Modeling and Data Mining Concepts Applied to Forest Resource Management

Image from: http://alvenka.deviantart.com/art/fractal-tree-34-366989431

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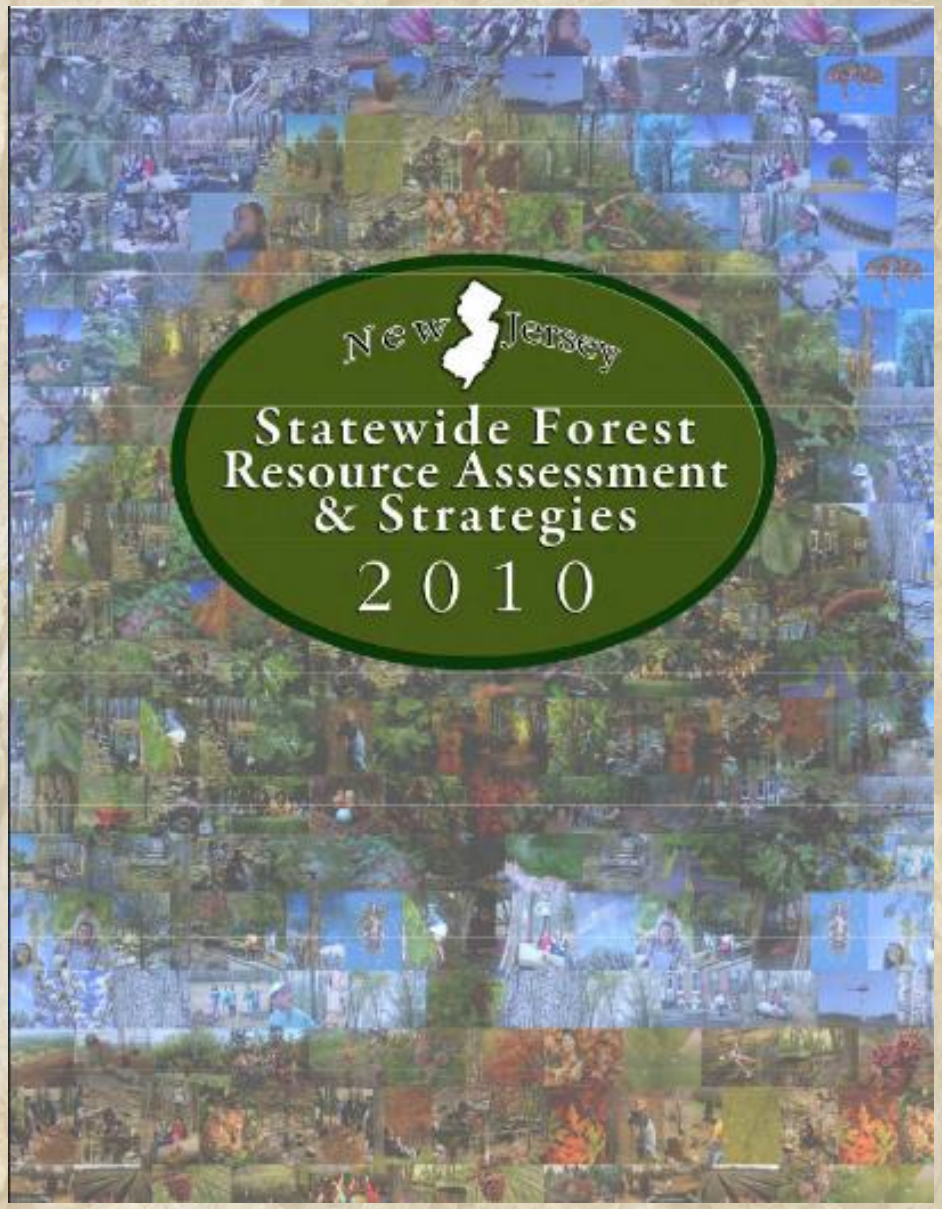
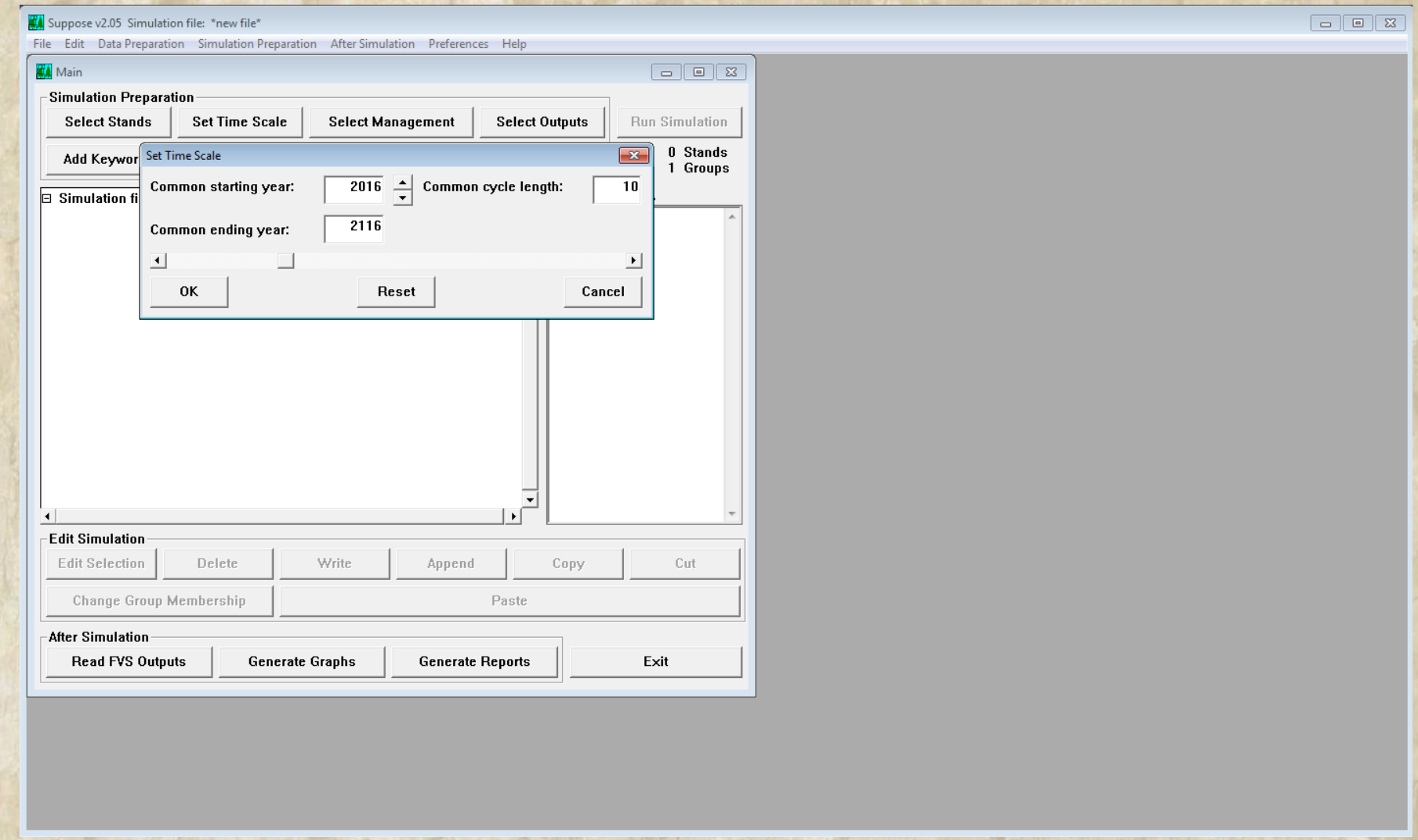
NJ State Forest Service

