29" N
S. Carolina	2,676	139,521	120	32°09'01" – 35°11'35" N
Georgia	4,867	236,349	139	30°21'54" – 34°59'32" N
Florida	3,215	132,523	129	24°36'28" – 30°59'49" N
Summary	33,087	1,423,500	238	24°36'28" – 47°26'14" N

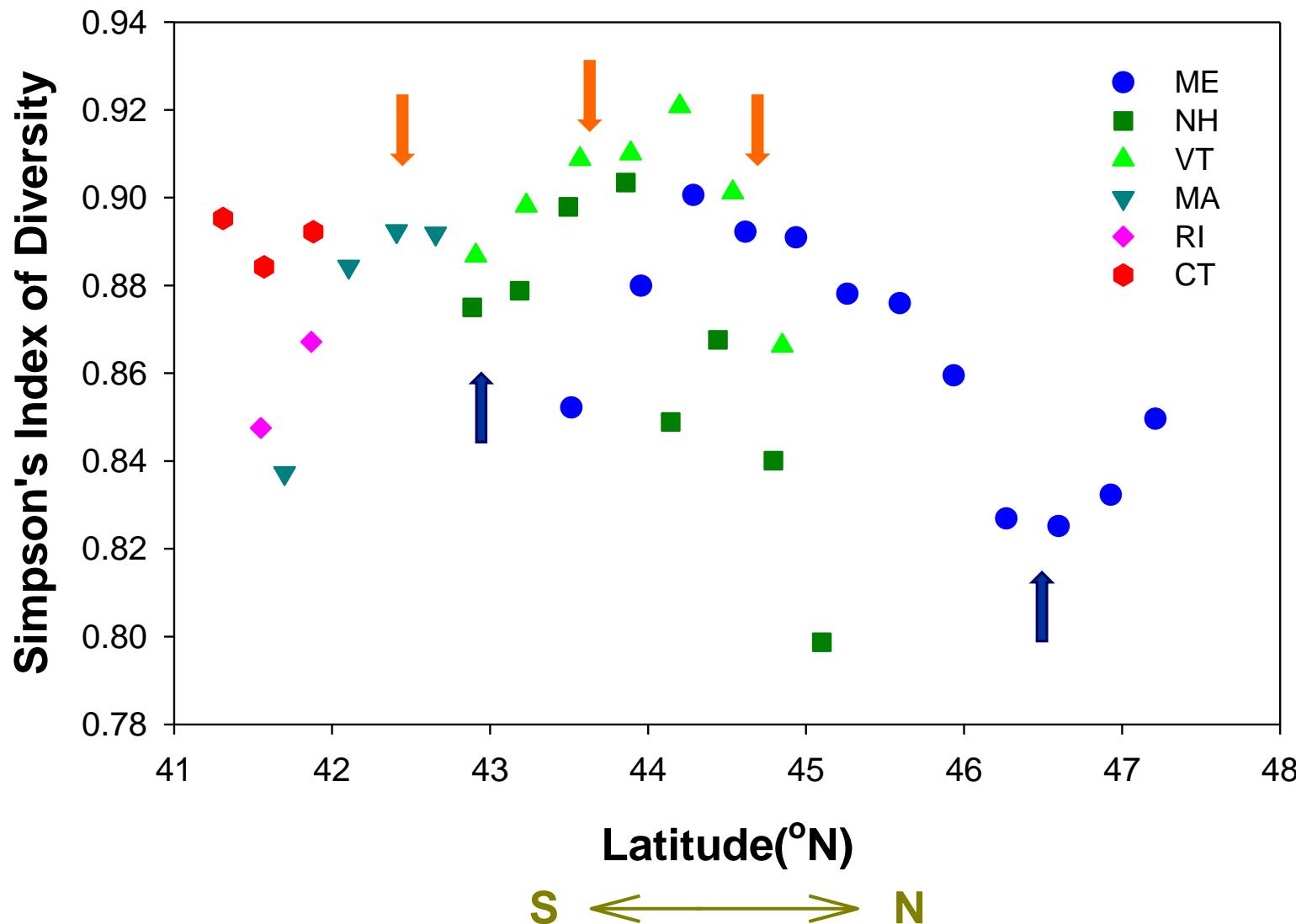
of Species (S) along New England Coastal Gradients



