

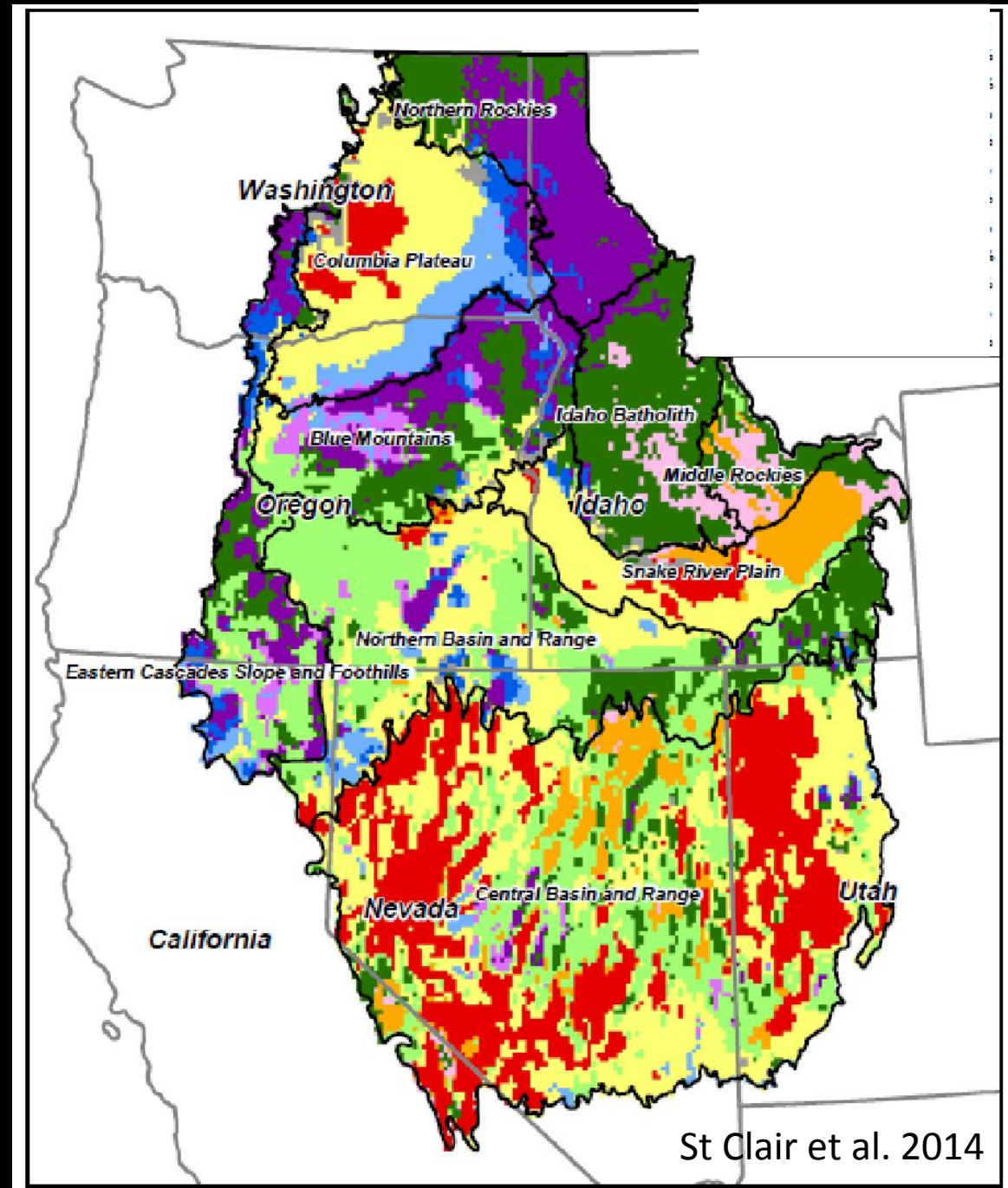
Beyond Climate: Incorporating Novel Factors into Seed Transfer Guidelines

Alexis Gibson, Cara Nelson, Lila Fishman, Susan Rinehart



Seed Transfer Zones

- Geographic genetic variation
- Map genetic variation on landscape
- Adapted to local conditions