NJ Forest Action Plan/Montreal Process



Part I – Present Capabilities



In Situ Data Collection Efforts

- State Lands Inventory
  - Snapshot in time
  - State Forest Level (Forest Type)
  - Variable Radius
- USFS FIA
  - http://www.fia.fs.fed.us/tools-data/
  - Continuous (entire state measured every 5 years)
  - 2X national grid intensity in NJ
  - Measure Change (growth, mortality, removals, etc.)

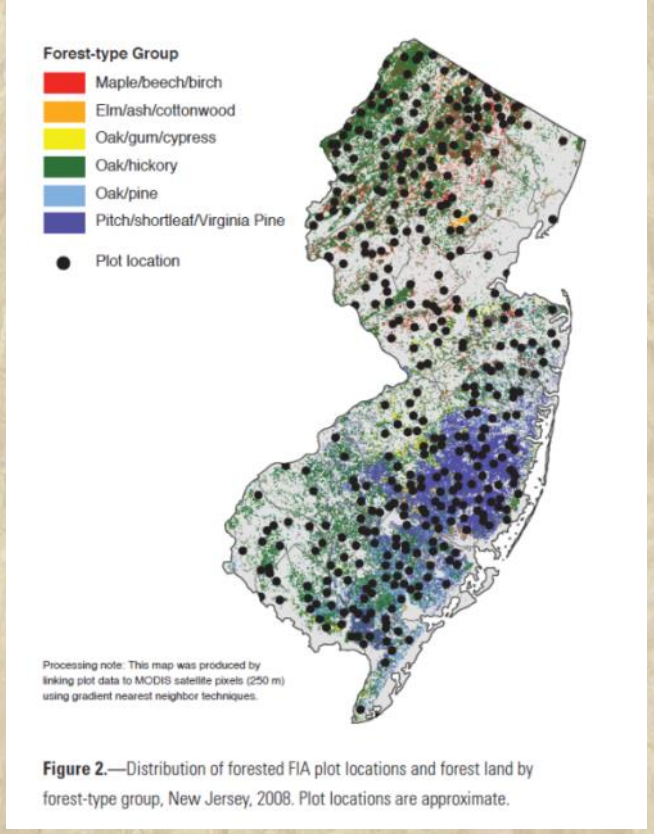


Figure 2.—Distribution of forested FIA plot locations and forest land by forest-type group, New Jersey, 2008. Plot locations are approximate.

Forest Modeling

- Ecosystem processes and management responses are complex!

- Models are mathematical representations of objects, processes, and/or interactions
  - They are abstractions of reality!
  - Often deliberately emphasize one aspect of the system at the expense of others

- Models take very complex problems and make them more manageable relative to our scope of understanding.
  - Large areas
  - Long time frames
  - Complex interactions

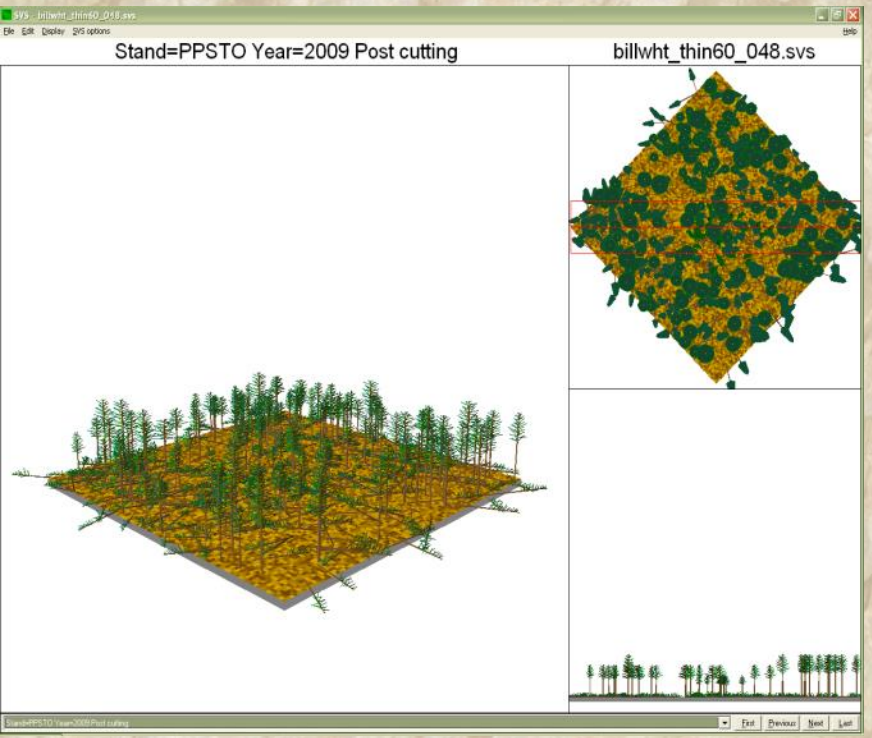
- Requires iteration, not a crystal ball!

