Spatial Modeling of American Chestnut at Mammoth Cave National Park

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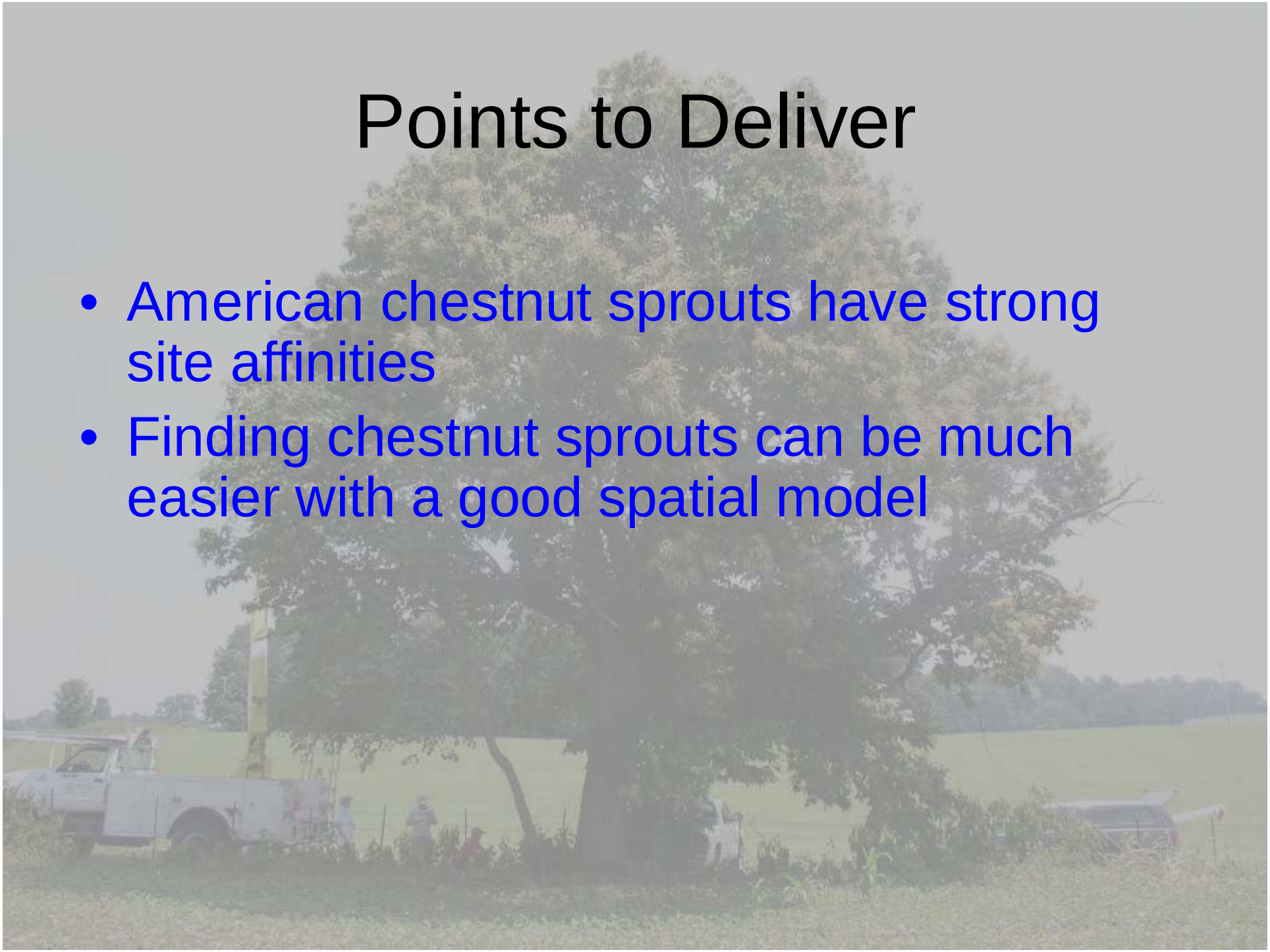
Photo by M. French

10/28/2007
TACF

Points to Deliver

- American chestnut sprouts have strong site affinities
- Finding chestnut sprouts can be much easier with a good spatial model



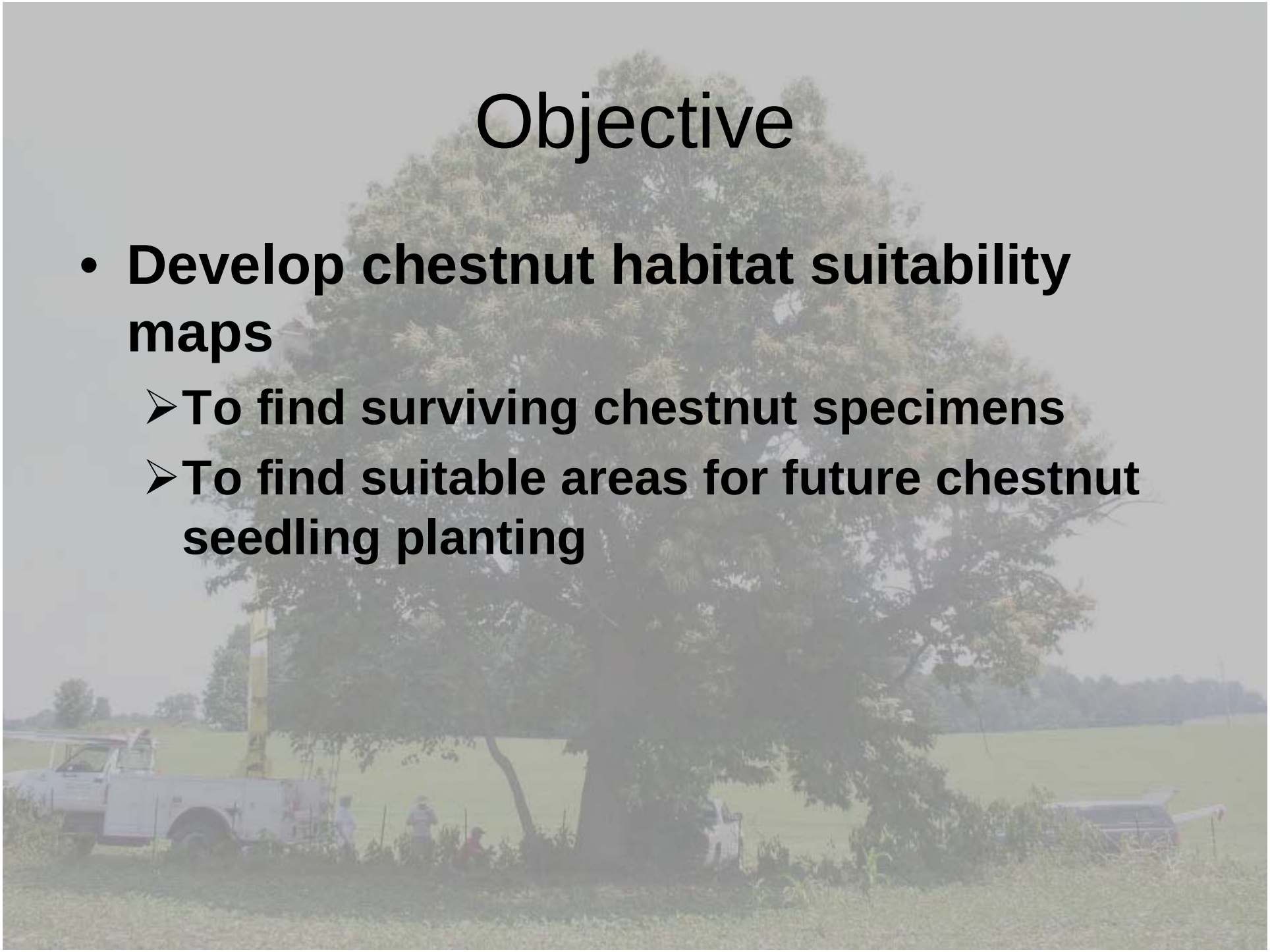
Why Spatial Modeling?