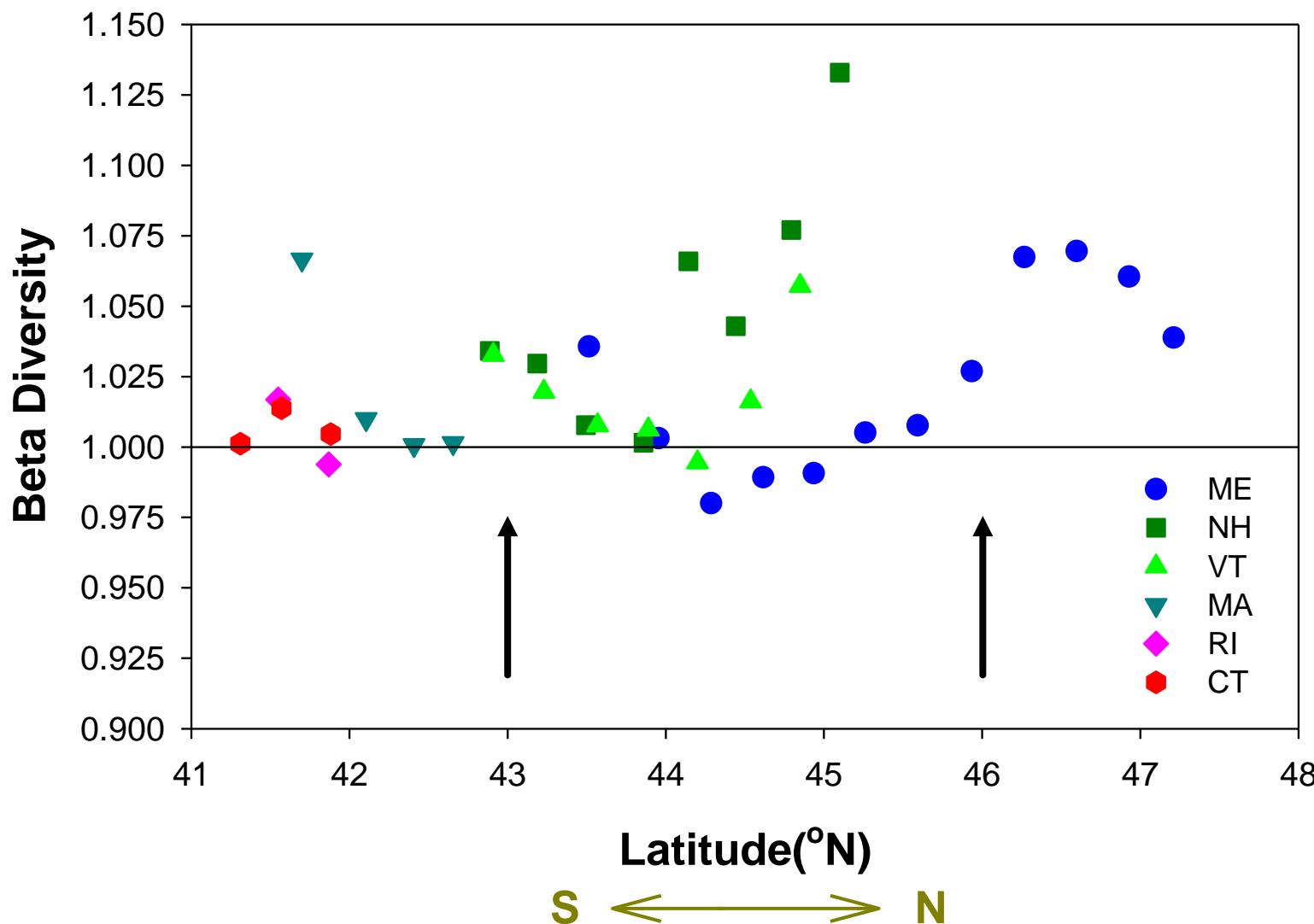
Species Diversity along New England Coastal Gradients



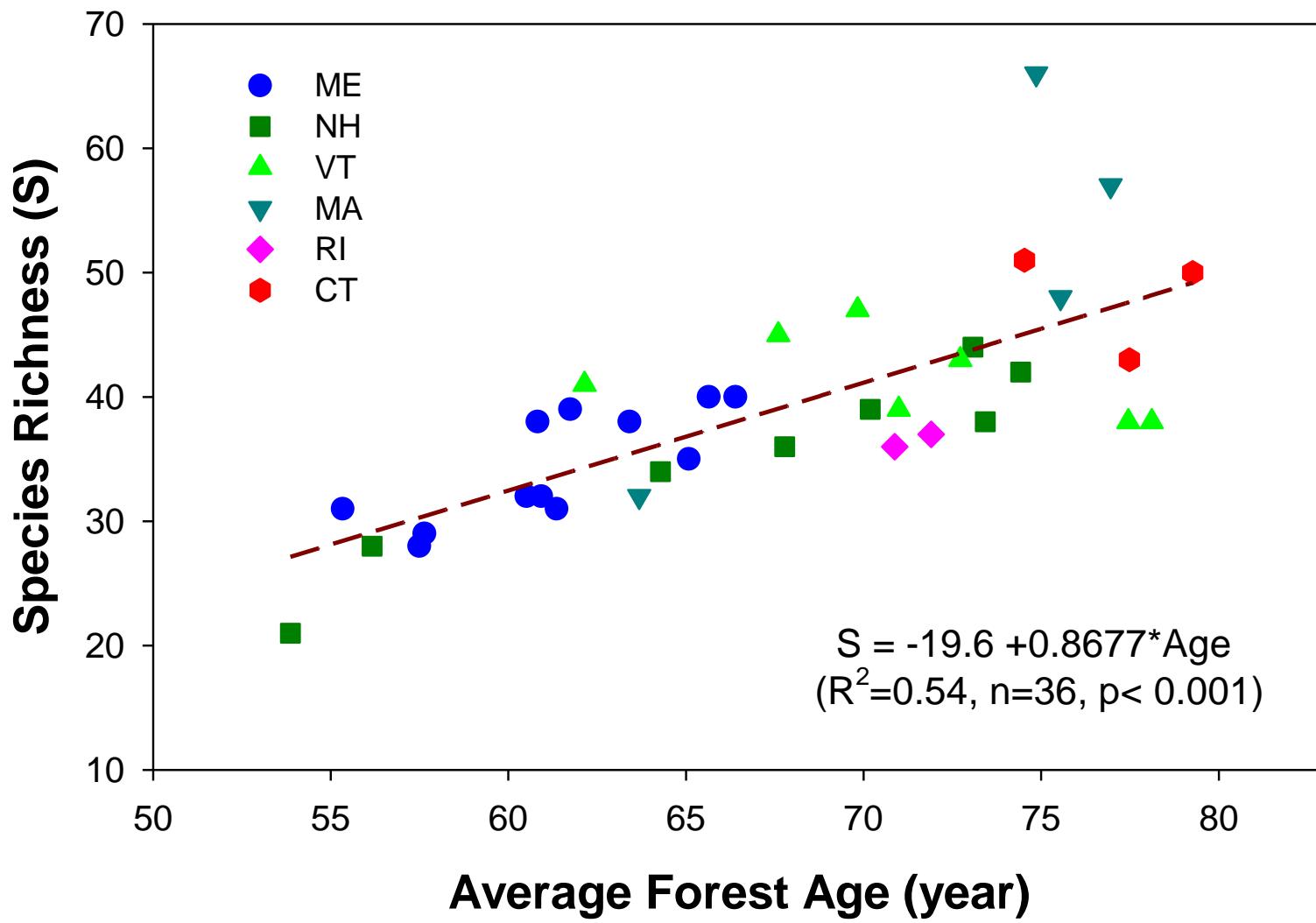
α Diversity along New England Coastal Gradients