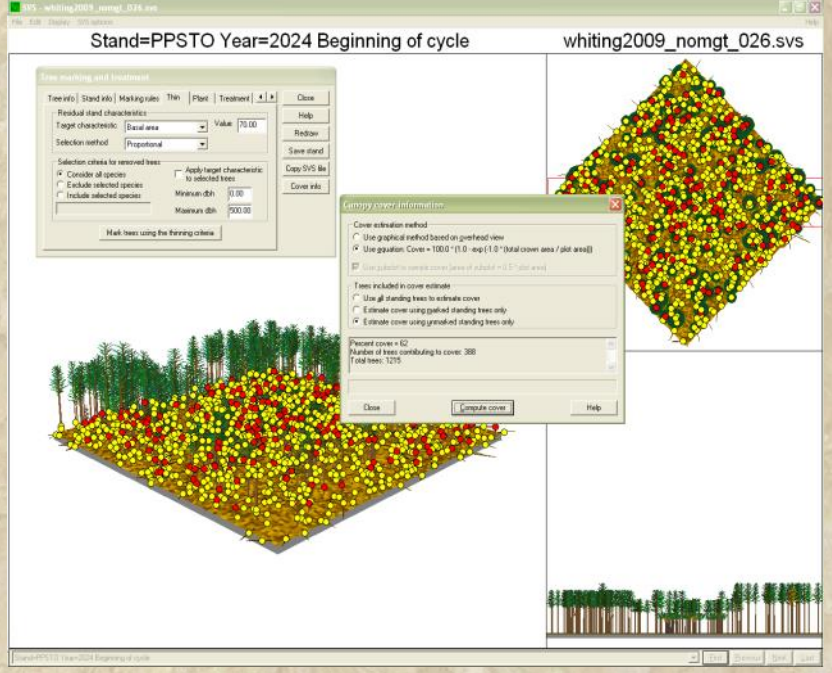
Simulation Modeling

Simulation Models

- Specific application of models to arrive at an OUTCOME
- Can evaluate outcomes of actions or lack thereof at varying time intervals and scales
- "Simming" does not generally tell you directly whether the outcome of a particular set of actions is "better" or "worse"
- Advantages
  - Test alternatives prior to doing
  - Economical
  - Time compression
  - Team development
  - Safety

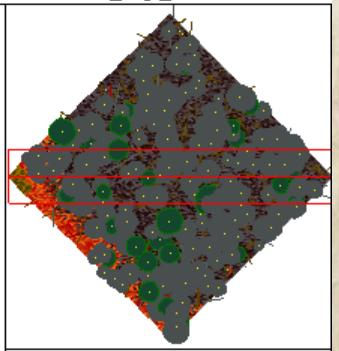
Treatment Design





Stand=PPSTOb Year=2053 During the fire (02/03)

no_mgt_009.svs



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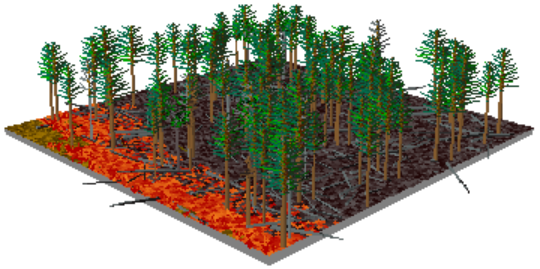
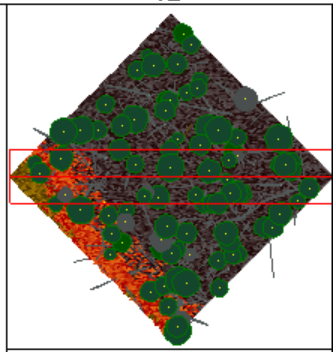
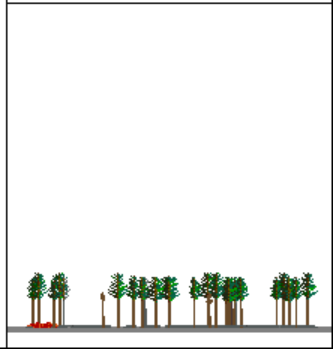
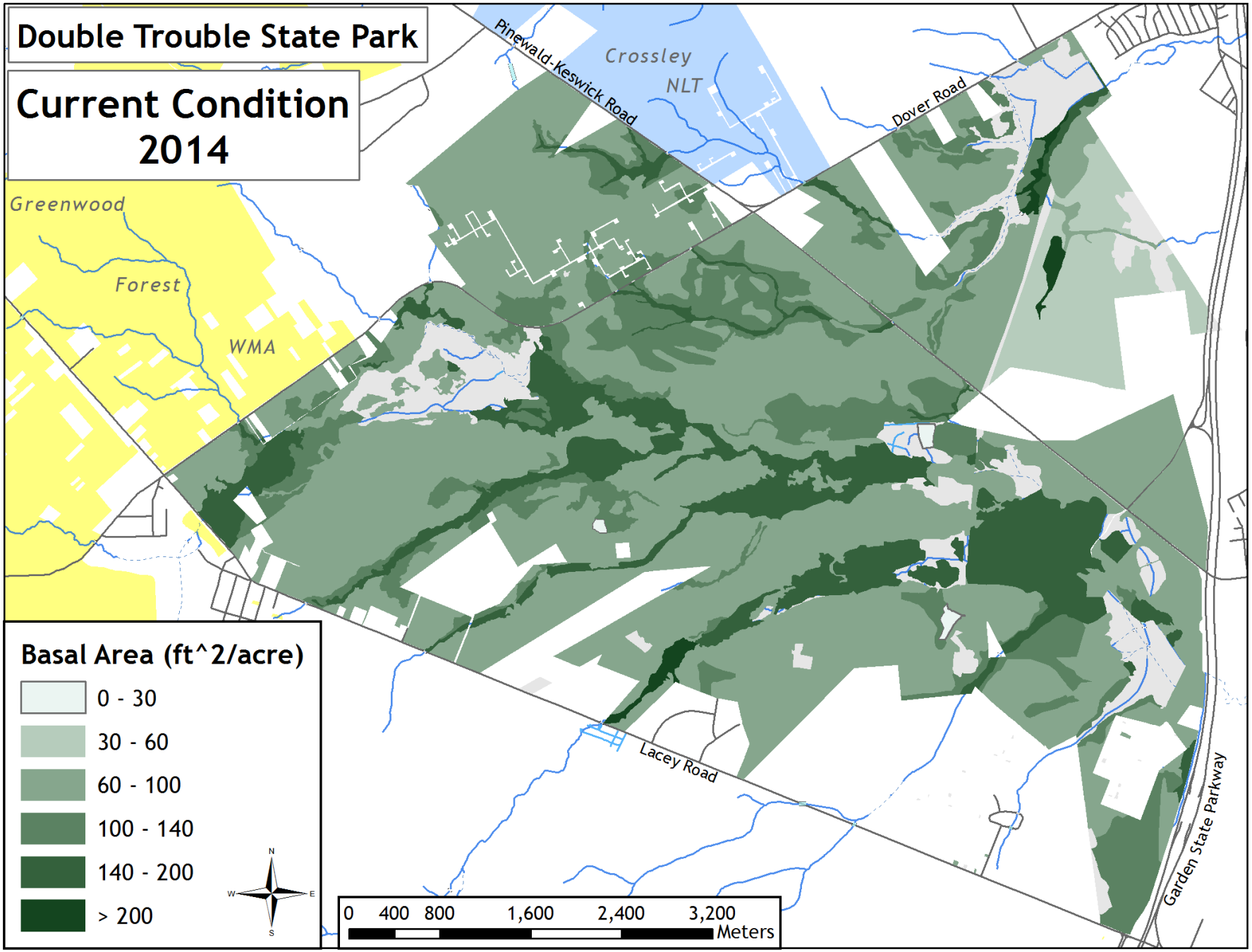
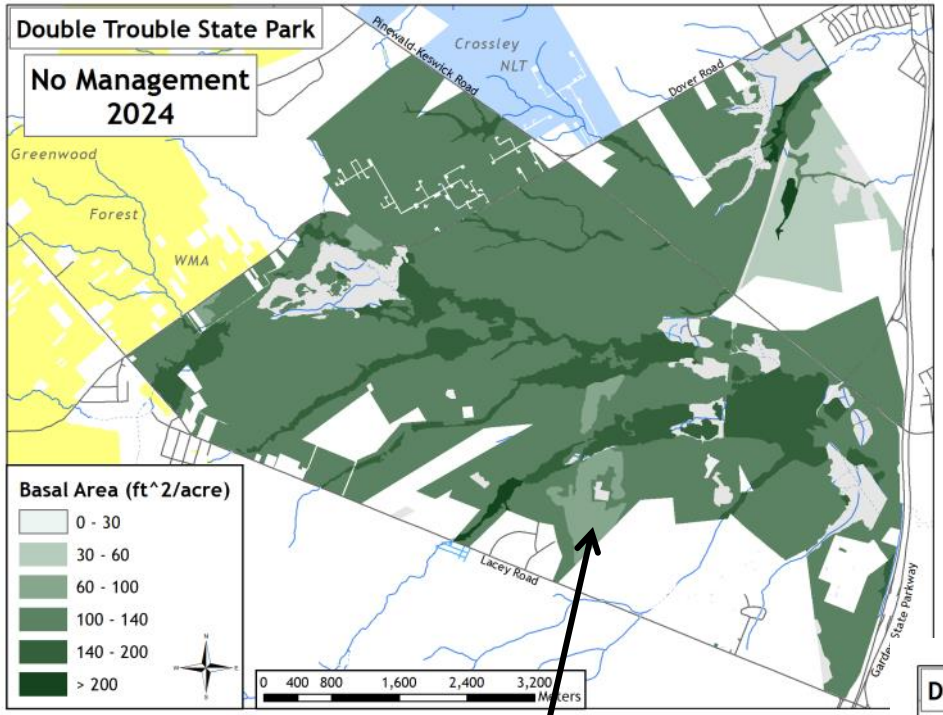
RxBOnly_027.svs