- Advance in TACF backcross breeding program
- A broad American chestnut genetic base is required to ensure local adaptability and preserve genetic diversity
- Need find more surviving American chestnut. *But this is time consuming…*

Solution:
A Good Predictive Spatial Model

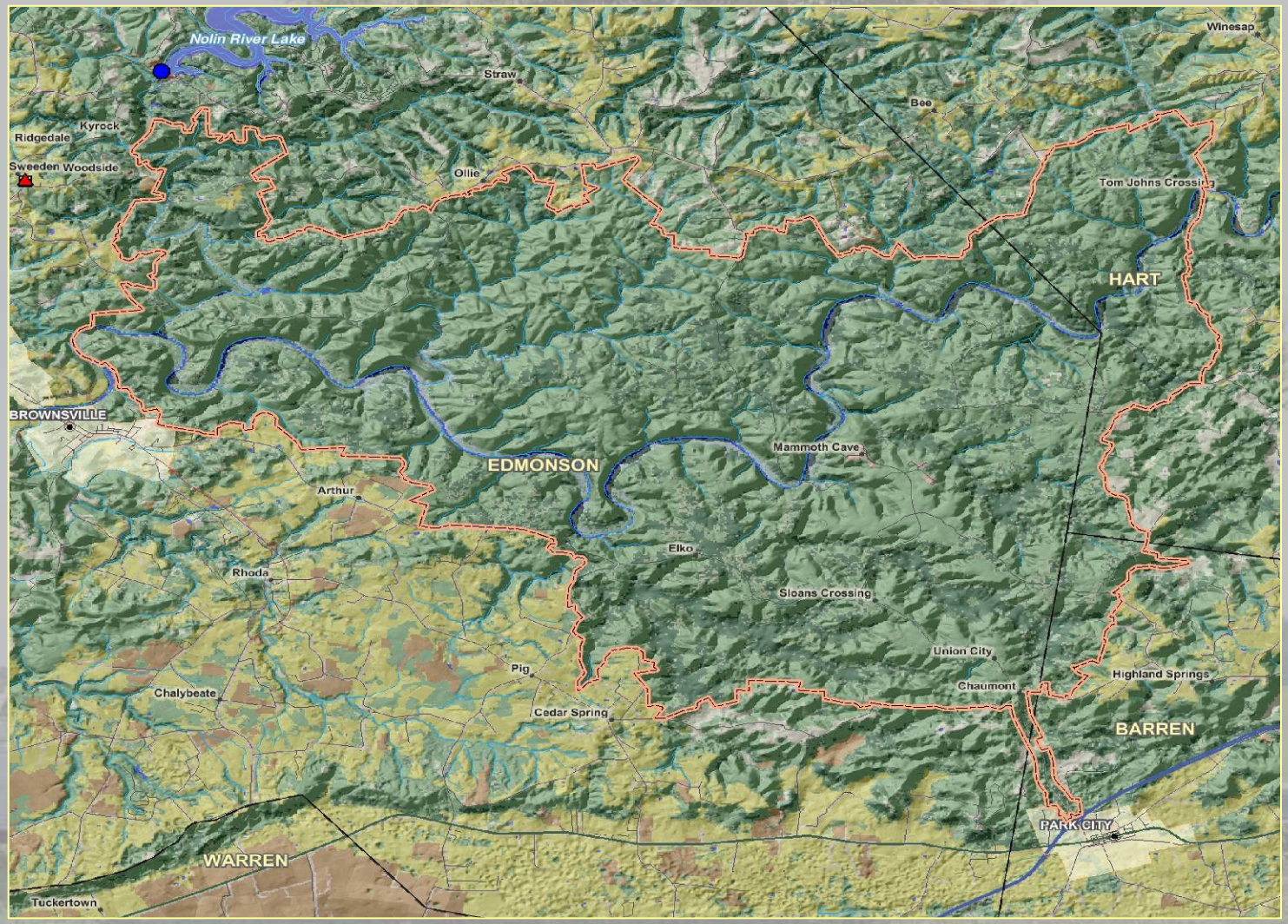
Objective

- **Develop chestnut habitat suitability maps**
  - **To find surviving chestnut specimens**
  - **To find suitable areas for future chestnut seedling planting**



Study Area

Mammoth Cave National Park

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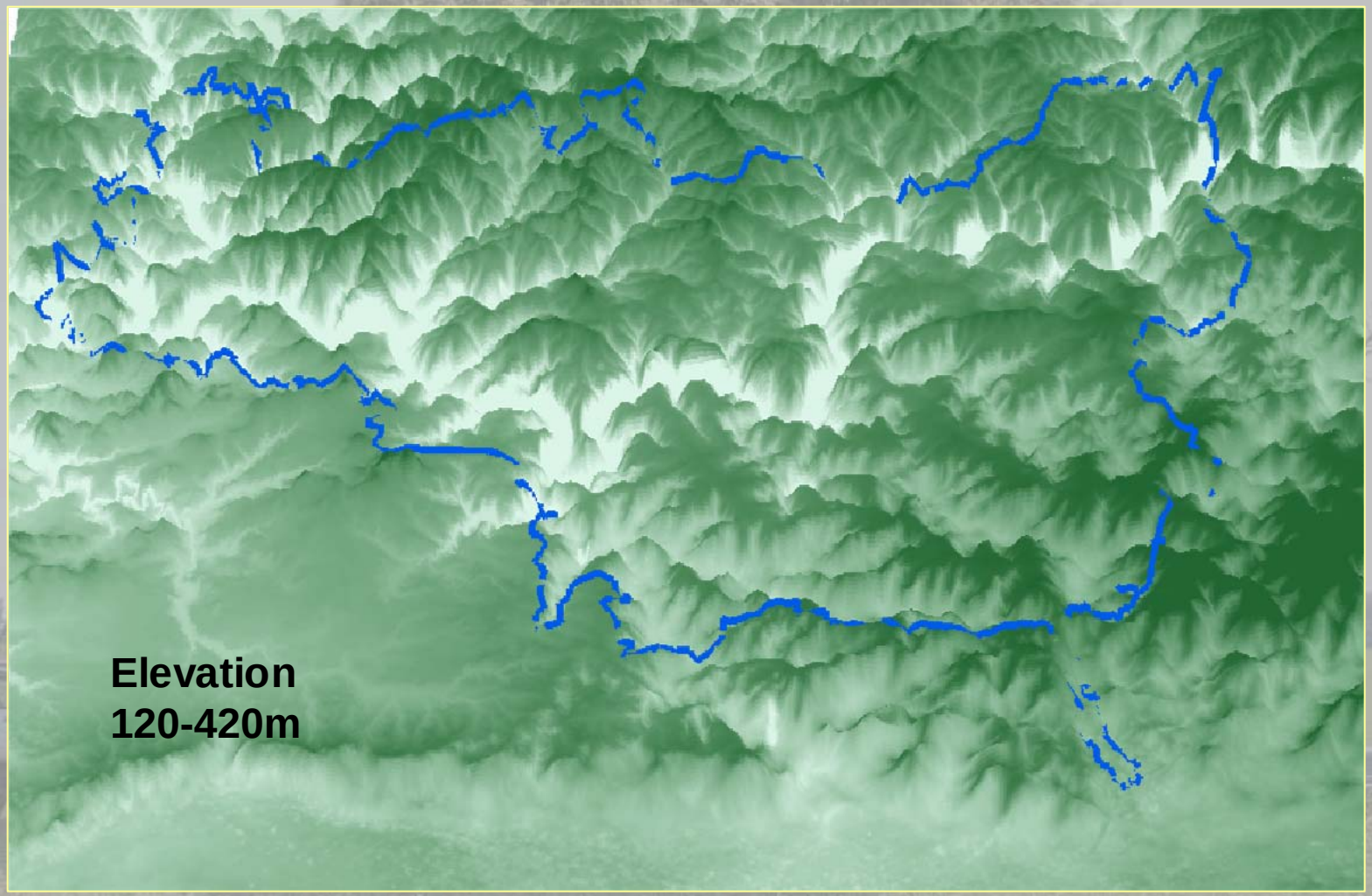
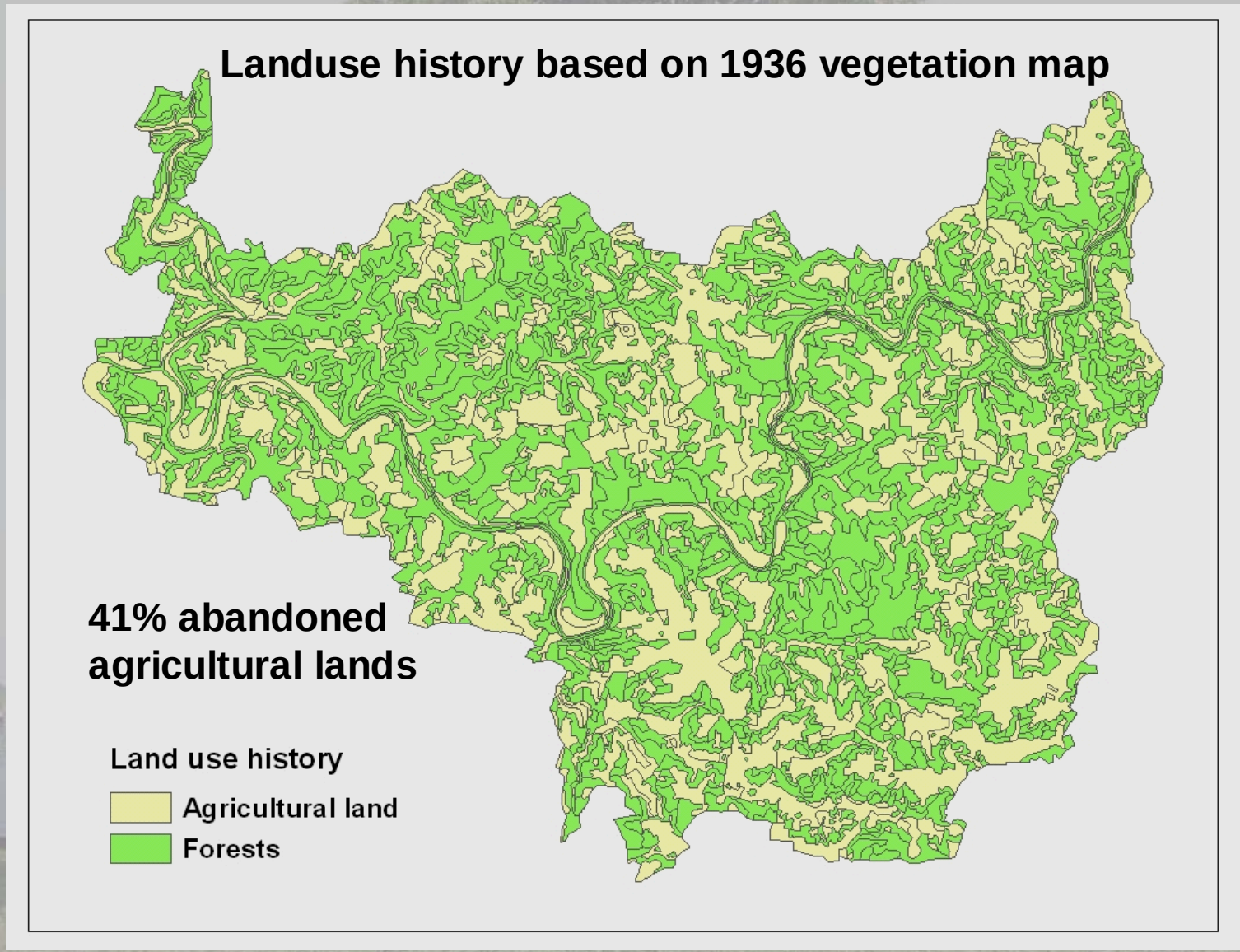
Mammoth Cave National Park