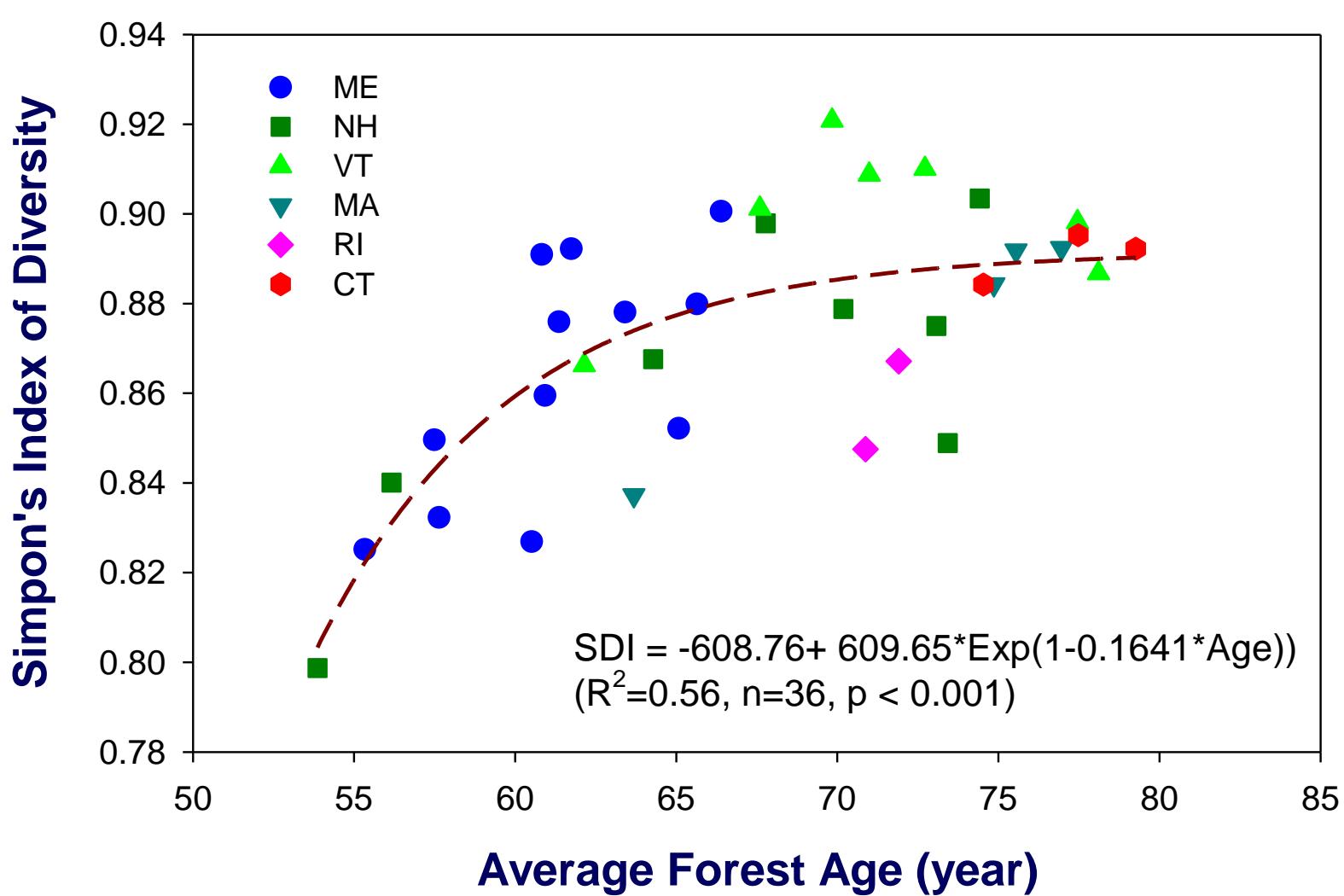
β Diversity of New England States along Gradients