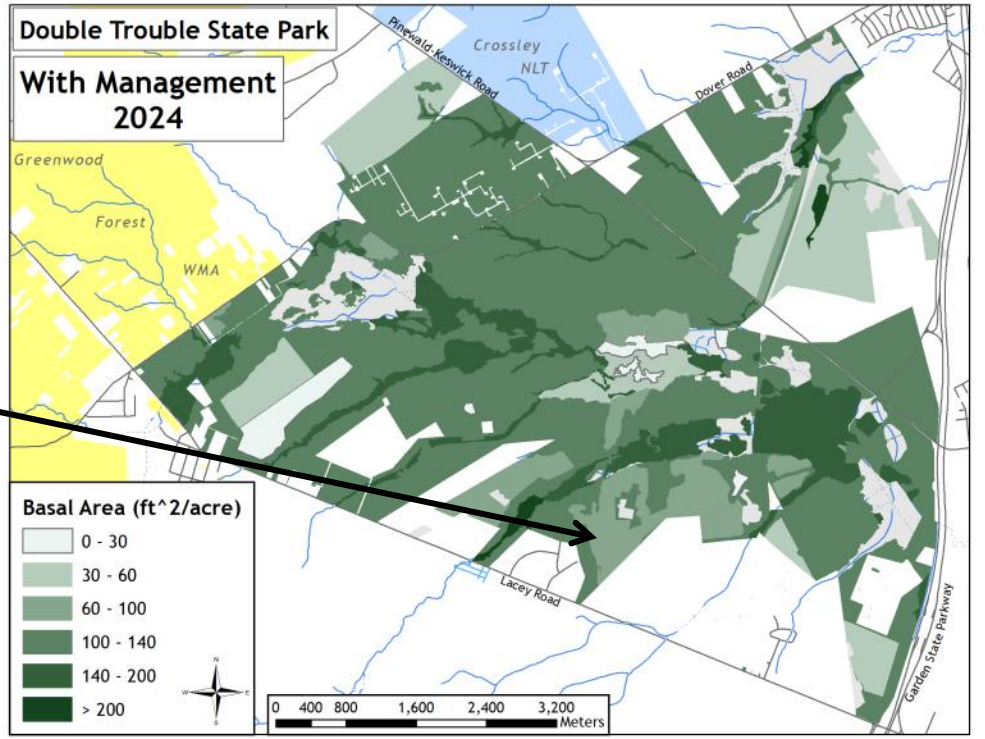


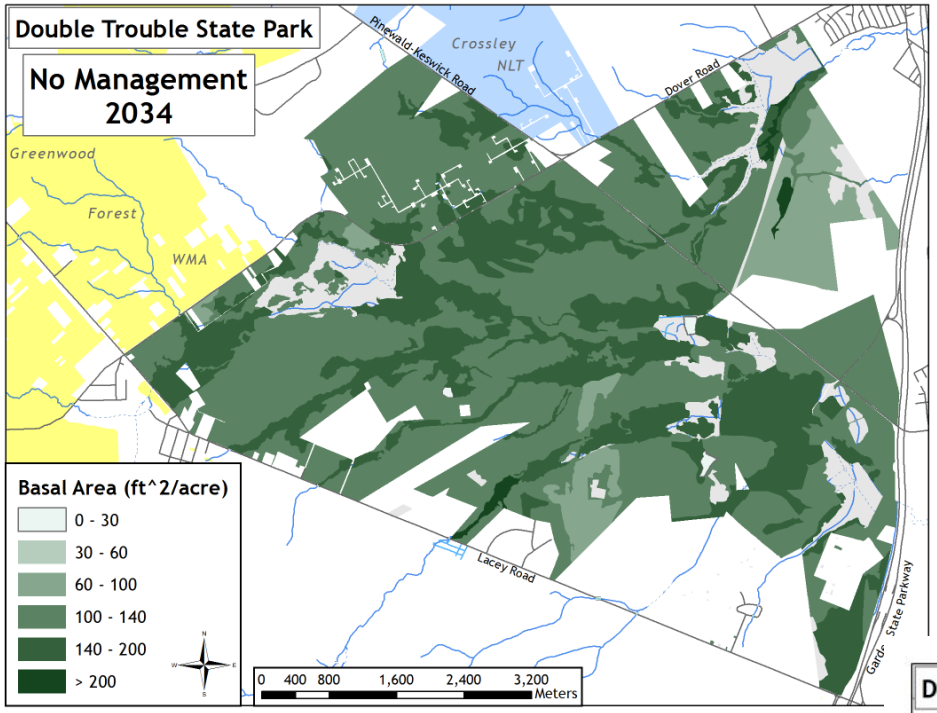

Double Trouble State Park
Current Condition
2014
Pinewald-Keswick Road
Crossley
NLT
Dover Road
Greenwood
Forest
WMA
Lacey Road
Garden State Parkway
Basal Area (ft^2/acre)
0 - 30
30 - 60
60 - 100
100 - 140
140 - 200
> 200
N
W
E
S
0 400 800 1,600 2,400 3,200
