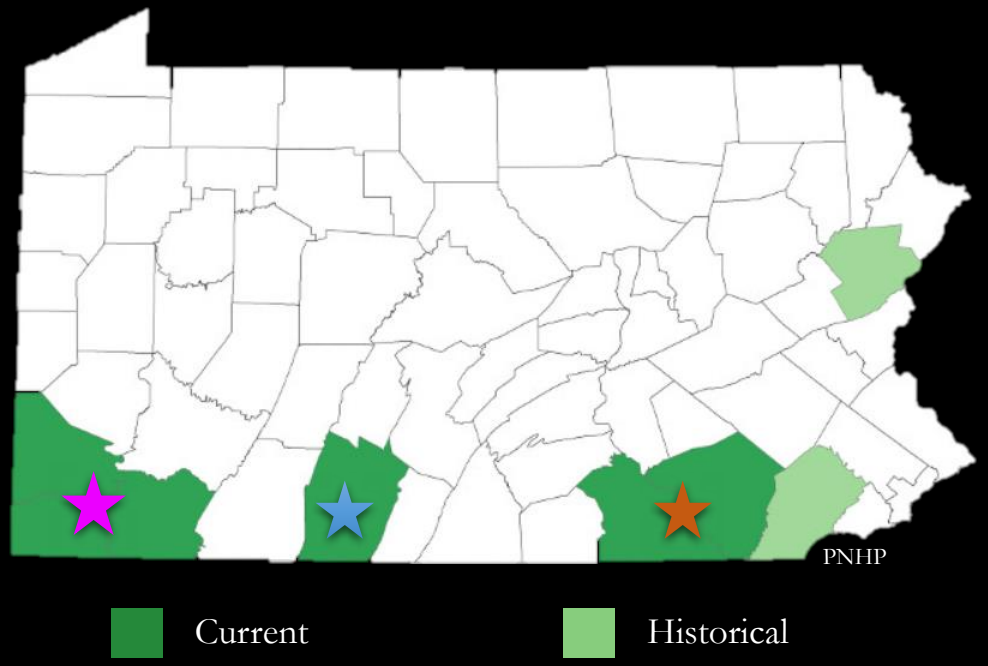
Chasmanthium latifolium in Pennsylvania

Critically Imperiled (S1)

- Declining populations
  - Habitat elimination
    - Agriculture, Industry, Housing
  - Damming of rivers
    - Alteration of flood patterns
  - Invasive species
- Disjunct populations
- Edge of range (northeastern edge)



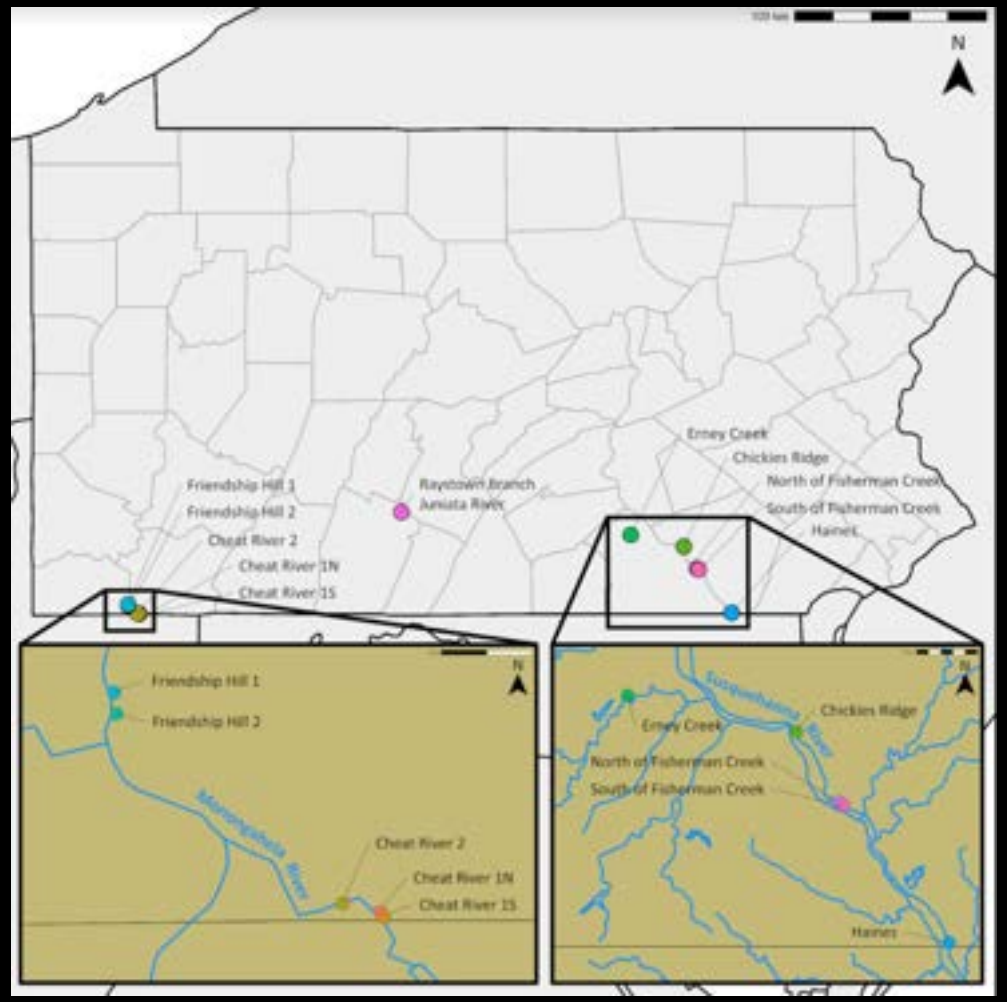
Monongahela (West)