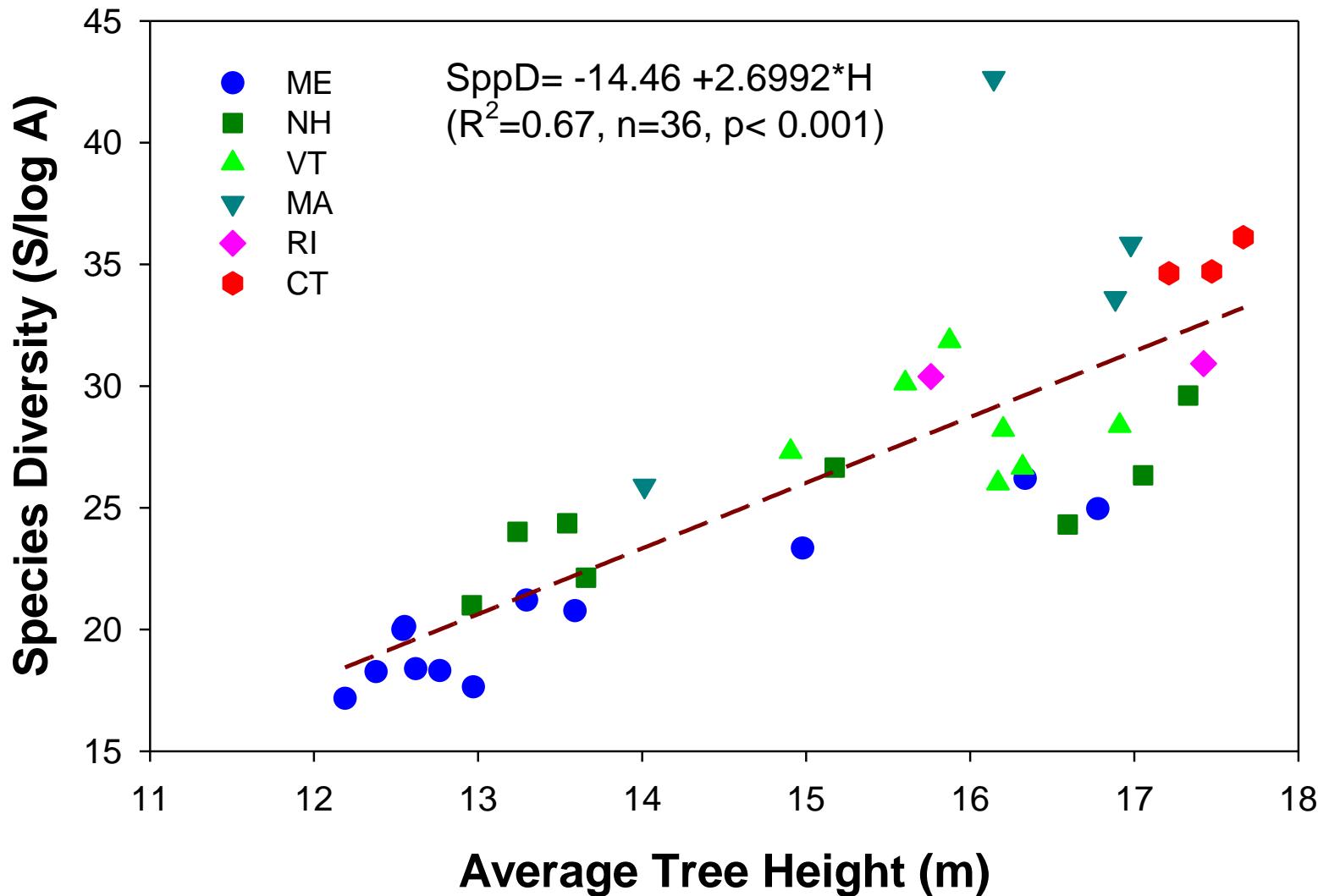
Forest Ages and Regional Species Richness



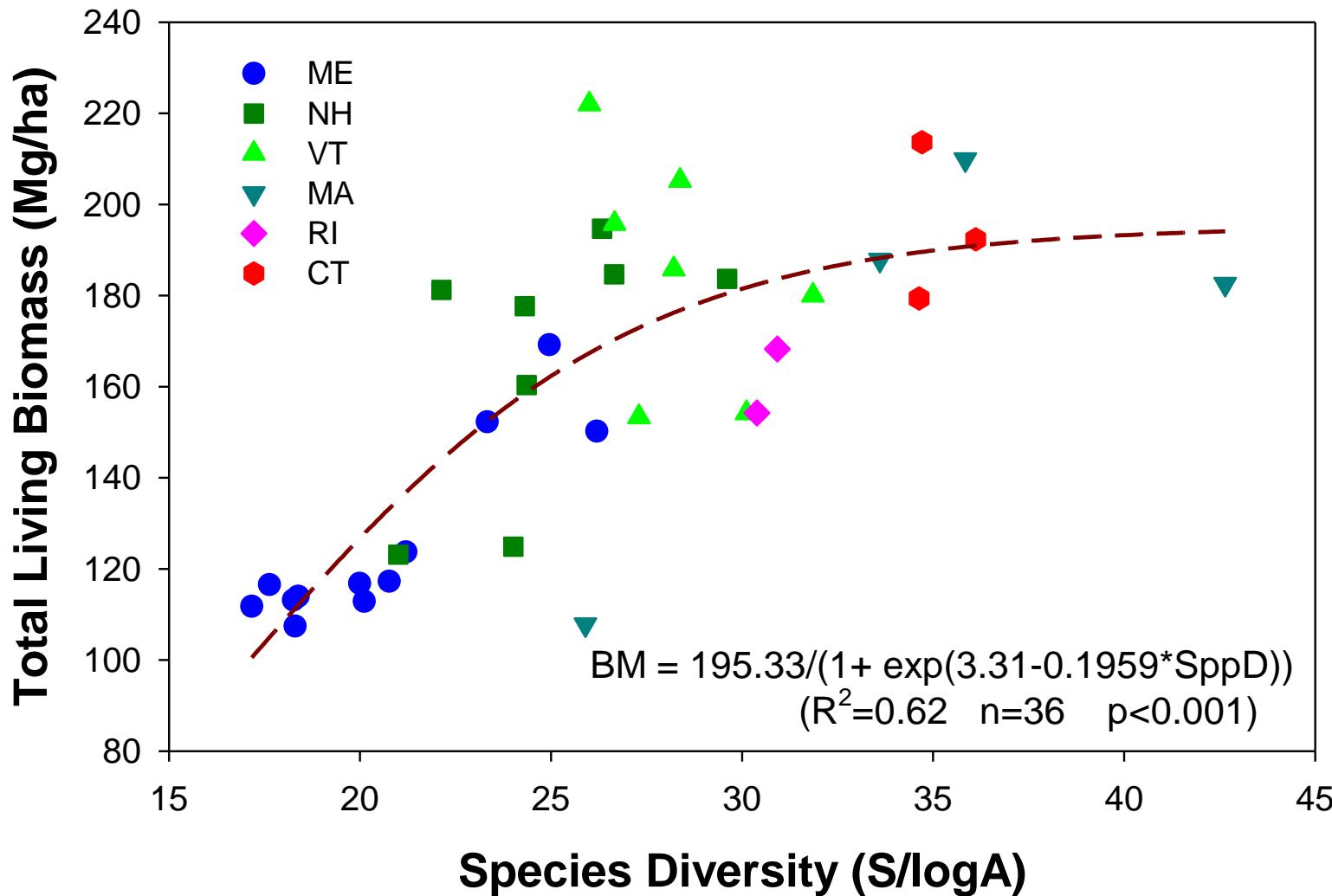
Forest Ages and Simpson's Index of Diversity