Meters



At Plan Completion

Check out wildfire impacts
From 1990's wildfire!




Double Trouble State Park
No Management
2034
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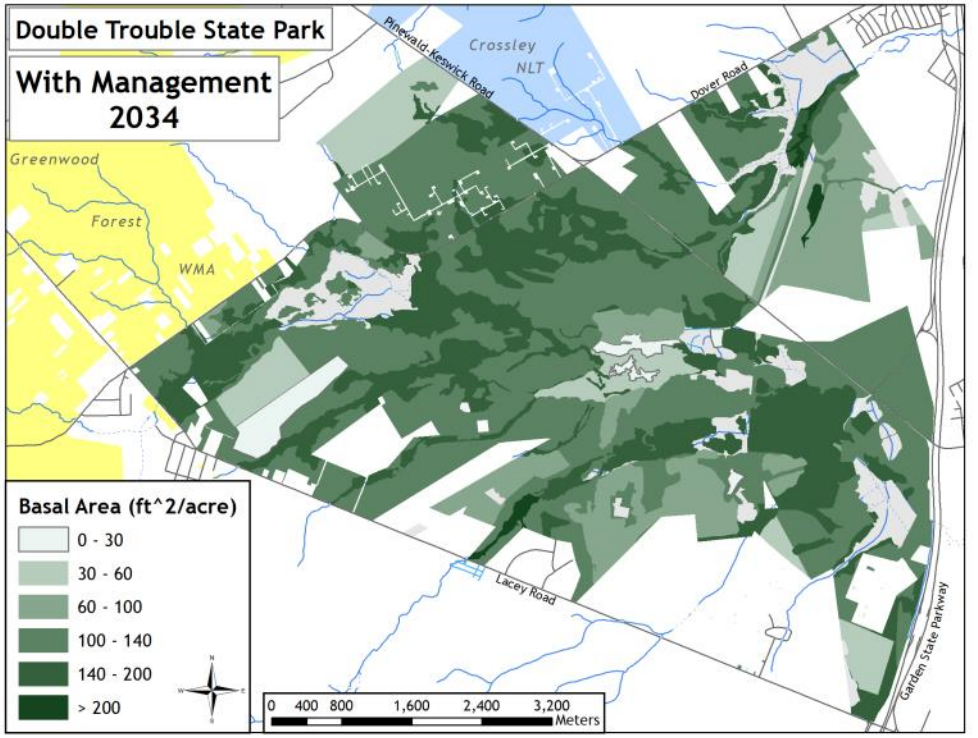
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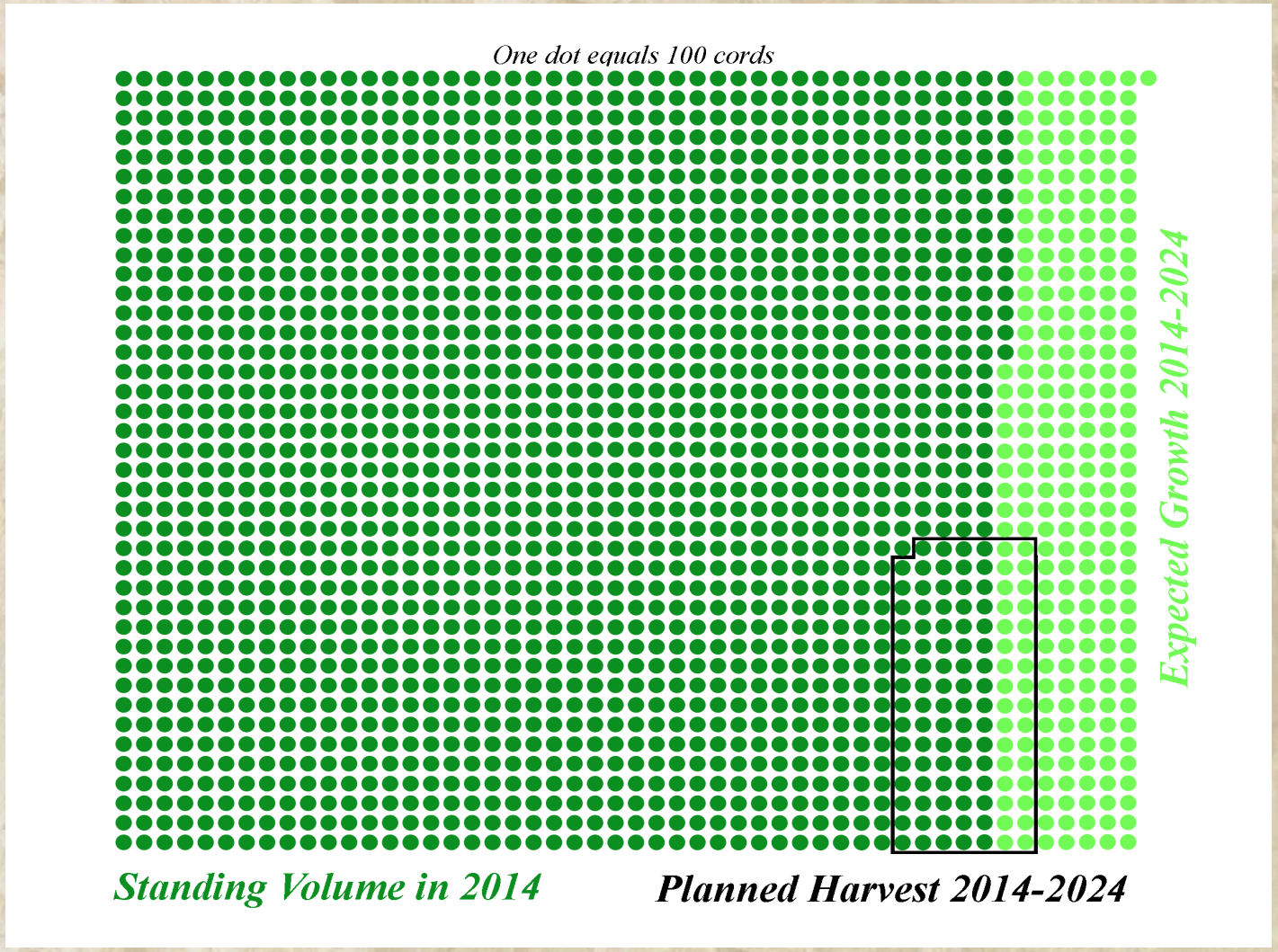
Sustainability