Juniata (Central)

Susquehanna (East)

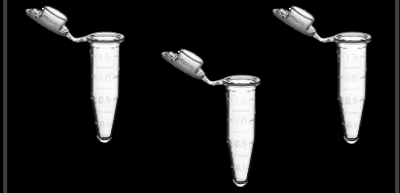
Sample Collections

- Field collections (Scott, Rachel, Tanisha)
  - 11 populations
  - 7-16 individuals per populations
  - 155 individuals total



Methods

- DNA extraction
- Digestion: ApeKI enzyme
- Genotyping by sequencing (GBS)
- Illumina NovaSeq 6000
- Single nucleotide polymorphisms (SNPs)



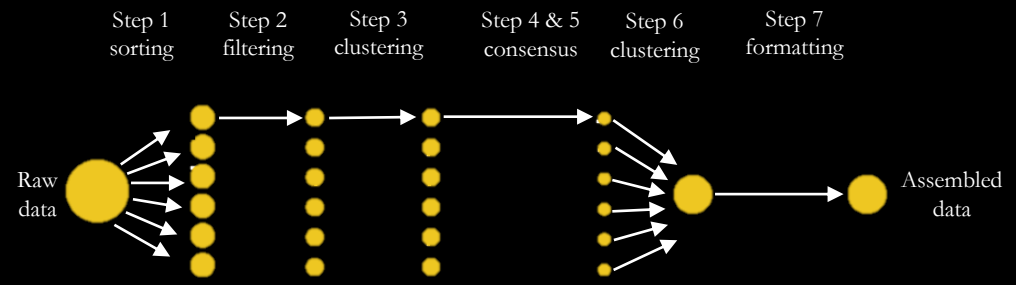
Extraction, quantification, adding restriction enzyme, adaptors, and barcodes

Pooling samples and PCR

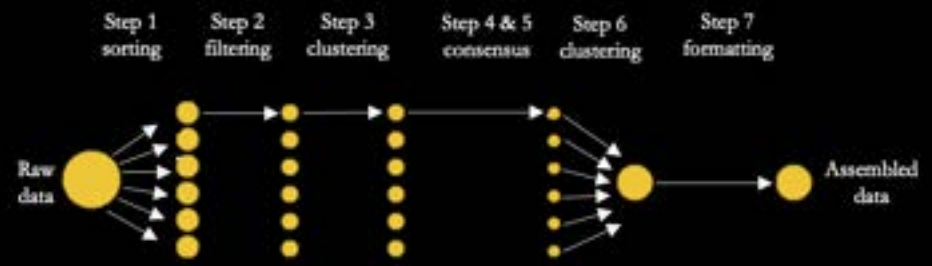
Sequencing

Methods

- Sequences assembled using ipyrad
- Hard Filtering: VCFtools
  - Removed samples with
    - <200,000 raw reads
    - Missingness ≧ 55% of loci across 75% of samples
- All populations genetics analyses done in R



Methods



Dr. Angela McDonnell

Workshop on population and speciation genomics (Czech Republic)