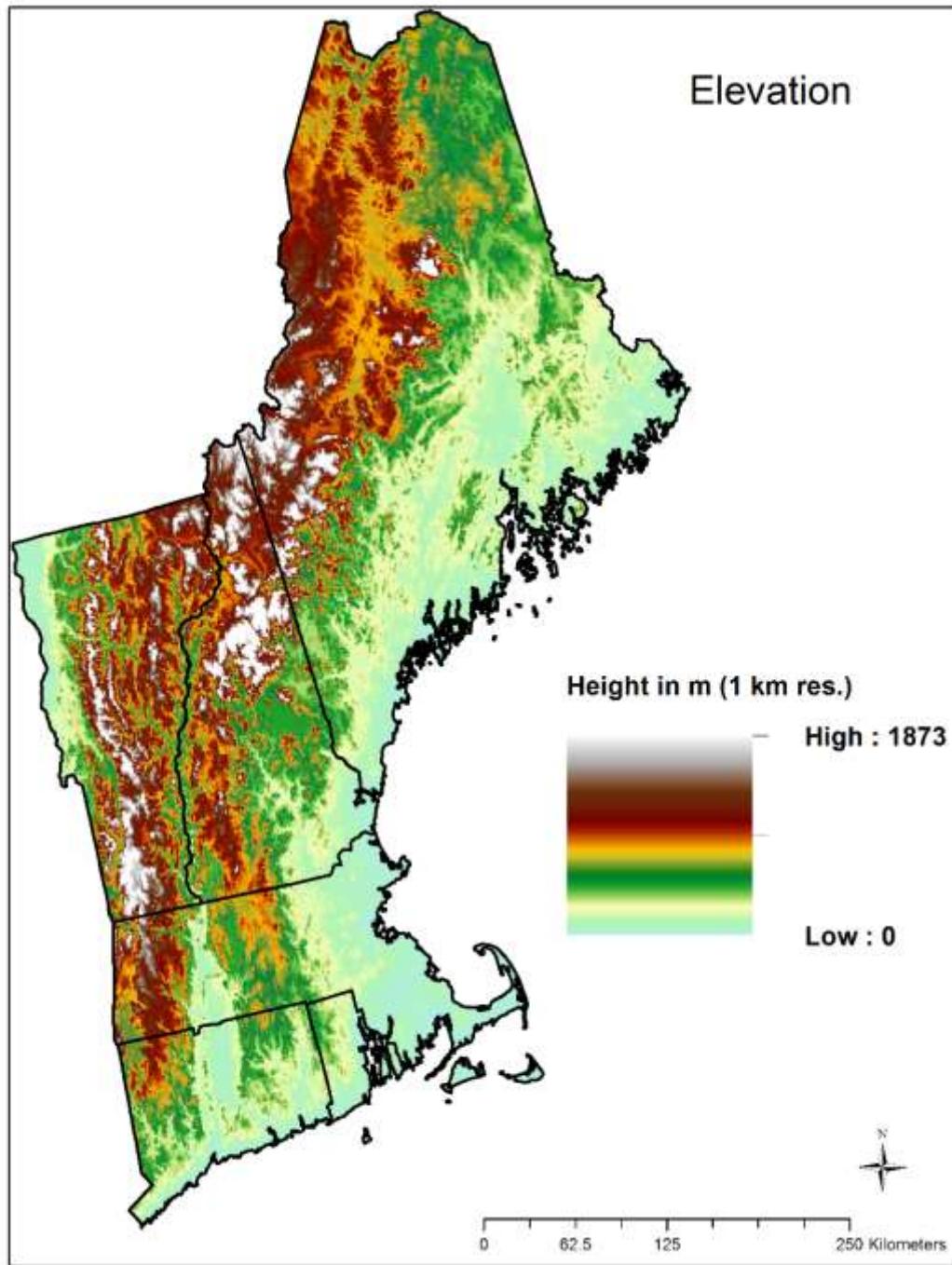
Tree Height and Species Diversity



Species Diversity and Forest Biomass



Topography of New England states



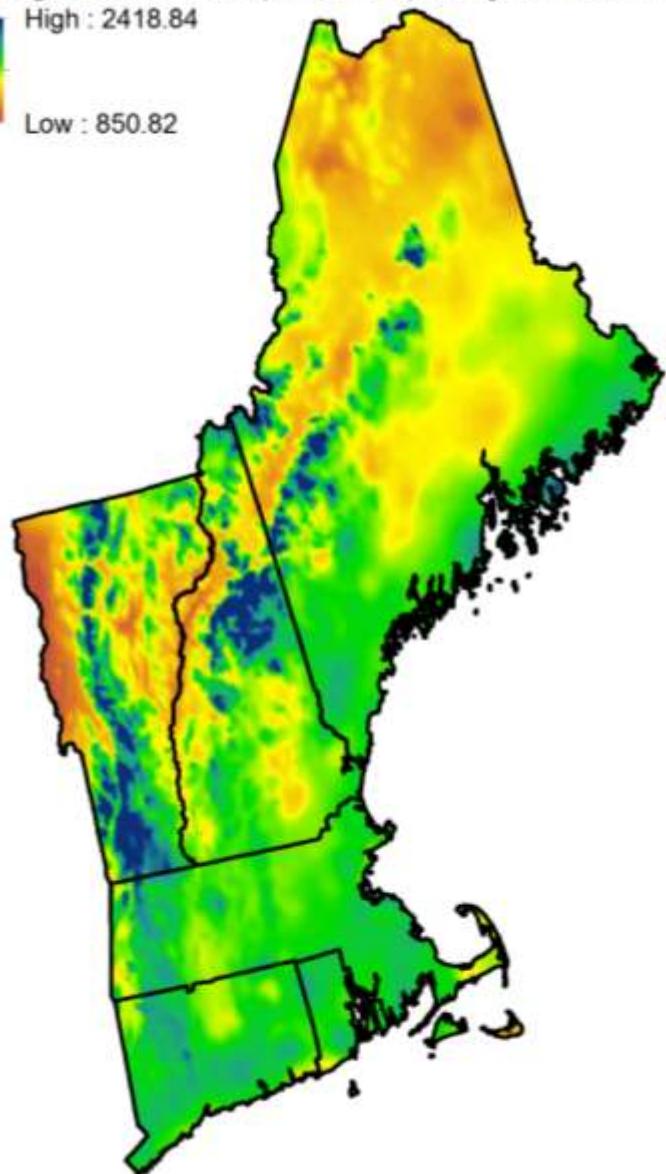
Average climates (1981-2010) of New England states

Average Total Precipitation (mm/yr, 1 km res.)