Part II – Future Possibilities

http://www.nanoday.com/single/224/top-10-future-technologies-that-will-change-the-world

Data Mining

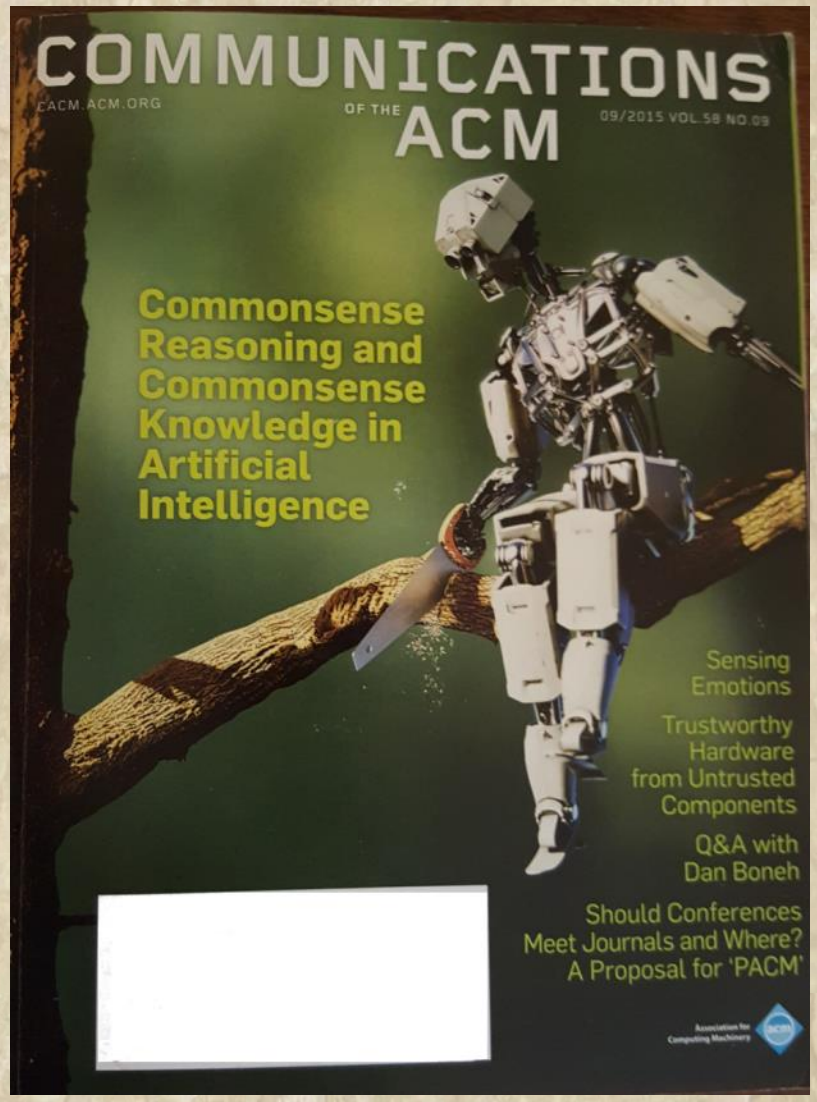
- Knowledge discovery from large data repositories
  - Extraction of interesting information or patterns from large collections of data
- Knowledge Discovery in Databases (KDD)
- Involves multiple disciplines
  - Pattern Recognition
  - Machine Learning
  - Databases
  - Statistics
  - Information Visualization

Association Mining

- Information extraction looking at association rules
  - Involves looking at support and confidence
  - i.e. Aprioi Algorithm
- Legend of Beer and Diapers

Machine Learning

- Models learned from data
- Supervised classification
- Unsupervised classification



J48 Decision Tree Example

J48 Decision Tree 10-Fold Cross Validation Results:

=== Stratified cross-validation ===

=== Summary ===

Correctly Classified Instances	2455	92.3627 %
Incorrectly Classified Instances	203	7.6373 %
Kappa statistic	0.6309	
Mean absolute error	0.116	
Root mean squared error	0.2466	
Relative absolute error	49.9371 %	
Root relative squared error	72.397 %	
Total Number of Instances	2658	