Results

Results

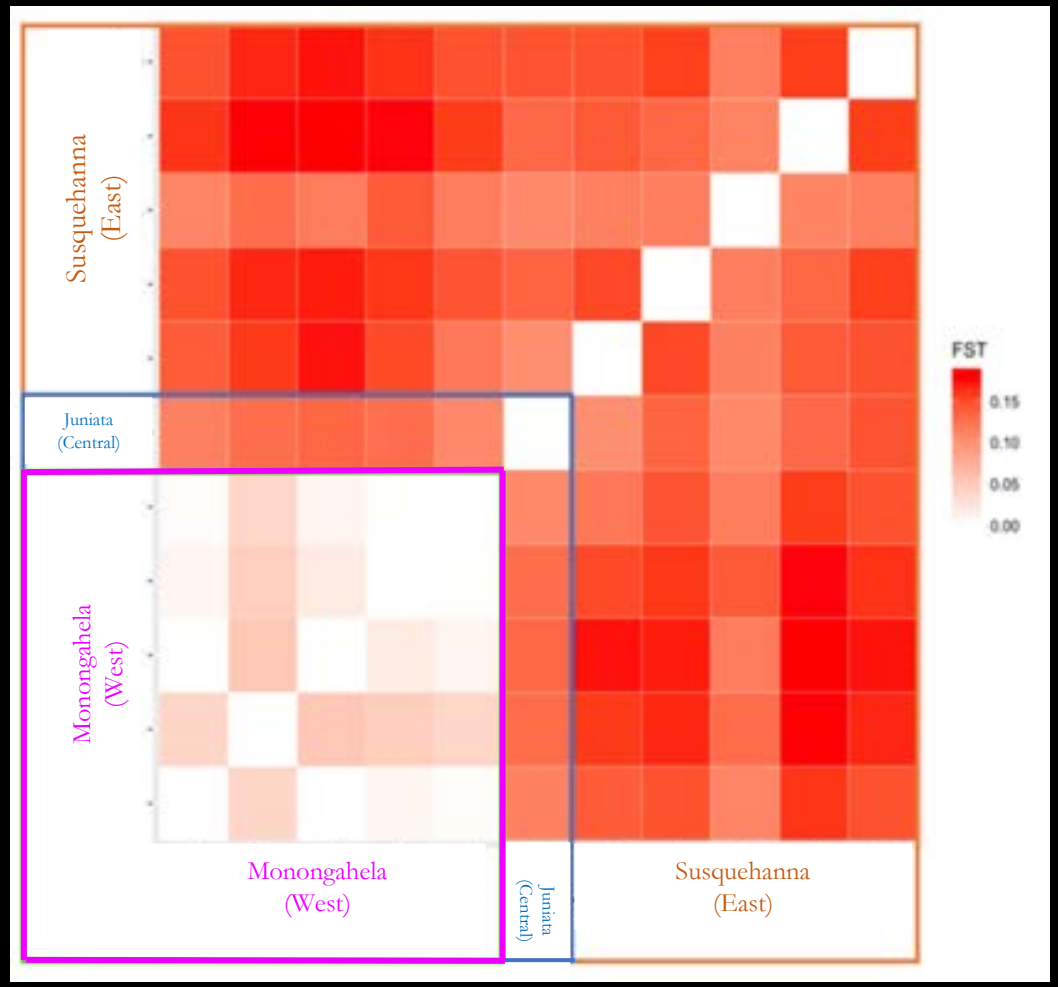
- 133 individuals across 11 populations
- 2 million reads per sample (average)
- 1,000 loci
  - 1,998 SNPs