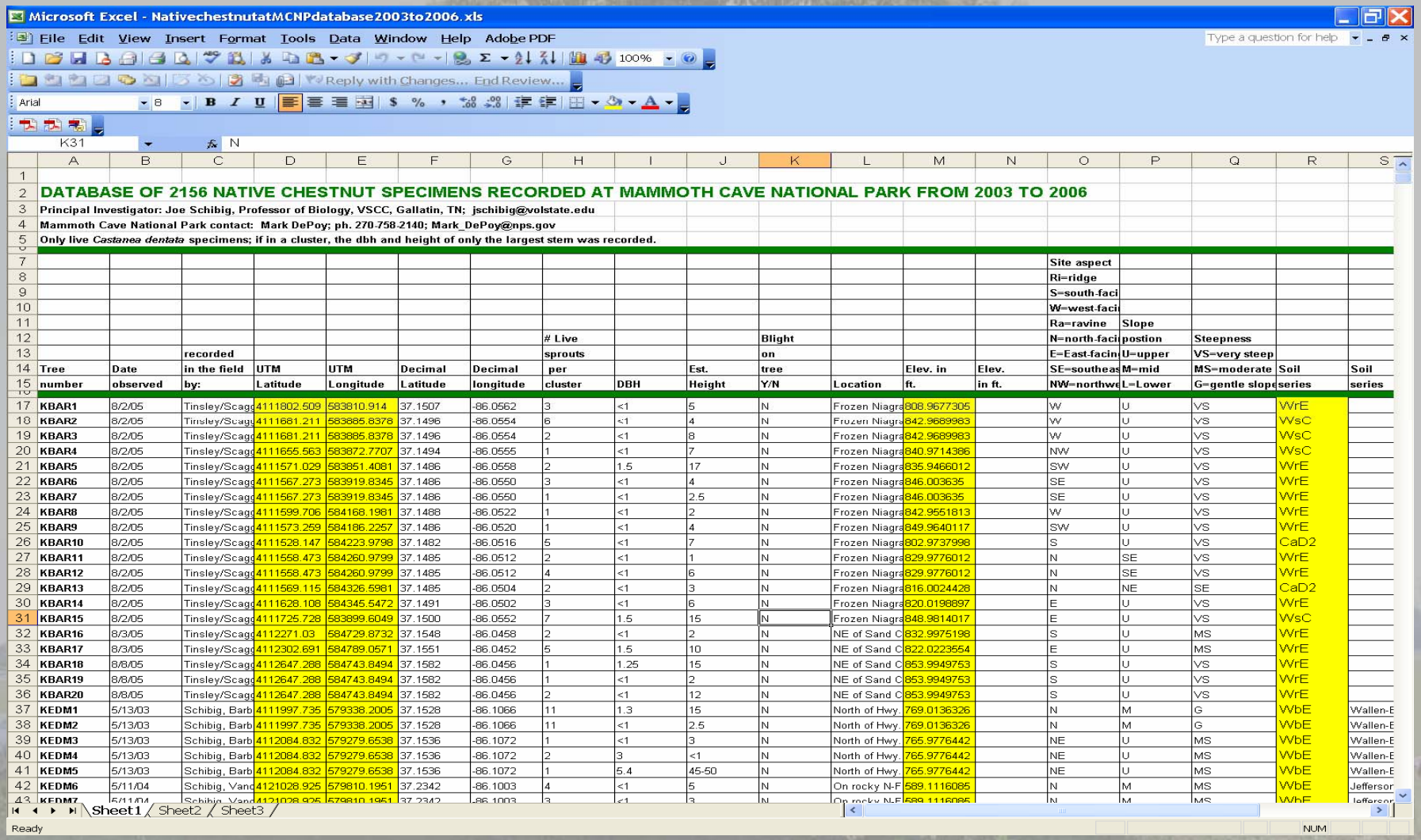
Mammoth Cave National Park




This is the remains of an old sandstone fence--this former agricultural land is now covered by a young mixed hardwood forest


Joe Schibig
Lead by Joe Schibig, a group of students and volunteers recorded 2156 American chestnut specimens from 2003 to 2006 at MCNP

Chestnut Modeling



Microsoft Excel - NativechestnutatMCNPdatabase2003to2006.xls

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DATABASE OF 2156 NATIVE CHESTNUT SPECIMENS RECORDED AT MAMMOTH CAVE NATIONAL PARK FROM 2003 TO 2006

Principal Investigator: Joe Schibig, Professor of Biology, VSCC, Gallatin, TN; jschibig@volstate.edu

Mammoth Cave National Park contact: Mark DePoy; ph. 270-758-2140; Mark_DePoy@nps.gov