High : 2418.84

Low : 850.82



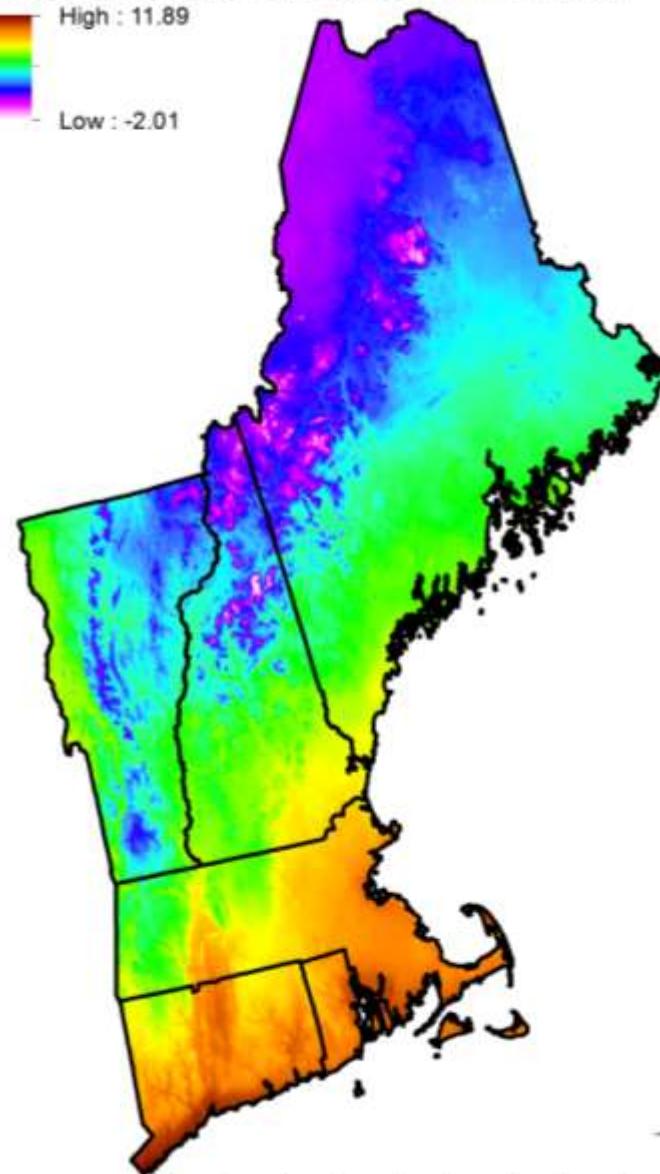
1981-2010 average of the PRISM data set

Average Temperature (Degree C, 1 km res.)