Results

- Overall F_{ST}
  - $F_{ST} = 0.1130$

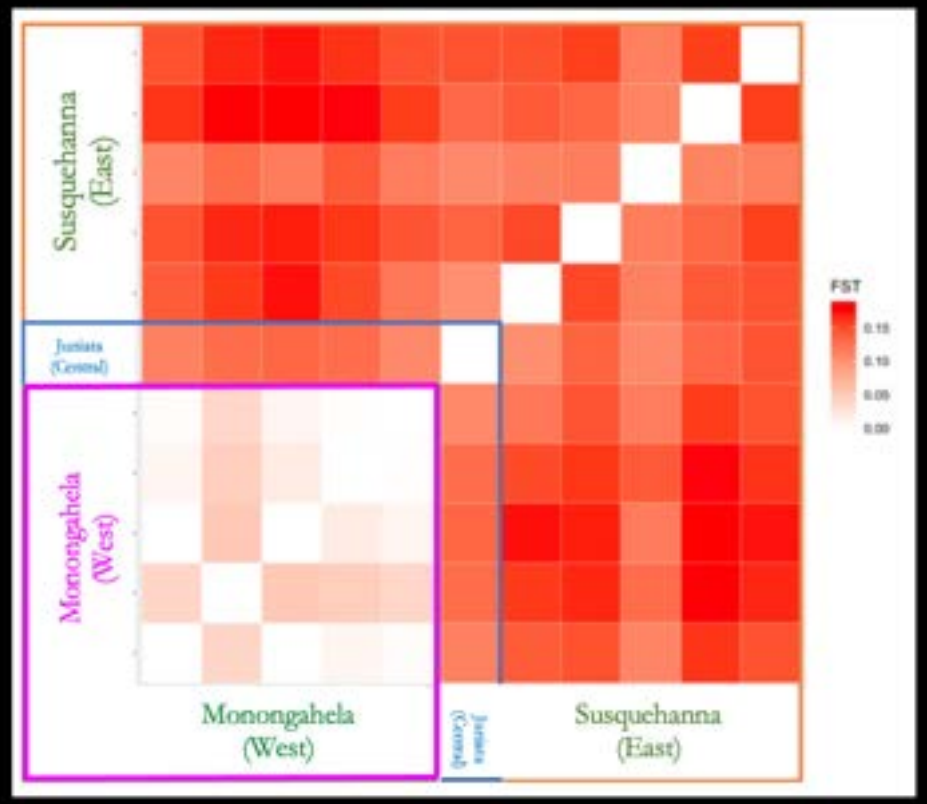
Results

- Pairwise F_{ST}



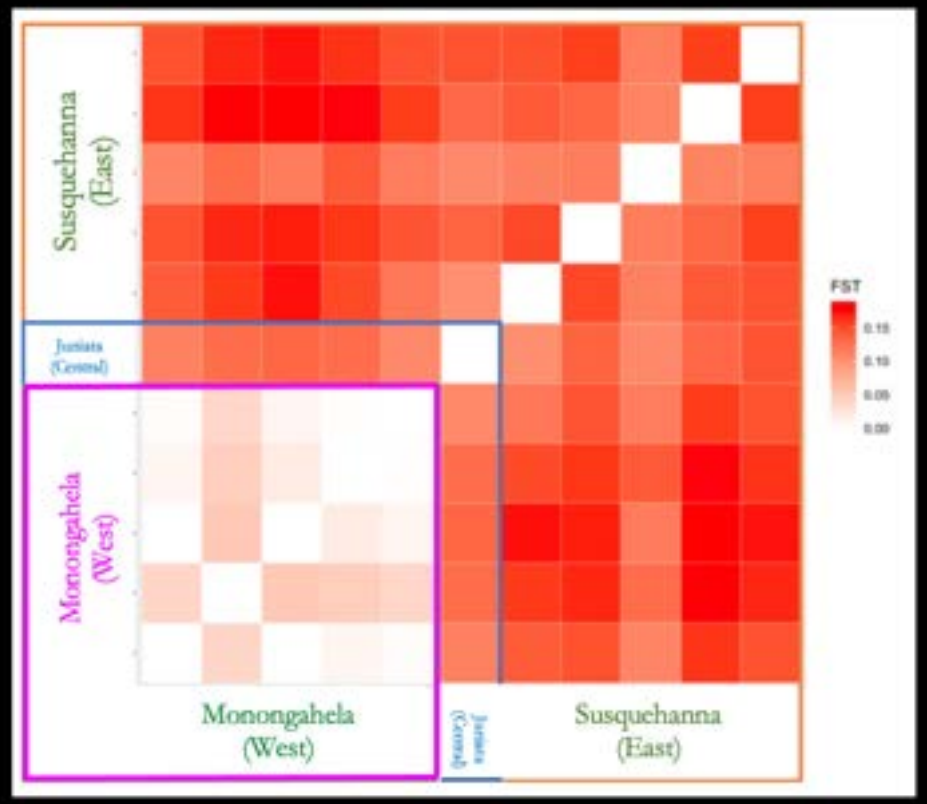
Results

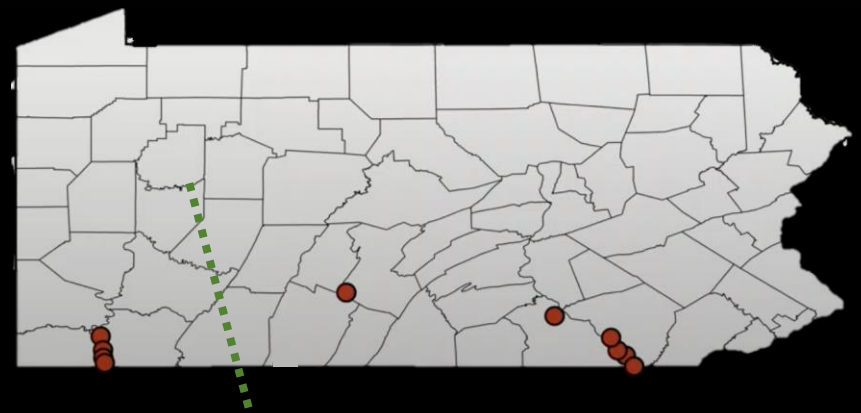
- Pairwise F_{ST}
  - A lot of gene flow between western pops



Results

- Pairwise F_{ST}
  - A lot of gene flow between western pops
  - Very little gene flow between western and central-eastern





Results

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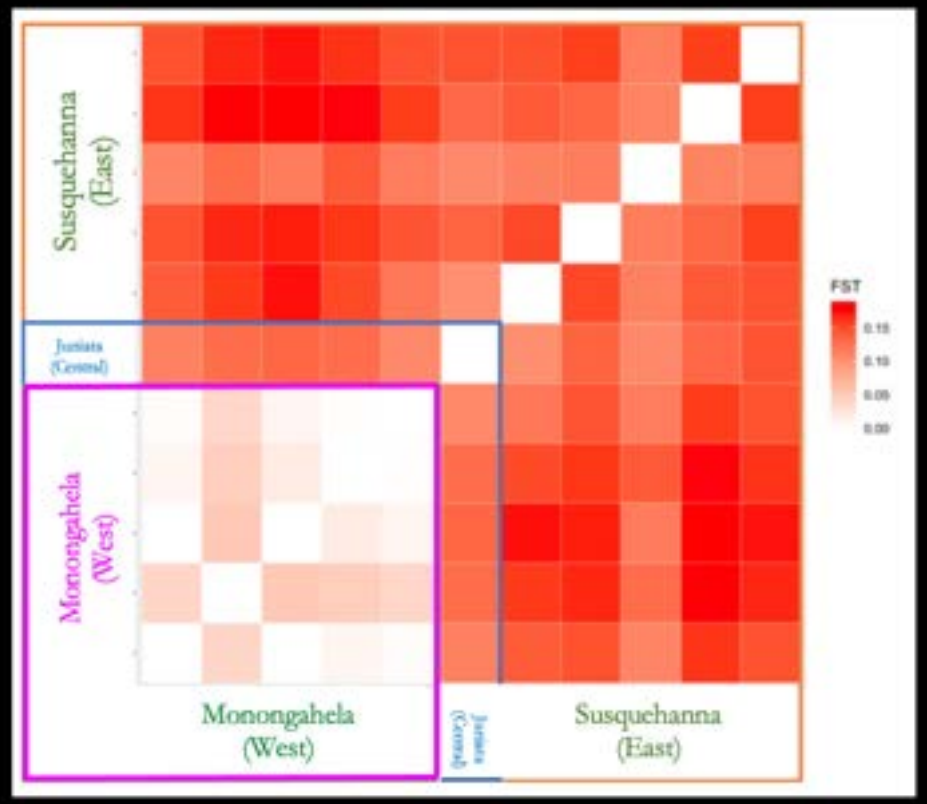
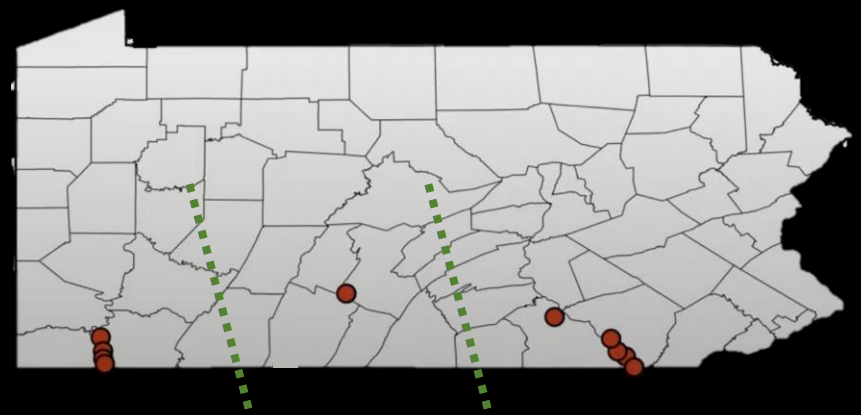