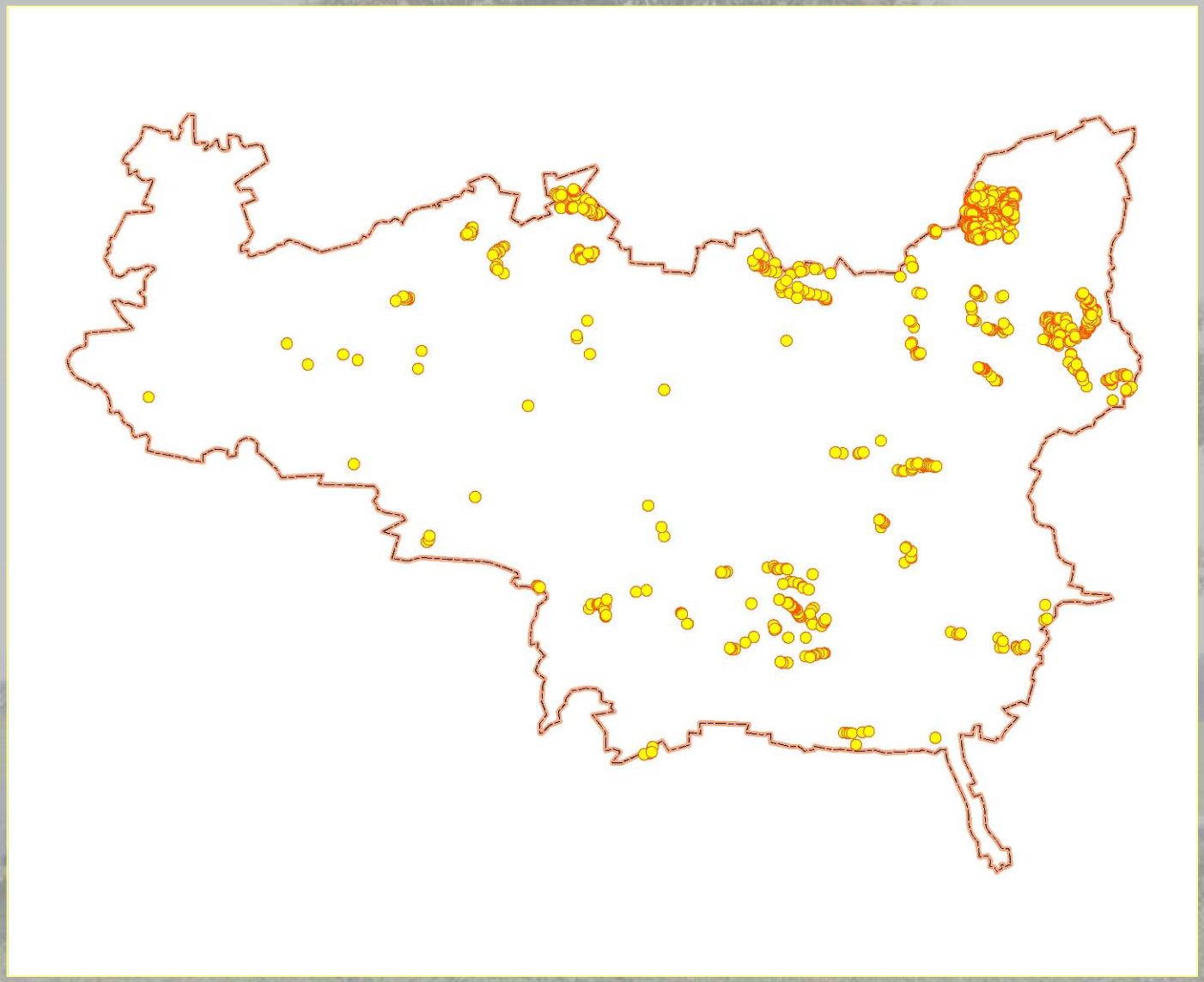
Only live *Castanea dentata* specimens; if in a cluster, the dbh and height of only the largest stem was recorded.

Tree number	Date observed	recorded in the field by:	UTM Latitude	UTM Longitude	Decimal Latitude	Decimal longitude	# Live sprouts per cluster	DBH	Est. Height	Blight on tree Y/N	Location	Elev. in ft.	Elev. in ft.	Site aspect Ri=ridge S=south-faci W=west-faci Ra=ravine N=north-faci E=East-facin SE=southeas NW=northwe	Slope postion U=upper M=mid L=Lower	Steepness VS=very steep MS=moderate G=gentle slope	Soil series	Soil series
KBAR1	8/2/05	Tinsley/Scagg	4111802.509	583810.914	37.1507	-86.0562	3	<1	5	N	Frozen Niagra	808.9677305		W	U	VS	WrE	
KBAR2	8/2/05	Tinsley/Scagg	4111681.211	583885.8378	37.1496	-86.0554	6	<1	4	N	Frozen Niagra	842.9689983		W	U	VS	WsC	
KBAR3	8/2/05	Tinsley/Scagg	4111681.211	583885.8378	37.1496	-86.0554	2	<1	8	N	Frozen Niagra	842.9689983		W	U	VS	WsC	
KBAR4	8/2/05	Tinsley/Scagg	4111655.563	583872.7707	37.1494	-86.0555	1	<1	7	N	Frozen Niagra	840.9714386		NW	U	VS	WsC	
KBAR5	8/2/05	Tinsley/Scagg	4111571.029	583851.4081	37.1486	-86.0558	2	1.5	17	N	Frozen Niagra	835.9466012		SW	U	VS	WrE	
KBAR6	8/2/05	Tinsley/Scagg	4111567.273	583919.8345	37.1486	-86.0550	3	<1	4	N	Frozen Niagra	846.003635		SE	U	VS	WrE	
KBAR7	8/2/05	Tinsley/Scagg	4111567.273	583919.8345	37.1486	-86.0550	1	<1	2.5	N	Frozen Niagra	846.003635		SE	U	VS	WrE	
KBAR8	8/2/05	Tinsley/Scagg	4111599.706	584168.1981	37.1488	-86.0522	1	<1	2	N	Frozen Niagra	842.9551813		W	U	VS	WrE	
KBAR9	8/2/05	Tinsley/Scagg	4111573.259	584186.2257	37.1486	-86.0520	1	<1	4	N	Frozen Niagra	849.9640117		SW	U	VS	WrE	
KBAR10	8/2/05	Tinsley/Scagg	4111528.147	584223.9798	37.1482	-86.0516	5	<1	7	N	Frozen Niagra	802.9737998		S	U	VS	CaD2	
KBAR11	8/2/05	Tinsley/Scagg	4111558.473	584260.9799	37.1485	-86.0512	2	<1	1	N	Frozen Niagra	829.9776012		N	SE	VS	WrE	
KBAR12	8/2/05	Tinsley/Scagg	4111558.473	584260.9799	37.1485	-86.0512	4	<1	6	N	Frozen Niagra	829.9776012		N	SE	VS	WrE	
KBAR13	8/2/05	Tinsley/Scagg	4111569.115	584326.5981	37.1485	-86.0504	2	<1	3	N	Frozen Niagra	816.0024428		N	NE	SE	CaD2	
KBAR14	8/2/05	Tinsley/Scagg	4111628.108	584345.5472	37.1491	-86.0502	3	<1	6	N	Frozen Niagra	820.0198897		E	U	VS	WrE	
KBAR15	8/2/05	Tinsley/Scagg	4111725.728	583899.6049	37.1500	-86.0552	7	1.5	15	N	Frozen Niagra	848.9814017		E	U	VS	WsC	
KBAR16	8/3/05	Tinsley/Scagg	4112271.03	584729.8732	37.1548	-86.0458	2	<1	2	N	NE of Sand C	832.9975198		S	U	MS	WrE	
KBAR17	8/3/05	Tinsley/Scagg	4112302.691	584789.0571	37.1551	-86.0452	5	1.5	10	N	NE of Sand C	822.0223554		E	U	MS	WrE	
KBAR18	8/8/05	Tinsley/Scagg	4112647.288	584743.8494	37.1582	-86.0456	1	1.25	15	N	NE of Sand C	853.9949753		S	U	VS	WrE	
KBAR19	8/8/05	Tinsley/Scagg	4112647.288	584743.8494	37.1582	-86.0456	1	<1	2	N	NE of Sand C	853.9949753		S	U	VS	WrE	
KBAR20	8/8/05	Tinsley/Scagg	4112647.288	584743.8494	37.1582	-86.0456	2	<1	12	N	NE of Sand C	853.9949753		S	U	VS	WrE	
KEDM1	5/13/03	Schibig, Barb	4111997.735	579338.2005	37.1528	-86.1066	11	1.3	15	N	North of Hwy.	769.0136326		N	M	G	WbE	Wallen-E
KEDM2	5/13/03	Schibig, Barb	4111997.735	579338.2005	37.1528	-86.1066	11	<1	2.5	N	North of Hwy.	769.0136326		N	M	G	WbE	Wallen-E
KEDM3	5/13/03	Schibig, Barb	4112084.832	579279.6538	37.1536	-86.1072	1	<1	3	N	North of Hwy.	765.9776442		NE	U	MS	WbE	Wallen-E
KEDM4	5/13/03	Schibig, Barb	4112084.832	579279.6538	37.1536	-86.1072	2	3	<1	N	North of Hwy.	765.9776442		NE	U	MS	WbE	Wallen-E
KEDM5	5/13/03	Schibig, Barb	4112084.832	579279.6538	37.1536	-86.1072	1	5.4	45-50	N	North of Hwy.	765.9776442		NE	U	MS	WbE	Wallen-E
KEDM6	5/11/04	Schibig, Vanc	4121028.925	579810.1951	37.2342	-86.1003	4	<1	5	N	On rocky N-F	589.1116085		N	M	MS	WbE	Jefferson
KEDM7	5/11/04	Schibig, Vanc	4121028.925	579810.1951	37.2342	-86.1003	3	<1	3	N	On rocky N-F	589.1116085		N	M	MS	WbE	Jefferson