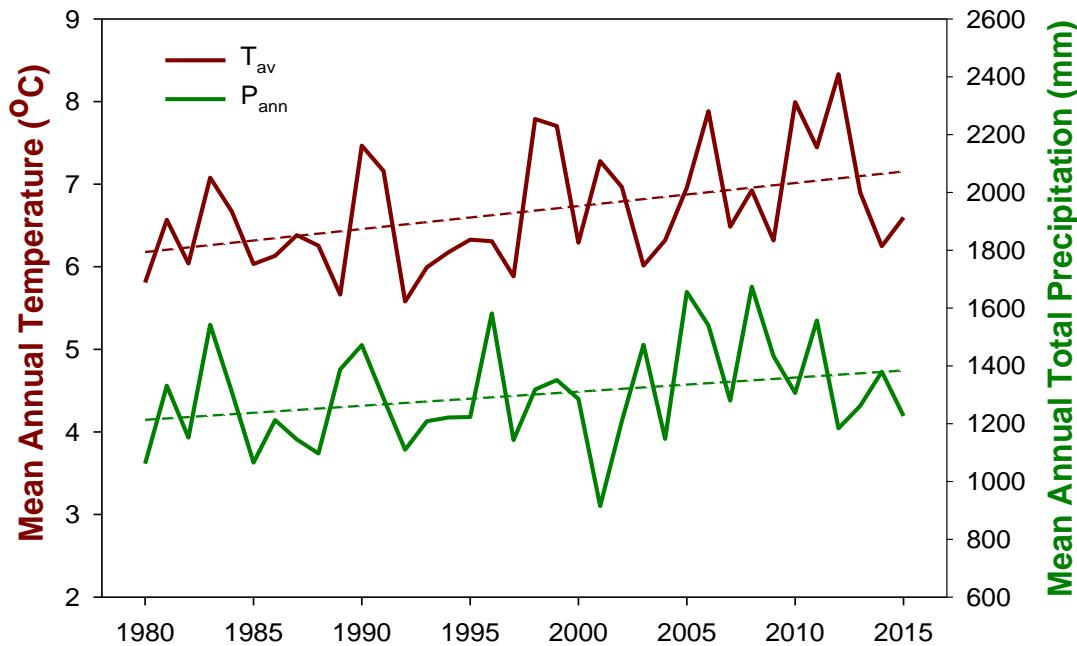
High : 11.89

Low : -2.01



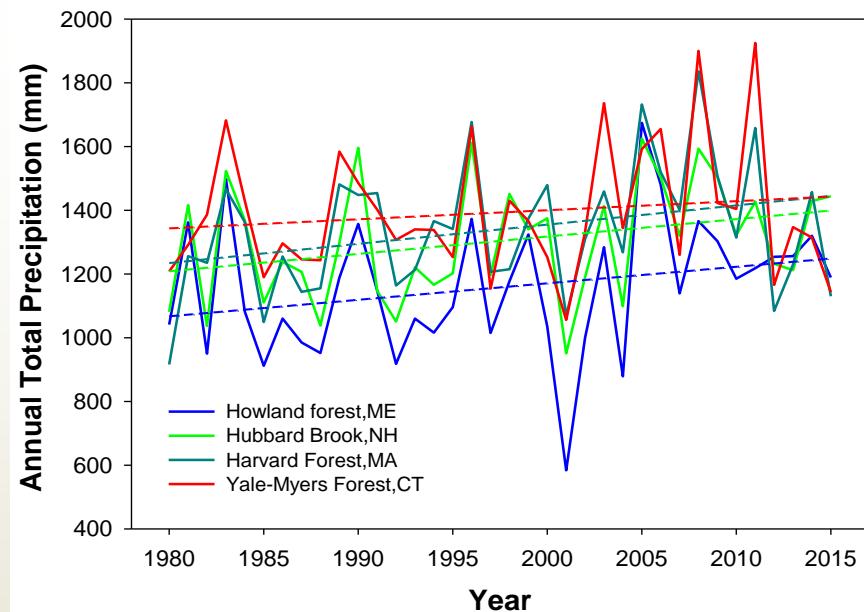
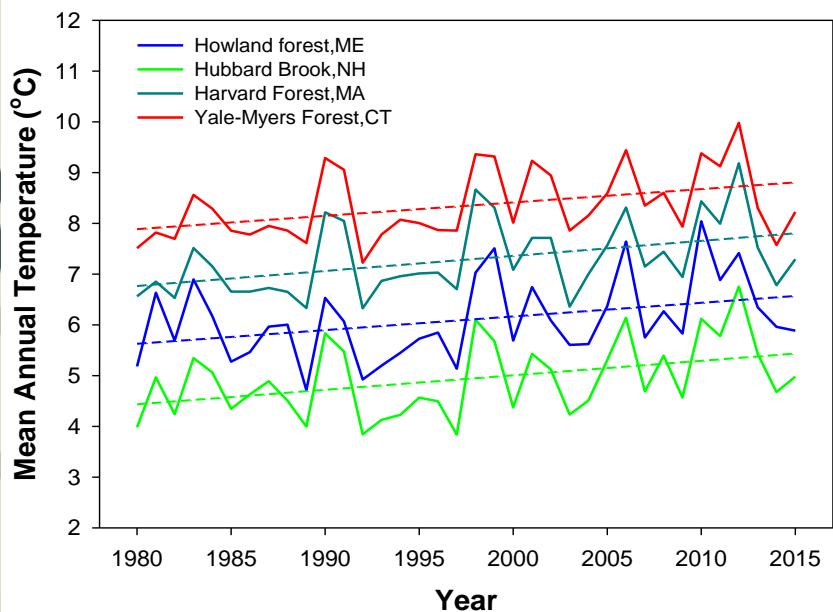
0 80 160 320 Kilometers