Potential Limitations

1. Are the most important environmental factors included?
2. Are there other genetic factors that impact fitness?

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 - Soils
 - Water availability, nutrients, pH, minerals



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1. Are the most important environmental factors included?
 - Soils
 - Water availability, nutrients, pH, minerals
 - Extreme and moderate differences (e.g. Wright, Stanton, Scherson 2006; Macel et al. 2007)



Potential Limitations

1. Are the most important environmental factors included?
 - Soils
 - Water availability, nutrients, pH, minerals
 - Extreme and moderate differences
 - Data quantity and quality



Data Availability

- *Bromus carinatus* (Johnson et al. 2010)
- Seven of eight soil variables related to variation in traits
- ~30% populations missing data





Mountain Brome

- Wide range and use
- Combine climate and soil variables
- New availability of soils data
 - Statewide soil data (NASIS)
 - NRCS database (SSURGO)





Mountain Brome

- 60 populations
- 11 National Forests in Montana and Idaho
- 2 years common garden
- R^2 and AIC model selection



Vigor

Size

Survival

Water Use

Vigor

Climate + Soils

Precipitation as snow

Available water
content

Organic Carbon

Soil temperature
regime

Vigor

Size

Survival

Water Use

Climate + Soils

Climate

End of growing
season

Annual precipitation

Mean coldest month
temperature

Vigor

Climate + Soils

Size

Climate

Survival

Soils

Available water
content

Clay content

Water Use

Soils

Soil order



CLIMATE + SOILS MODELS

- 6 ecotypes
 - 2 main
- Mid vigor, small plants



CLIMATE + SOILS MODELS

- 6 ecotypes
 - 2 main
- Mid vigor, small plants

CLIMATE ONLY

- 2 ecotypes
 - 1 main
- High vigor, small plants



Soils Matter

- Increase variation explained by the model



- Water use efficiency
 - R^2 : 9% \rightarrow 20%



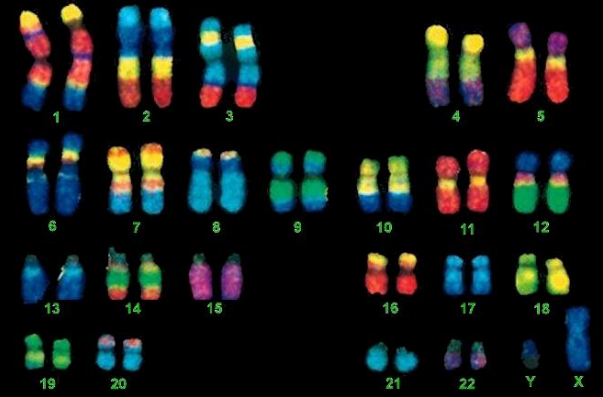
- Less extreme for other traits
 - 4 – 7%

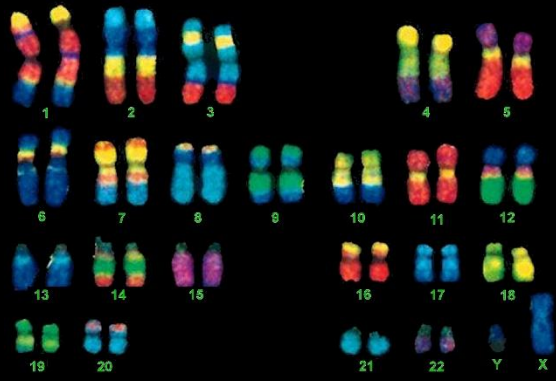
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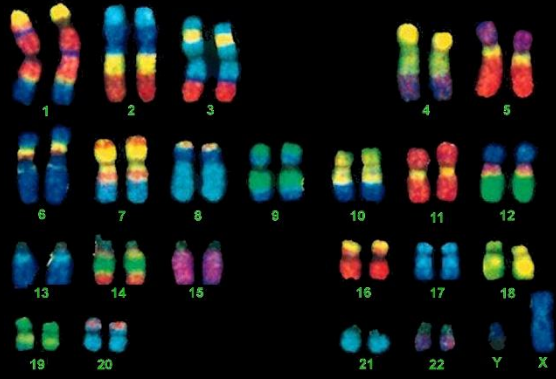
Potential Limitations