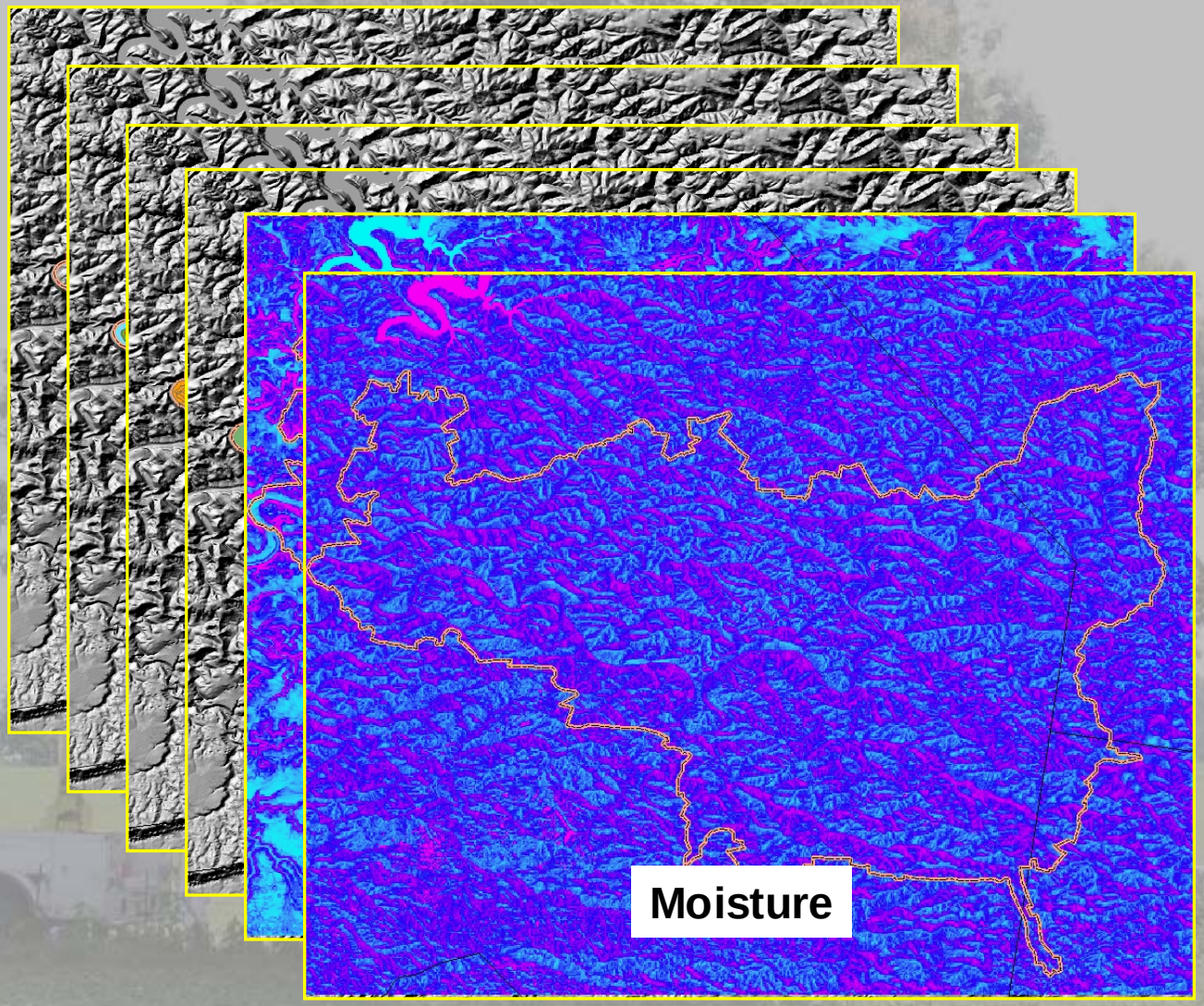
Sheet1 Sheet2 Sheet3

Ready NUM

Chestnut Modeling

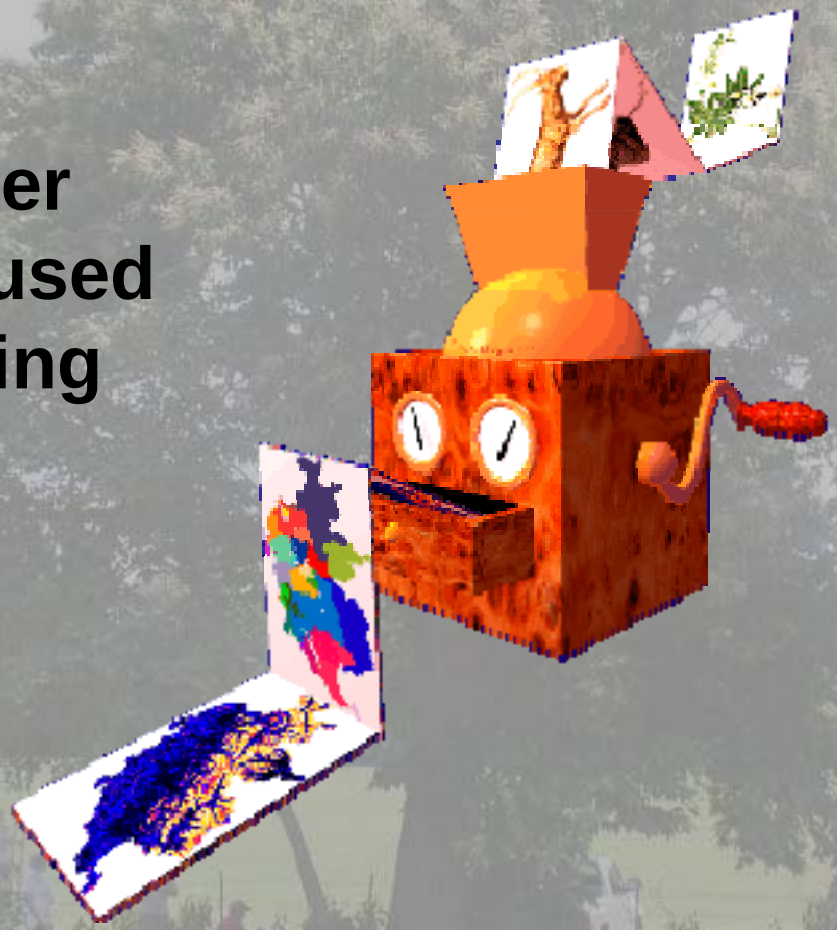


Chestnut Modeling



Chestnut Modeling

Biomapper
2/3 data used
in modeling



http://www2.unil.ch/biomapper/

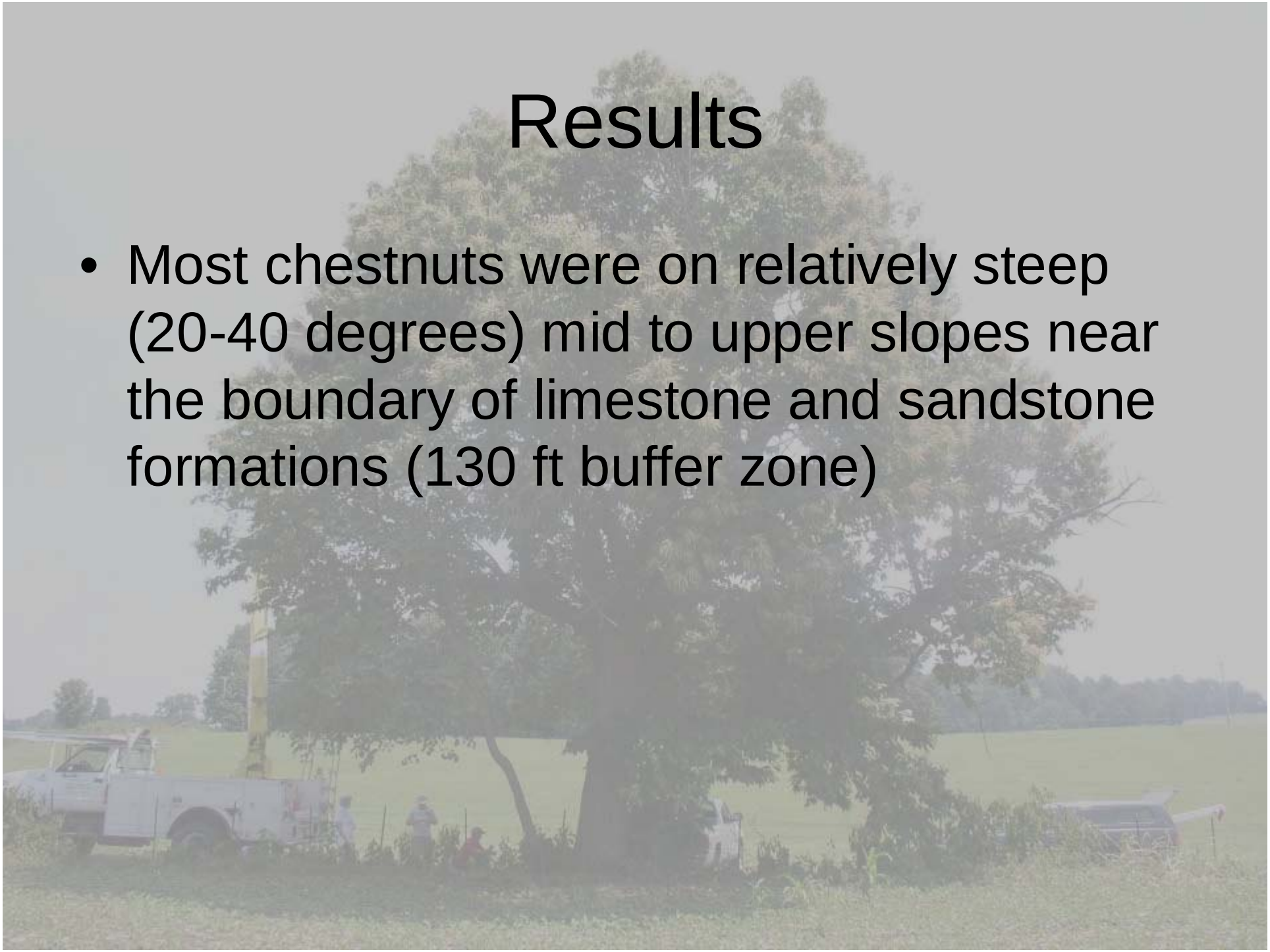