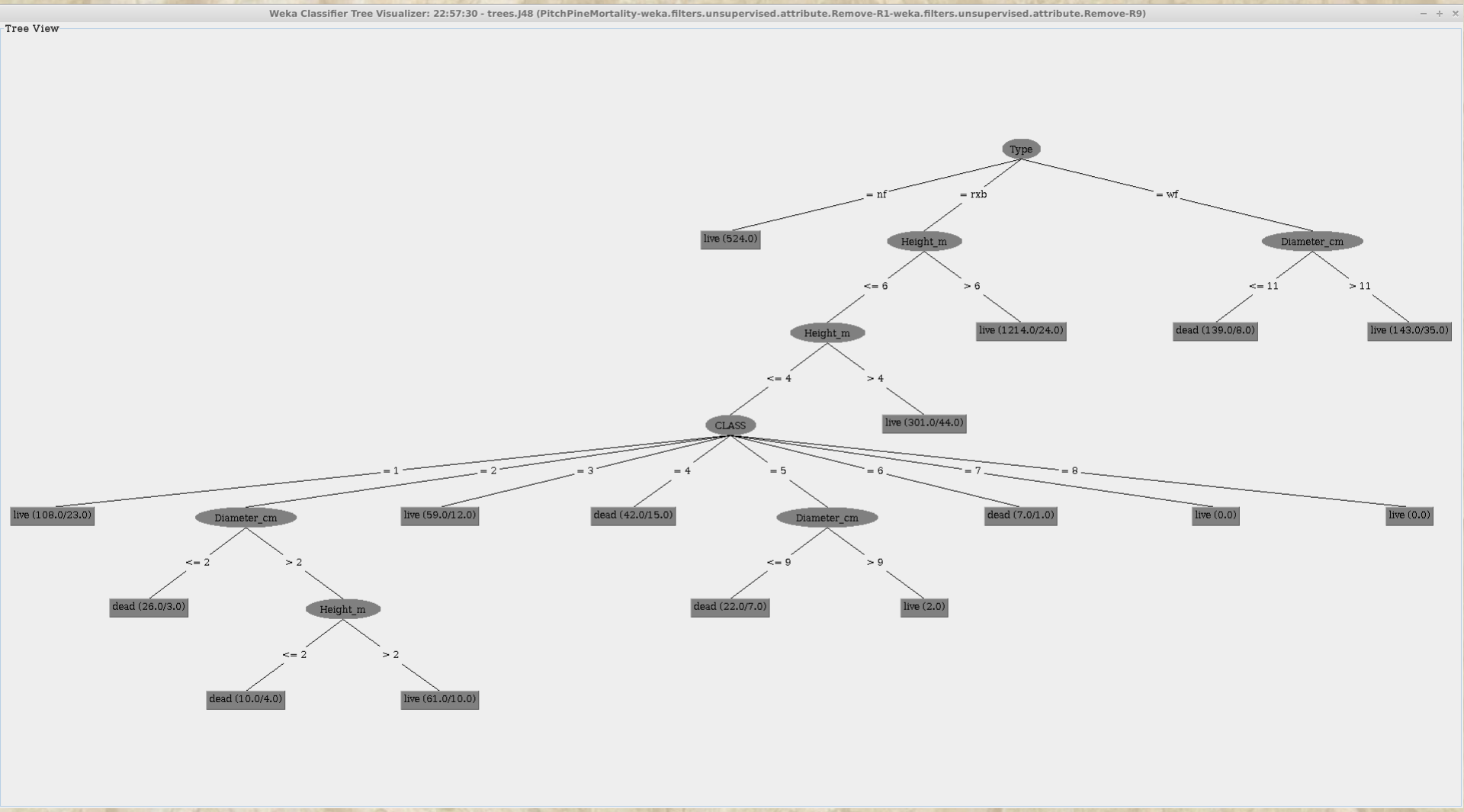
=== Detailed Accuracy By Class ===

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
	0.976	0.413	0.939	0.976	0.957	0.912	live
	0.587	0.024	0.789	0.587	0.673	0.912	dead
Wtd. Avg.	0.924	0.361	0.918	0.924	0.919	0.912	