2. Are there other genetic factors that impact fitness?
 - Polyploidy
 - 13% species have multiple cytotypes (Severns et al. 2006)

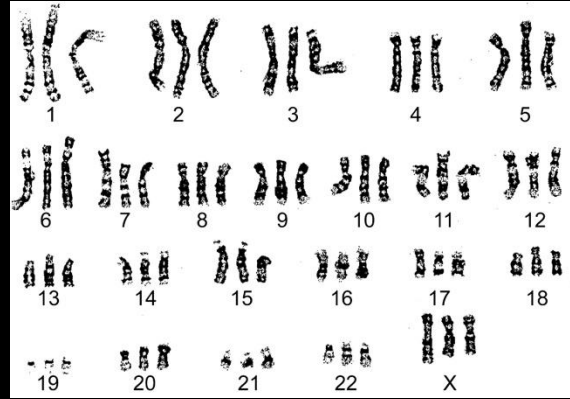




DIPLOID
(2x)



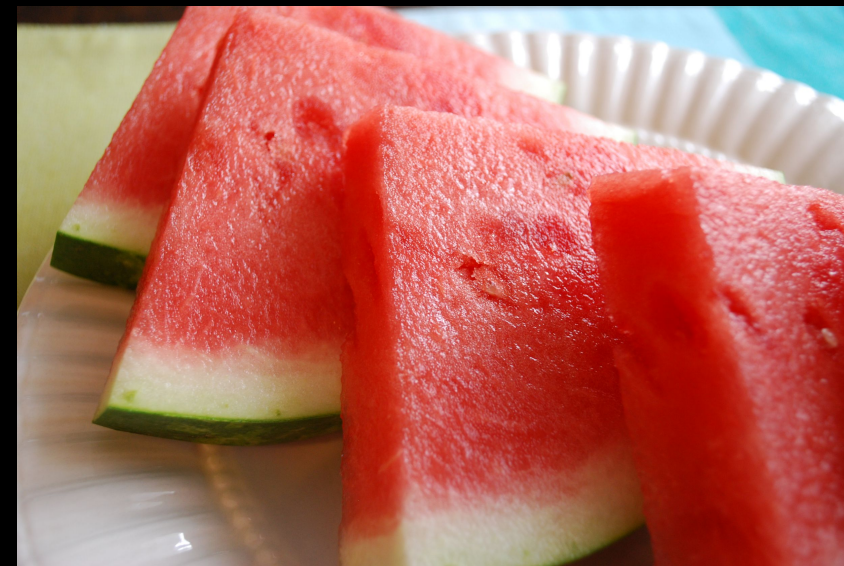
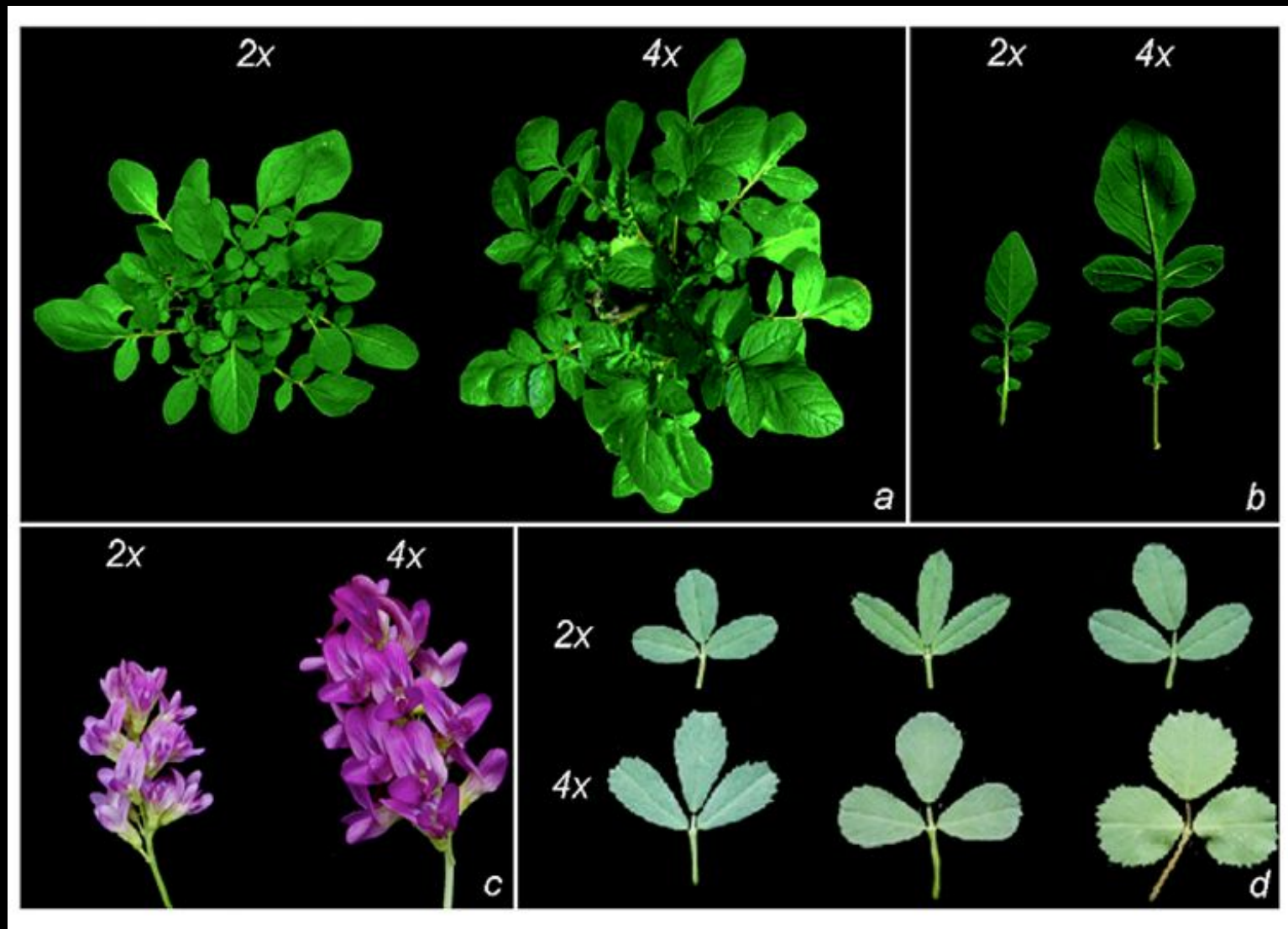
DIPLOID
(2x)