Results

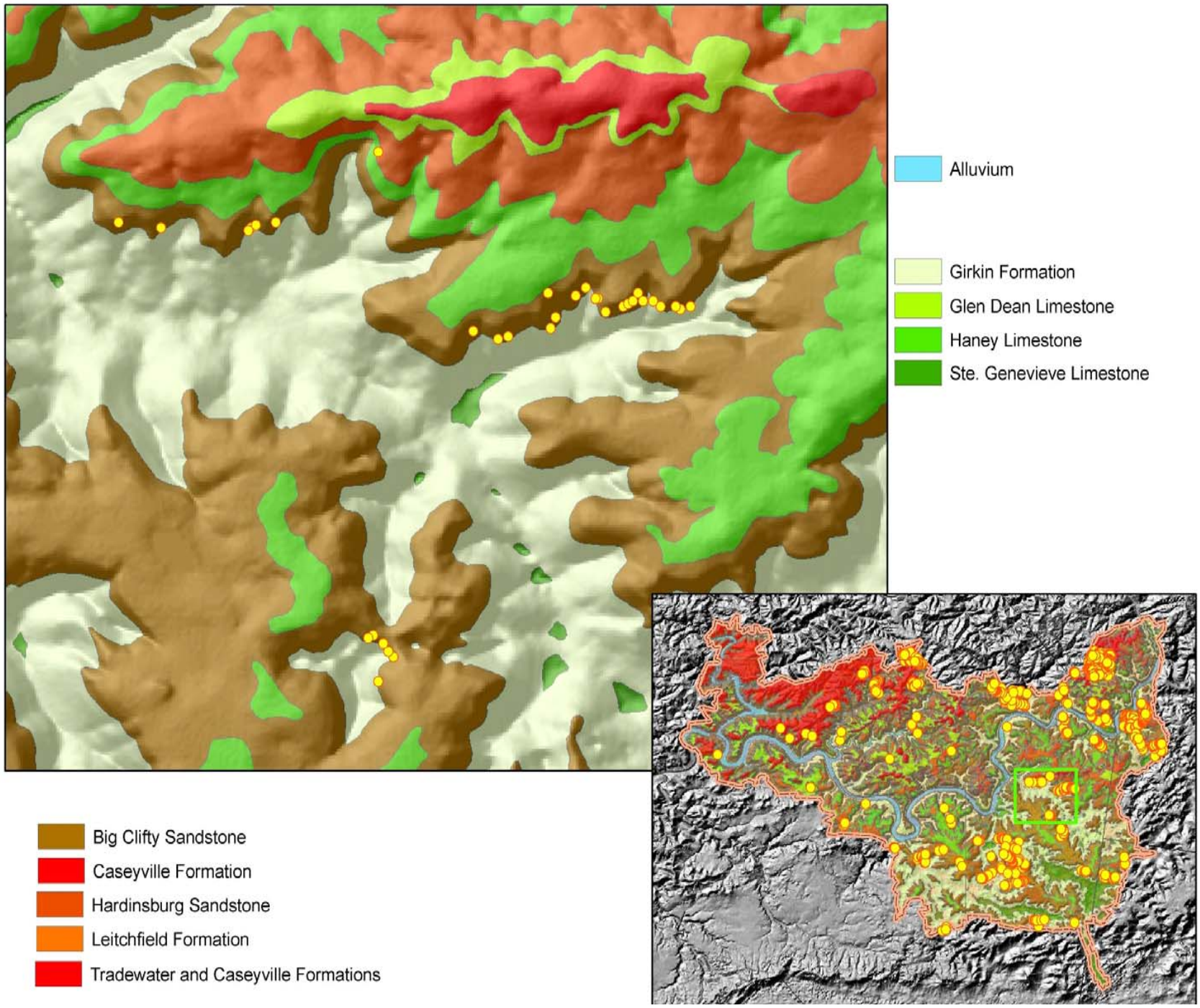
- Historical land use had a strong influence on current chestnut distribution
  - 89% of the chestnut sprouts at MCNP were located within non-agricultural lands
  - The remaining 11% were located within a 10m buffer around non-agricultural land