Results

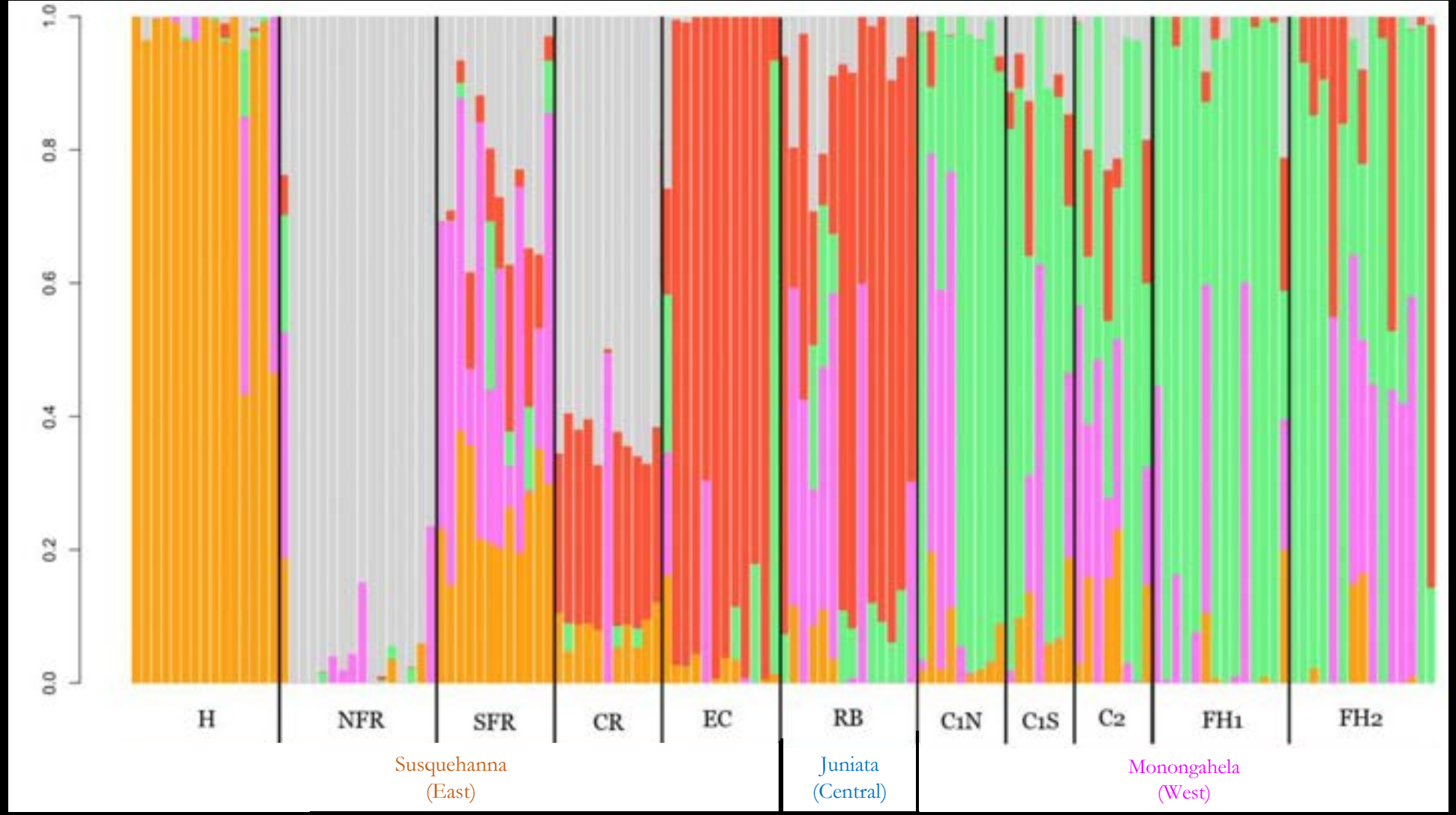
- Heterozygosity
  - Overall:
    - H_O: 0.6590
    - H_E: 0.3969
  - Every case $H_O > H_E$