TRIPLOID
(3x)



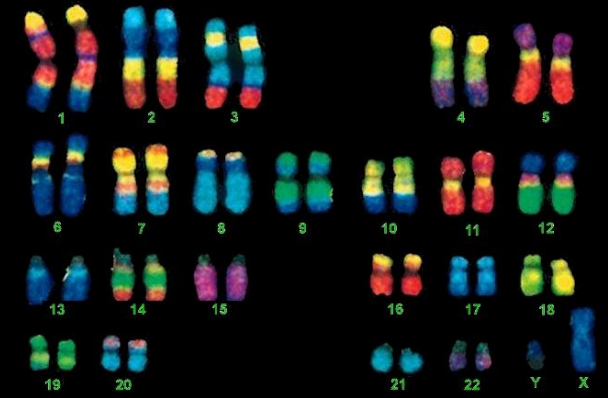
TETRAPLOID
(4x)



Potential Limitations

2. Are there other genetic factors that impact fitness?

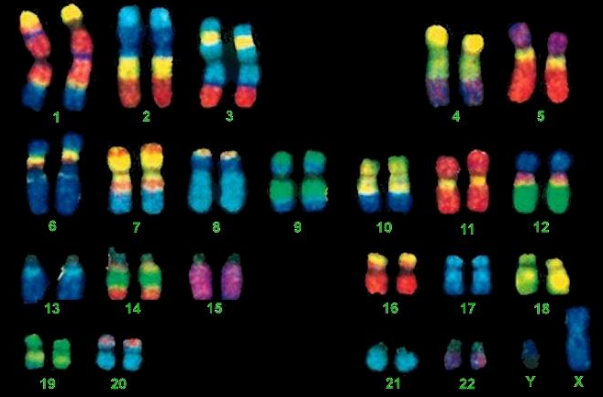
- Polyploidy
- 13% species have multiple cytotypes (Severns et al. 2006)
- Cytotypes may not segregate by habitat (e.g. Baack 2004)