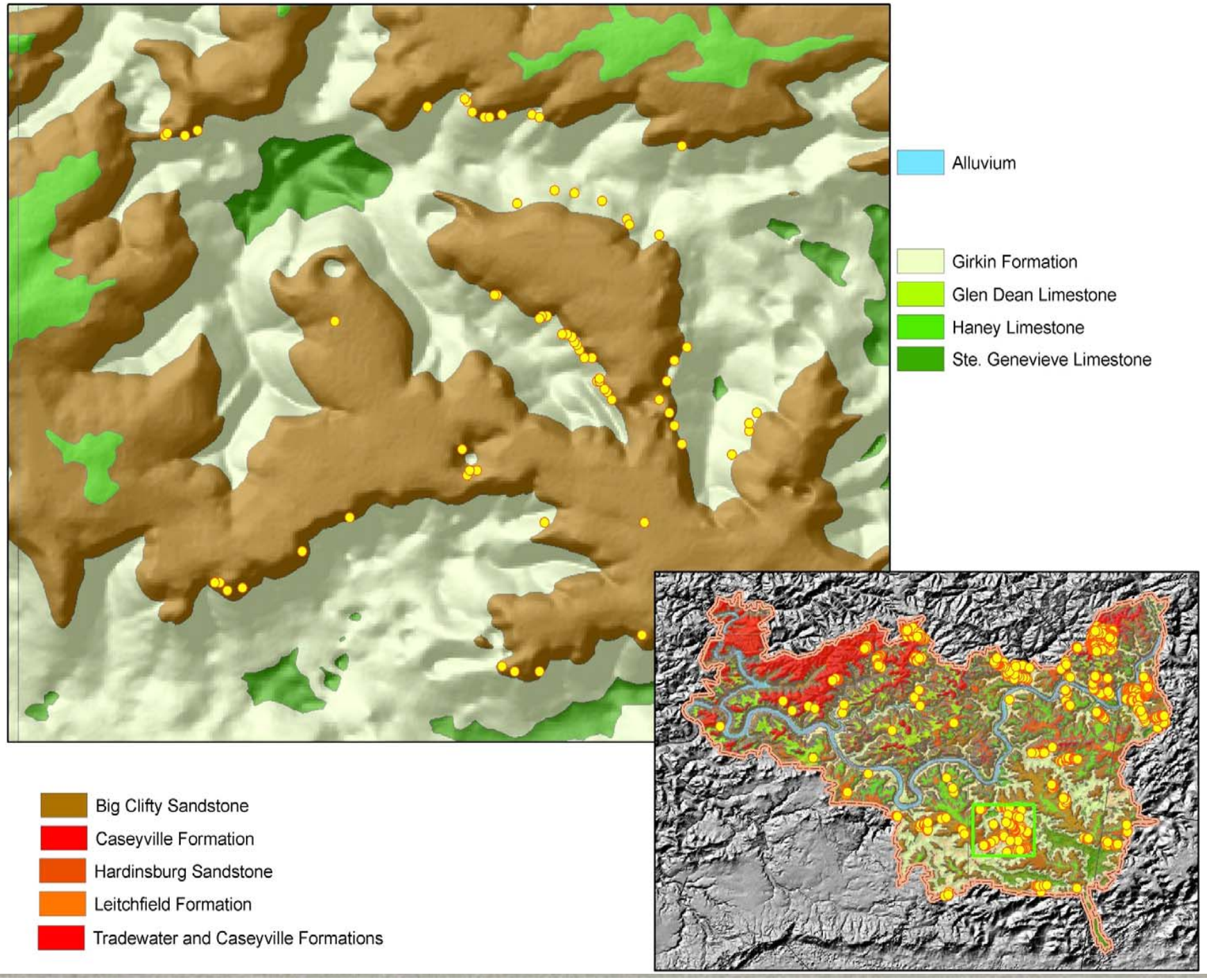
Results

Results

- Most chestnuts were on relatively steep (20-40 degrees) mid to upper slopes near the boundary of limestone and sandstone formations (130 ft buffer zone)