Region	Population	H_O	H_E	Bartlett's K^2 $^*p < 2.2e^{-16}$
Susquehanna (East)	Haines	0.7103	0.3837	421.6*
	North of Fisherman Run	0.7355	0.3944	457.0*
	South of Fisherman Run	0.5154	0.4097	372.1*
	Chickies Ridge	0.7388	0.3926	454.6*
	Erney Creek	0.7400	0.3985	482.0*
Juniata (Central)	Raystown Branch Juniata River	0.6440	0.4047	401.3*
Monongahela (West)	Cheat River 1N	0.6969	0.3958	423.1*
	Cheat River 1S	0.6212	0.4147	475.5*
	Cheat River 2	0.5507	0.3863	355.5*
	Friendship Hill 1	0.6847	0.3909	396.4*
	Friendship Hill 2	0.6119	0.4035	355.8*

Results

- Inbreeding (F_{IS})
  - Overall:
    - F_{IS} = -0.6219

Region	Population	F_{IS}	F_{IS} [95% CI]
Susquehanna (East)	Haines	-0.8512	[-0.8615, -0.8408]
	North of Fisherman Run	-0.8649	[-0.8754, -0.8526]
	South of Fisherman Run	-0.2580	[-0.2905, -0.2238]
	Chickies Ridge	-0.8817	[-0.8911, -0.8713]
	Erney Creek	-0.8569	[-0.8694, -0.8434]
Juniata (Central)	Raystown Branch Juniata River	-0.5915	[-0.6087, -0.5746]
Monongahela (West)	Cheat River 1N	-0.7608	[-0.7789, -0.7412]
	Cheat River 1S	-0.4978	[-0.5246, -0.4692]
	Cheat River 2	-0.4258	[-0.4577, -0.3963]
	Friendship Hill 1	-0.7517	[-0.7648, -0.7387]
	Friendship Hill 2	-0.5166	[-0.5360, -0.4976]