=== Confusion Matrix ===

a	b	<-- classified as
2246	56	a = live
147	209	b = dead

J48 Decision Tree Example



Decision Support – Linear/Goal Programming

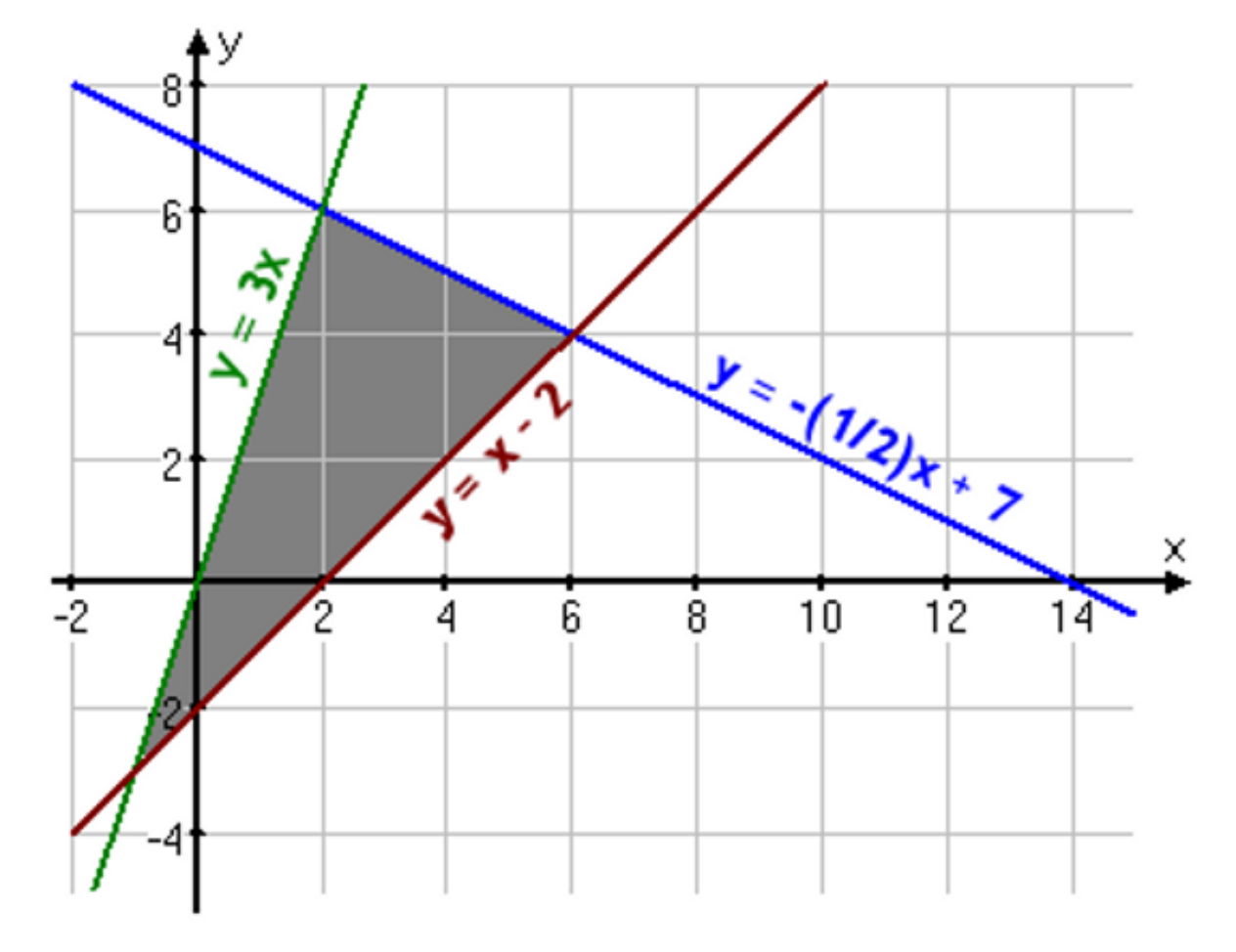
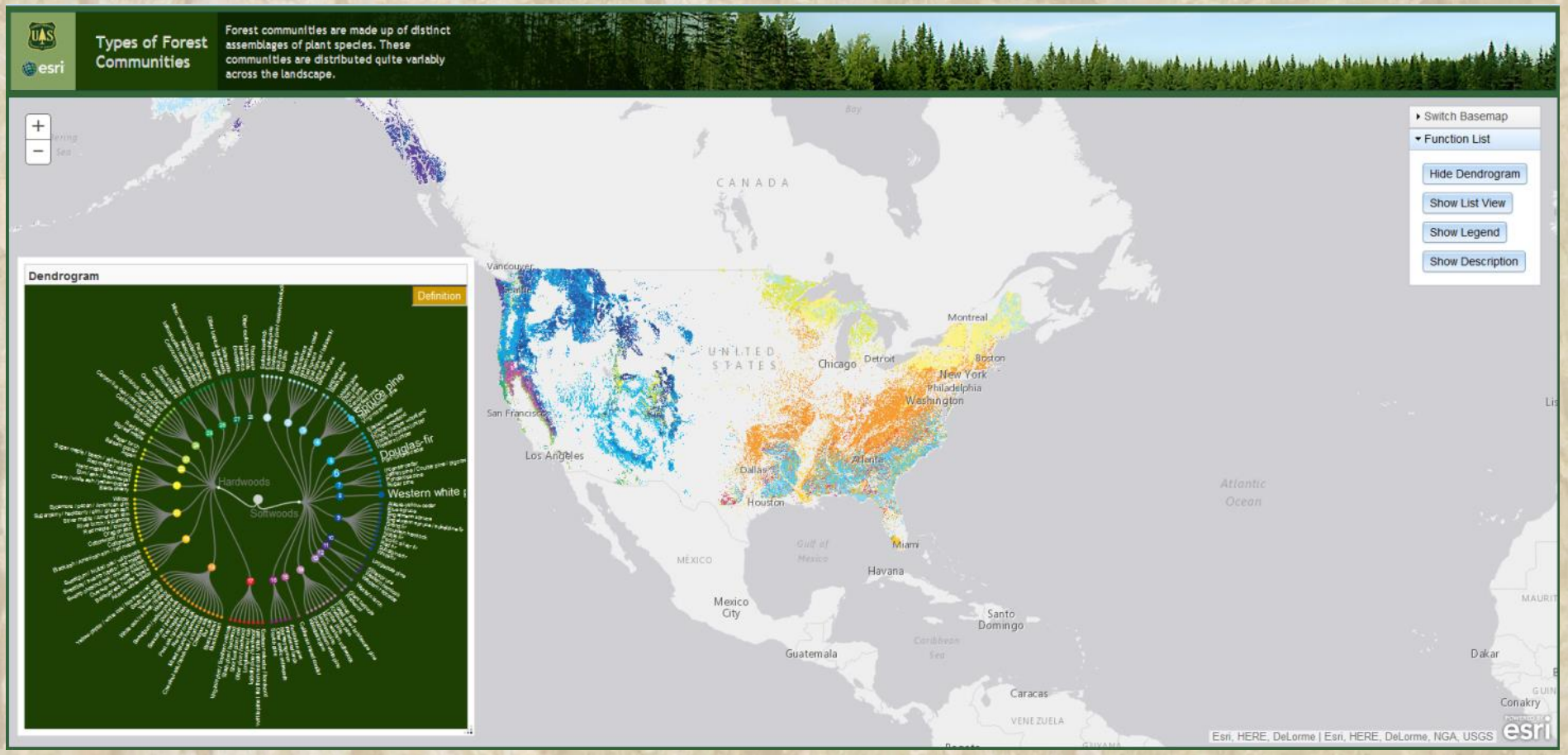
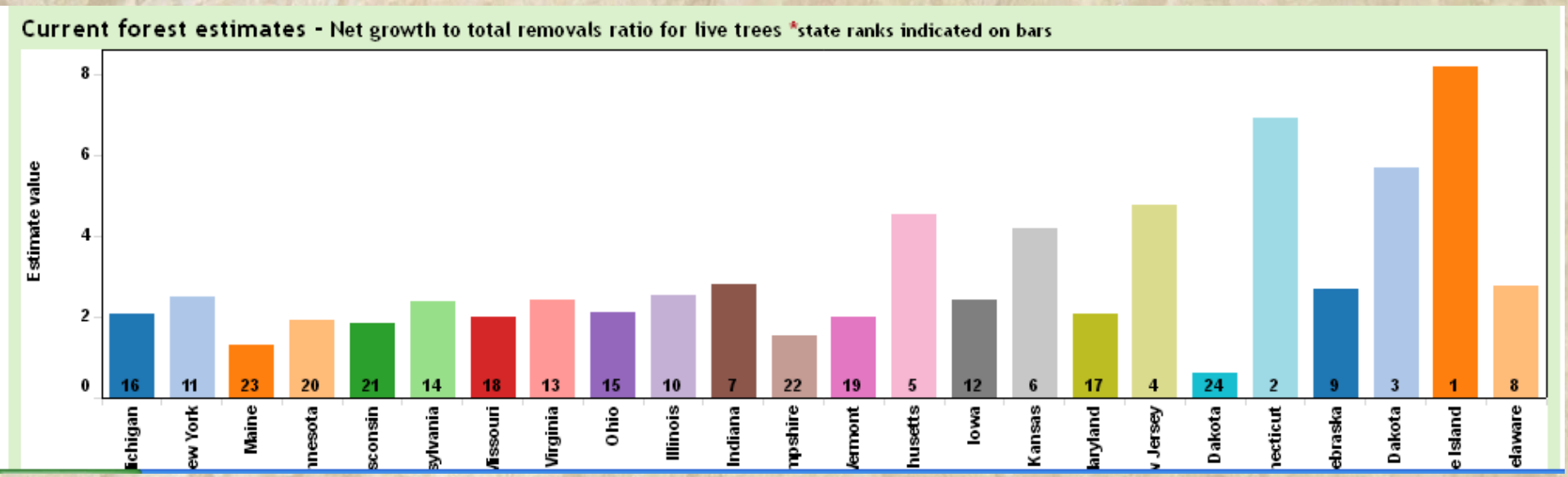


Image from Purplemath “Linear Programming: Introduction”
http://www.purplemath.com/modules/linprog.htm

Data Visualization



Data Dashboards



Other Data Visualization Ideas

http://thewestsidestory.net/blog

Questions?

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