Alluvium
Girkin Formation
Glen Dean Limestone
Haney Limestone
Ste. Genevieve Limestone
Big Clifty Sandstone
Caseyville Formation
Hardinsburg Sandstone
Leitchfield Formation
Tradewater and Caseyville Formations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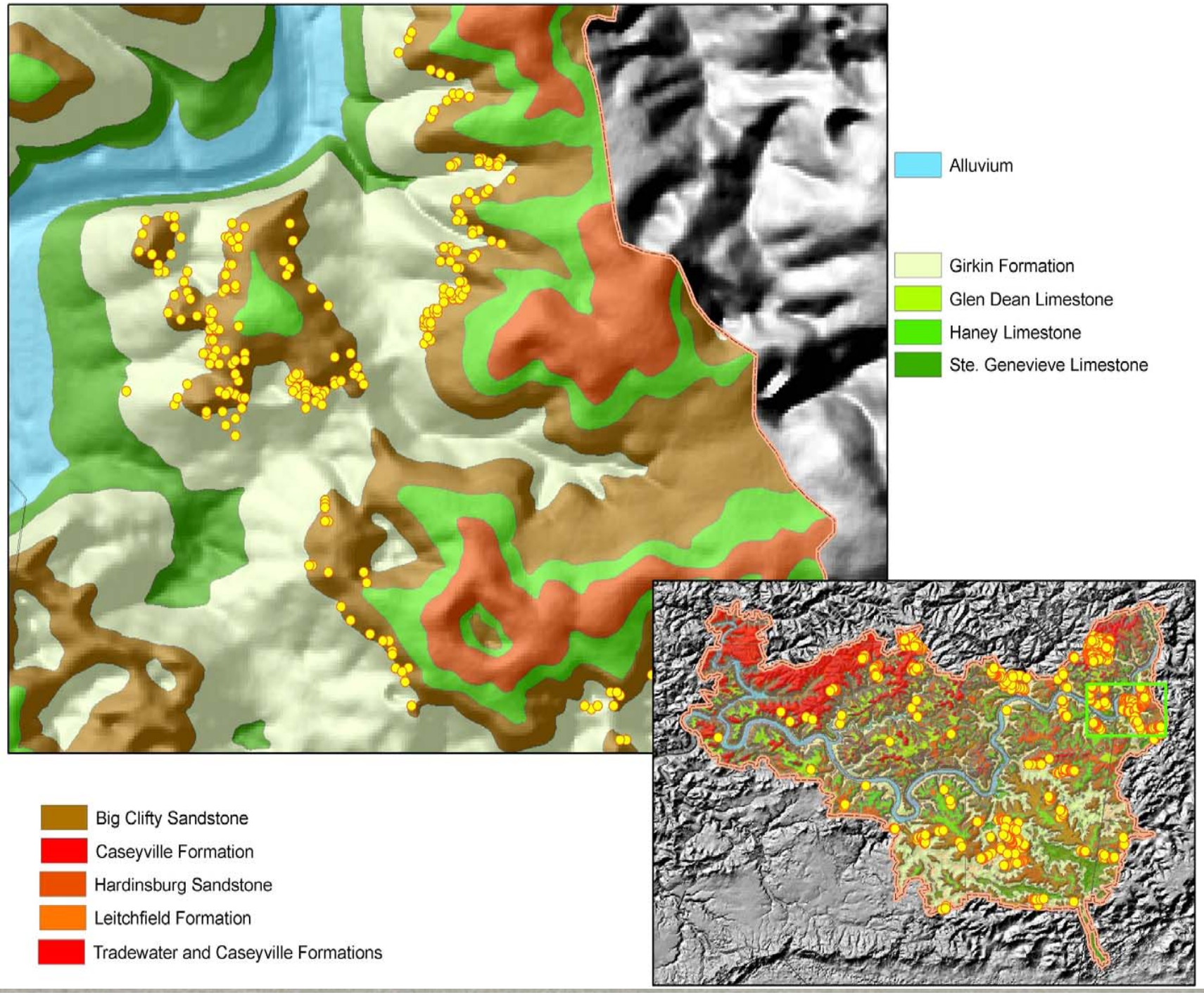
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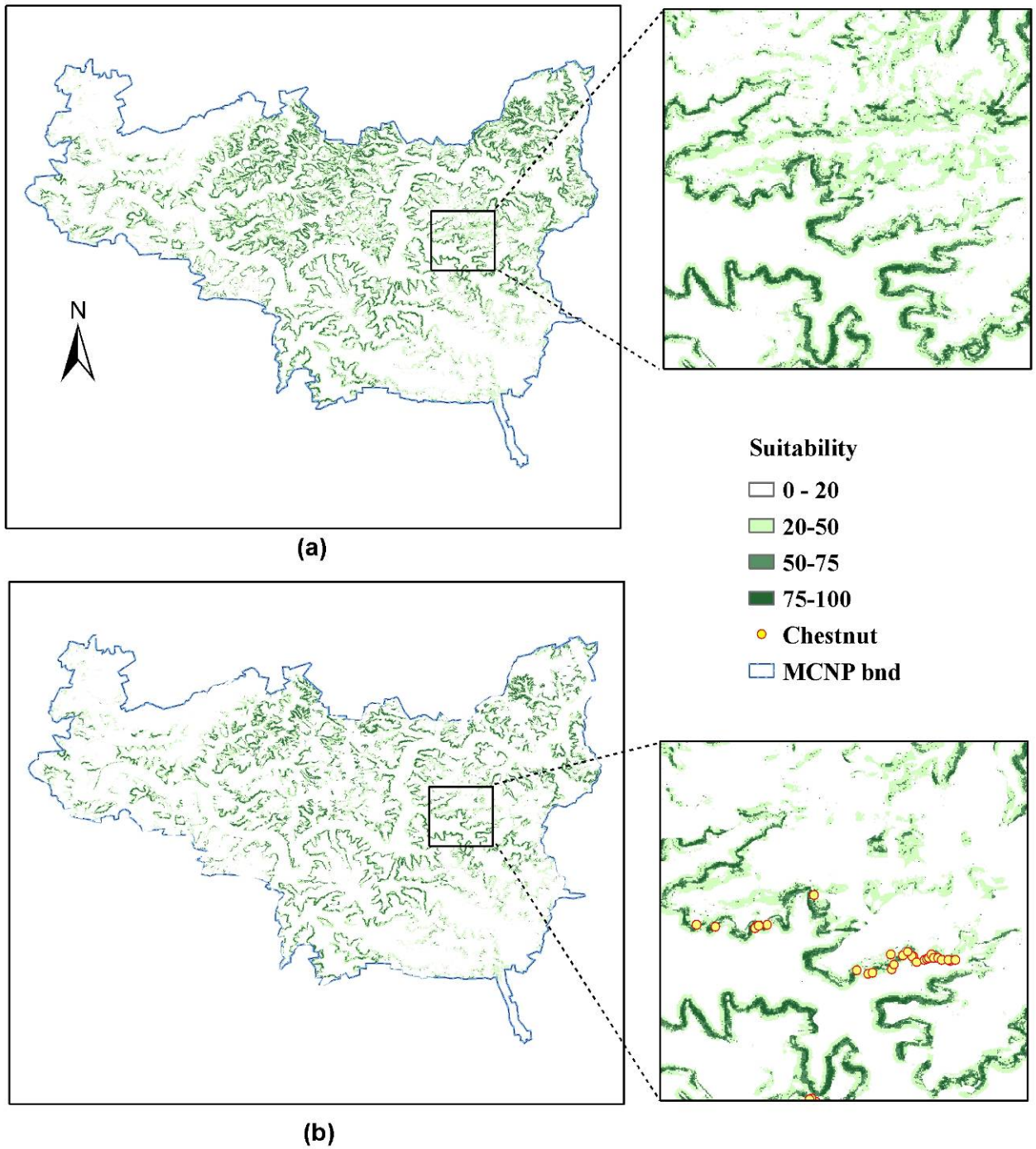
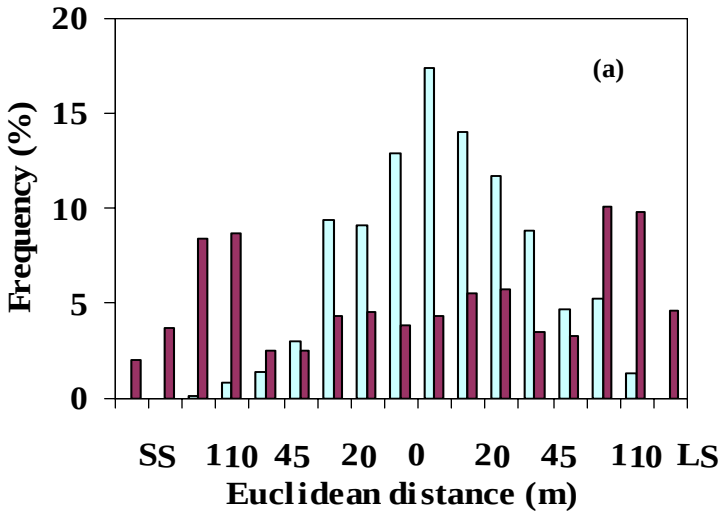
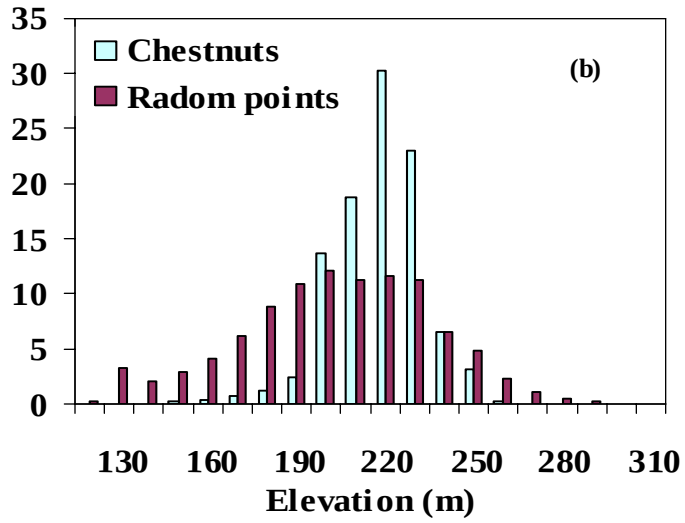
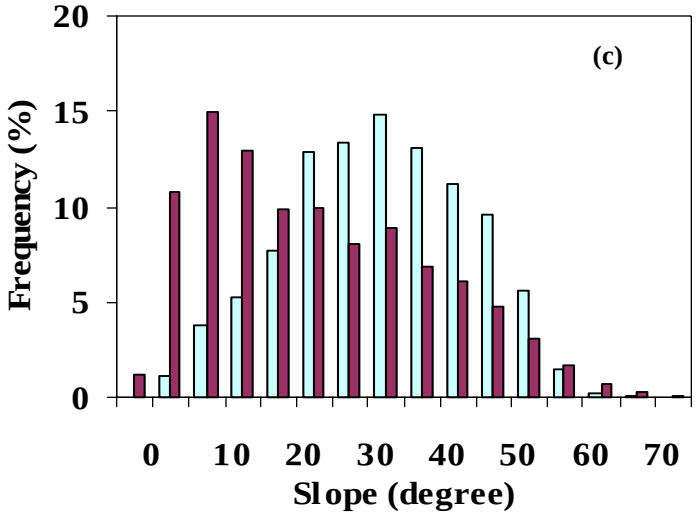
Chestnut Habitat Suitability Map

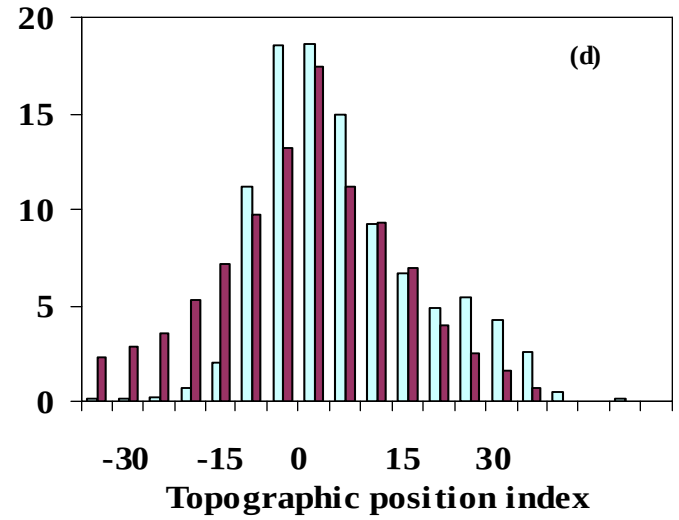


Model Validation









Model Validation

- Cross-validation based on continuous Boyce index (CBI = 0.97) indicate the model is good
- 90% of the test data (1/3 of total sample) were located in the suitable habitat predicted by the model

Take Home Message

- Chestnut have a very low presence on abandoned agricultural lands, but most often occur in less disturbed forest on relatively steep mid to upper slopes near the boundary of limestone and sandstone formations
- Model can be used in areas that have similar conditions as MCNP, and caution is needed when apply anywhere else

Acknowledgement

Many people contributed to this project. Mark, Jeramie, Anne, Lloyd (VSCC students), and Matt (WKU student) participated in the inventorying. MCNP Science personnel (Lillian, Brice, and Nathan) and interns (Shannon, Seth, Chris, and Laura) were helpful. This research was funded by the National Park Service, and the National Forest Foundation. We are grateful to Mark DePoy and Paul Sisco for their support.


Thank You!
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