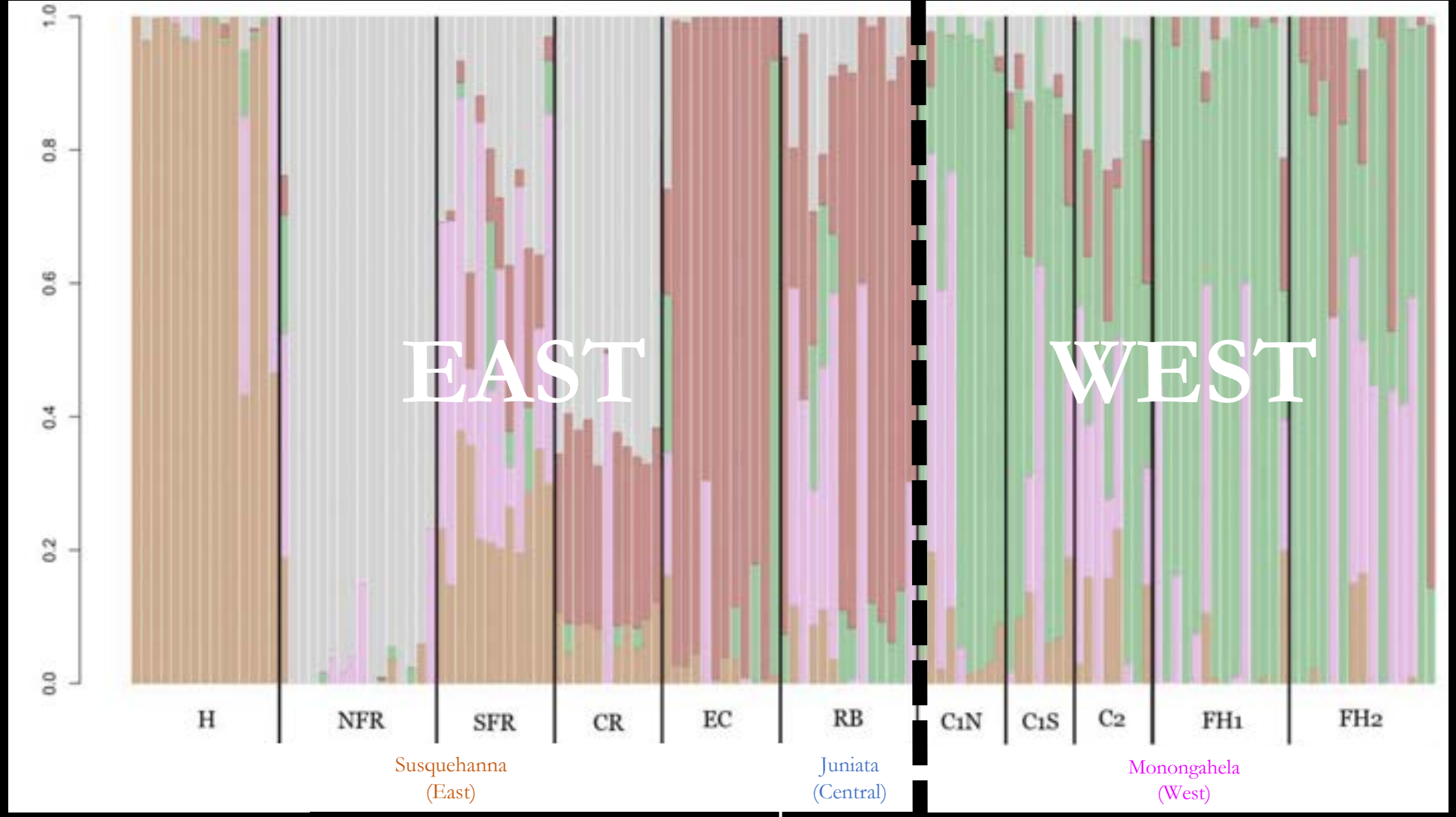
STRUCTURE Analysis

K = 5 ancestral clades

Eastern: Lots of genetic differentiation

Western: Genetically similar

Central: Clustering with EC



STRUCTURE Analysis

K = 5 ancestral clades

East-West Disjunction

Conclusions

- Currently, all populations are genetically healthy
- Western pops are genetically similar
- Eastern and central populations are genetically isolated from each other and western pops

Global F_{ST}: moderate differentiation

F_{IS}: no inbreeding is occurring

STRUCTURE & DAPC: western pops similar, while generally central-eastern pops are genetically different

Pairwise F_{ST}: high gene flow only in western pops

Heterozygosity: higher than expected

Conservation Implications

- Limited and declining state distribution
- Populations appear to be massive and healthy
- Western populations appear genetically secure, while eastern and central populations are of greater concern

Genetic diversity & connectivity of *Chasmanthium latifolium* (Poaceae) in Pennsylvania & the effect on conservation status of a rare species

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HONORS DEFENSE

APRIL 19, 2021

HONORS COMMITTEE:

TANISHA WILLIAMS	CHRIS MARTINE	BRIAN SMITH	RACHEL GOAD
BUCKNELL UNIVERSITY	BUCKNELL UNIVERSITY	BUCKNELL UNIVERSITY	PENNSYLVANIA NATURAL HERITAGE PROGRAM

Updated from this work!!
Critically imperiled across the state!!

Western Pennsylvania Conservancy
water, land, life.

PNHP
Pennsylvania Natural Heritage Program

Scott Schuette

Thanks to…

Funding

- David Burpee Endowment
- PA DCNR Wild Resource Conservation Program
- Sigma Xi
- Torrey Botanical Society
- Botanical Society of America

Thanks to…

Rachel Goad

Dr. Scott Schuette

Dr. Chris Martine

Jon Hayes

Dr. Angela McDonnell

Ariel Antoine

Cheyenne Moore

Population Genomics and Climate Change Vulnerability of an Appalachian Endemic Plant in Pennsylvania

NEW!

Research seeks to clarify the conservation and protection status of bog Jacob's ladder (*Polemonium vanbruntiae*), a species of conservation concern, using a combination of traditional herbarium and field-based assessments, modern population genetics methods and climate modeling. This will be a model for rare plant conservation work that uses comparative plant population genomic techniques and climate change modeling methods, in combination with traditional natural heritage methods.

Bucknell UNIVERSITY

Western Pennsylvania Conservancy
water, land, life.

DCNR

PNHP

Lead PI: TM Williams (C. Martine; S. Schuette)