Mean climates of four sites across the region

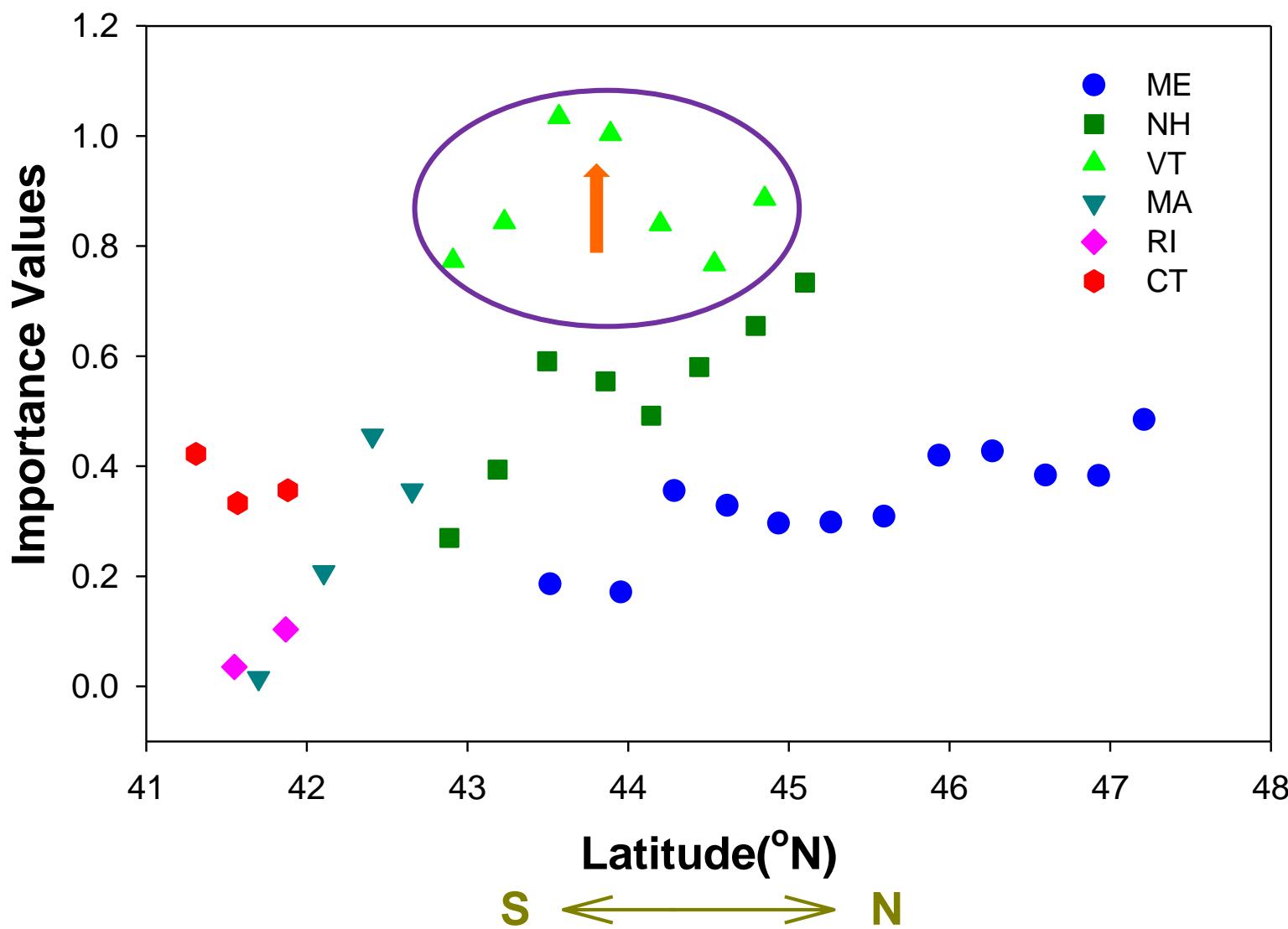


Climate trends of
the last decades
in New England
states

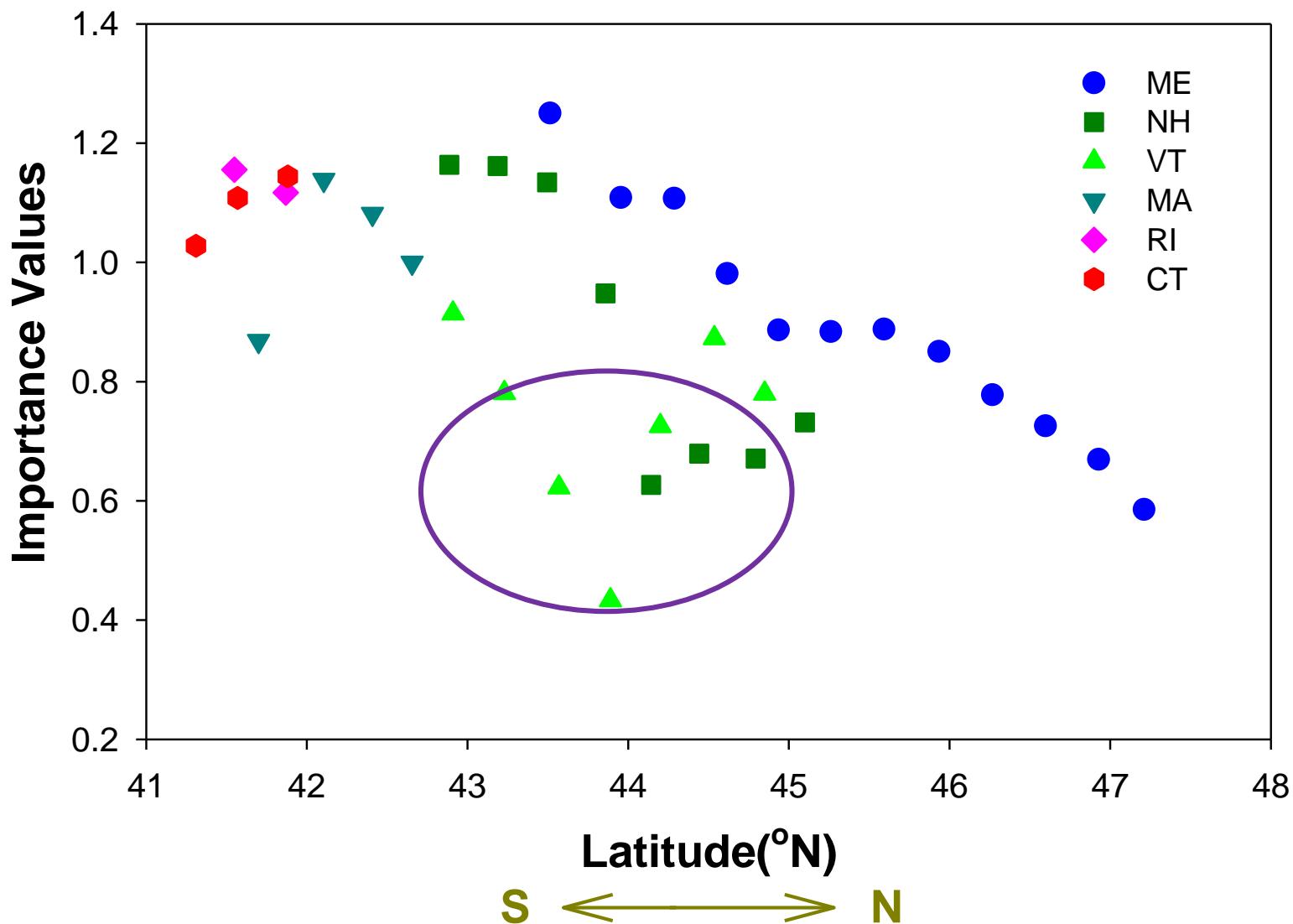
Howland forest, ME
Hubbard Brook, NH
Harvard Forest, MA
Yale-Myers forest, CT



Importance Values of Sugar Maple in New England



Importance Values of Red Maple in New England



Summaries

- Simpson's index of diversity only has a fair relationship to forest ages but not to other structure attributes (height, biomass)
- ▶ Tree height has a better relationship with species diversity than to species numbers occurred in the region
- ▶ Tree ages have a better relationship with species numbers in the region than to species diversity
- ▶ Relationship between species diversity and biomass could be more caused by the effects of forest structures on tree species
- ▶ Forest resilience may relate to stability of the range of a forest type
- ▶ Tree species shifting should be tested using more narrowly distributed species and the shift of its distribution center



Thank You!