David Burpee Endowment

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Bucknell University

Northern Territory Government, Dept. of Environment & Natural Resources

National Science Foundation

Western Pennsylvania Conservancy

Pennsylvania Natural Heritage Program

San Francisco State University

Chicago Botanica Garden

Dr. Christopher Martine

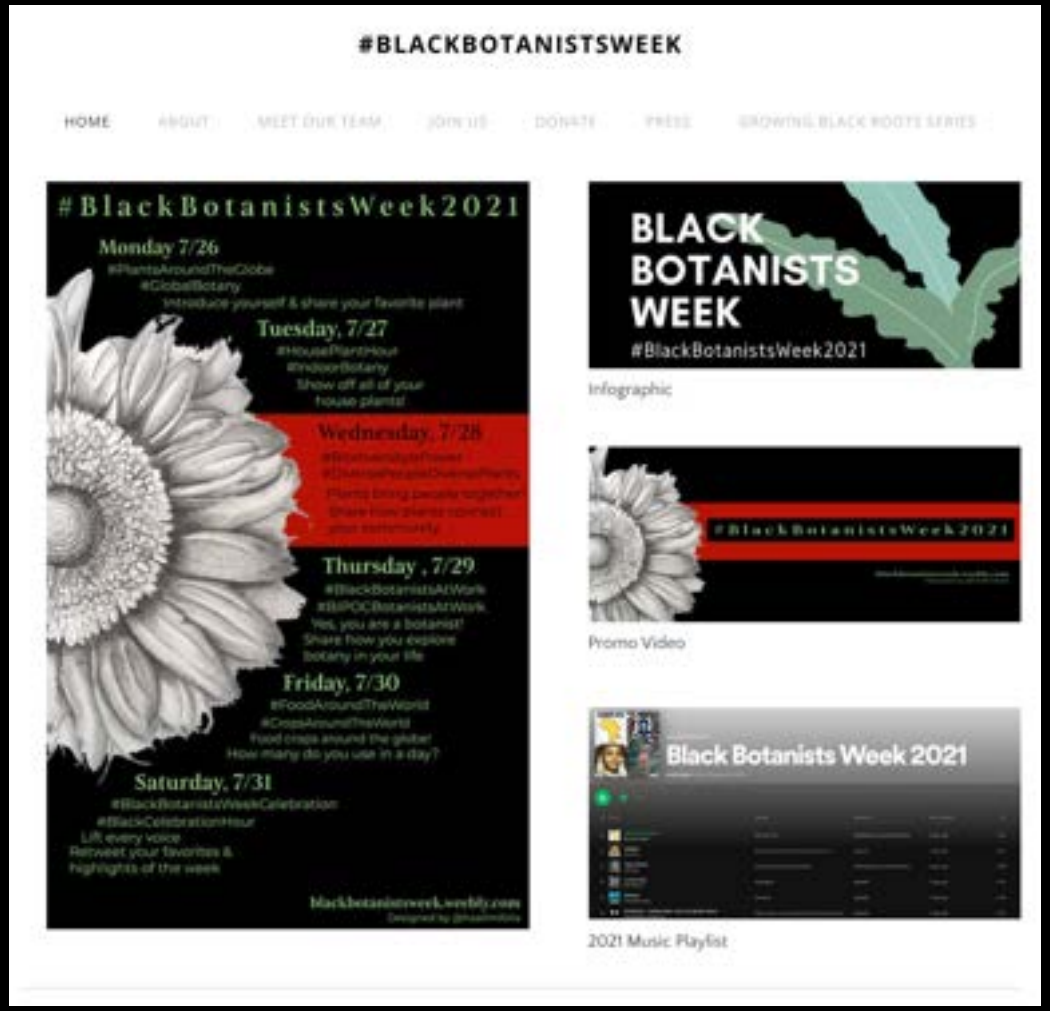
Dr. Angela McDonnell

Dr. Jason Cantley

Peter Jobson

One last thing…

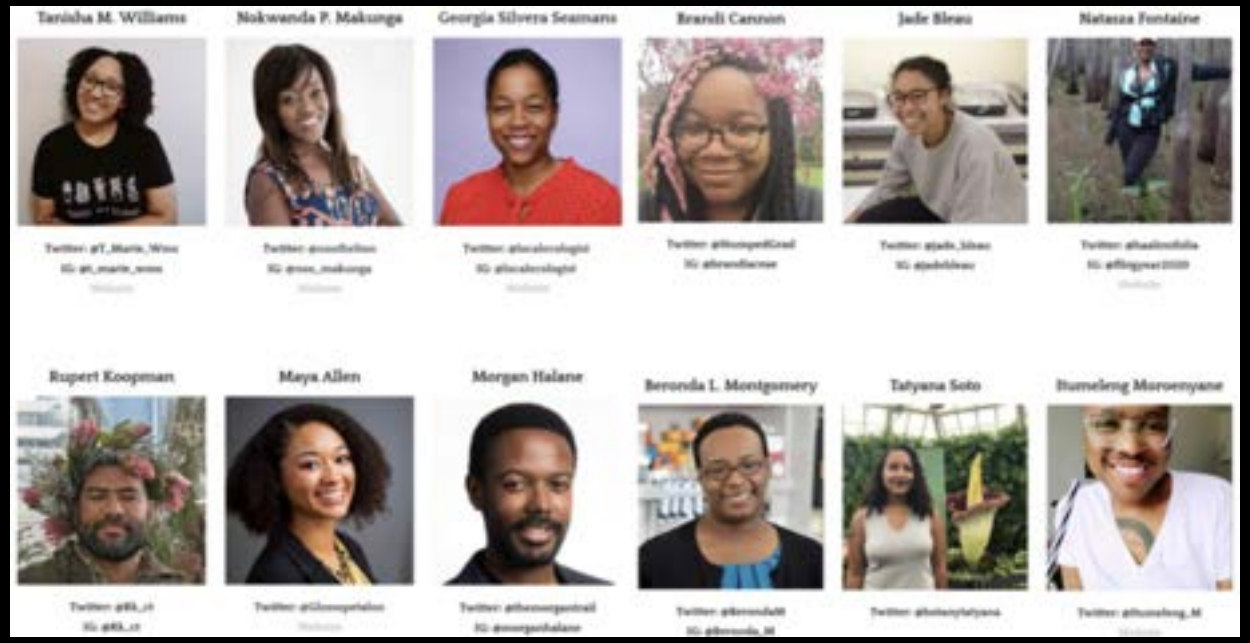
Black Botanists Week



www.blackbotanistsweek.weebly.com

Started in 2020 to promote, encourage, create a safe space for, and find more Black (and BIPOC) people who love plants!

Black Botanists Week



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Special Issue on Conservation

From Theory to Practice: New Innovations and Their Application in Conservation Biology

- Best practices
- Novel conceptual frameworks
- Software of database
- Best practices for managing ex situ collections
- New techniques to combat poaching

- Abstracts due April 4, 2023

Applications in Plant Sciences

Official publication of the Botanical Society of America

Questions?

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