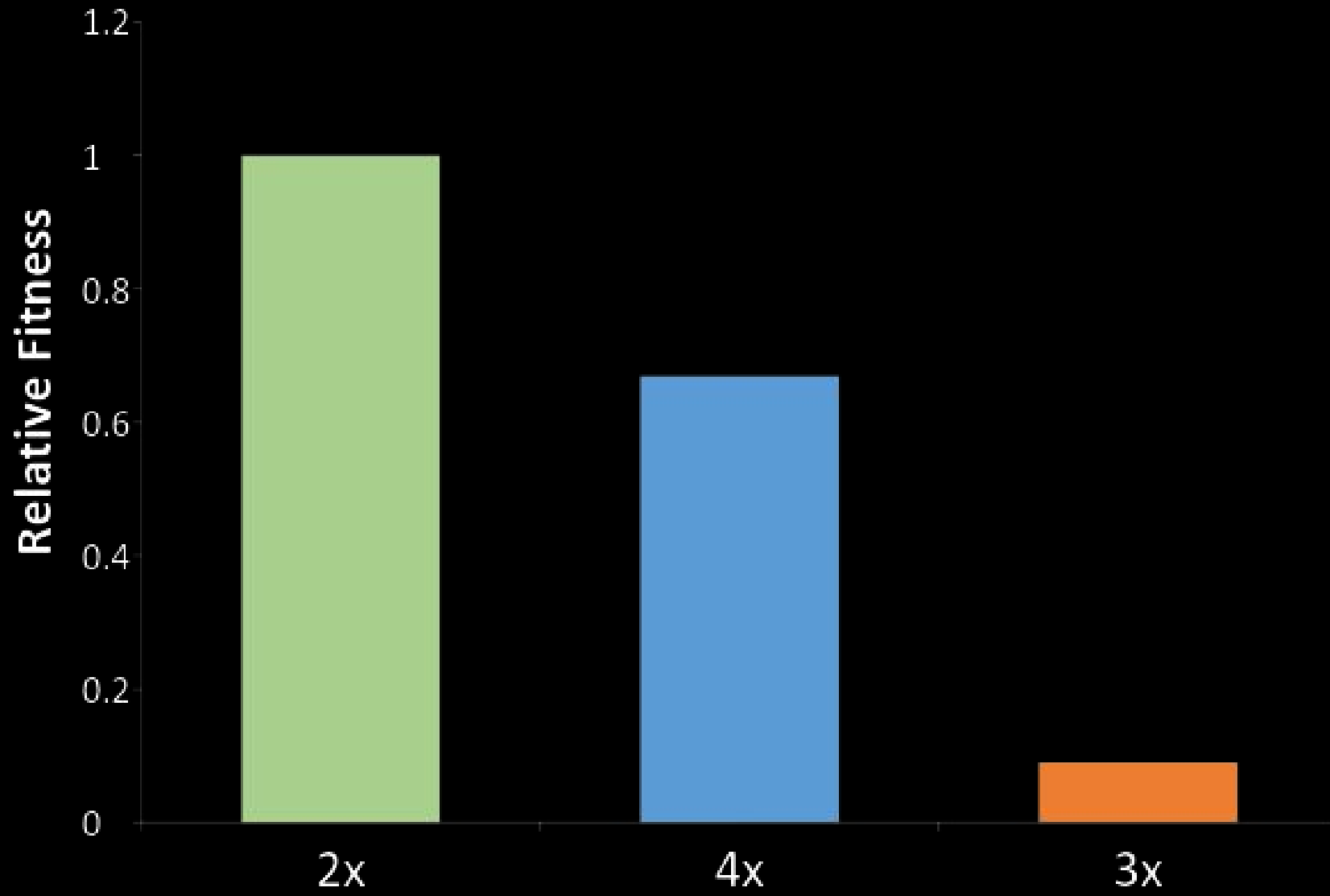


Potential Limitations

2. Are there other genetic factors that impact fitness?

- Polyploidy
- 13% species have multiple cytotypes (Severns et al. 2006)
- Cytotypes may not segregate by habitat (e.g. Baack 2004)
- Fitness and population viability





Adapted from Burton and Husband 2000

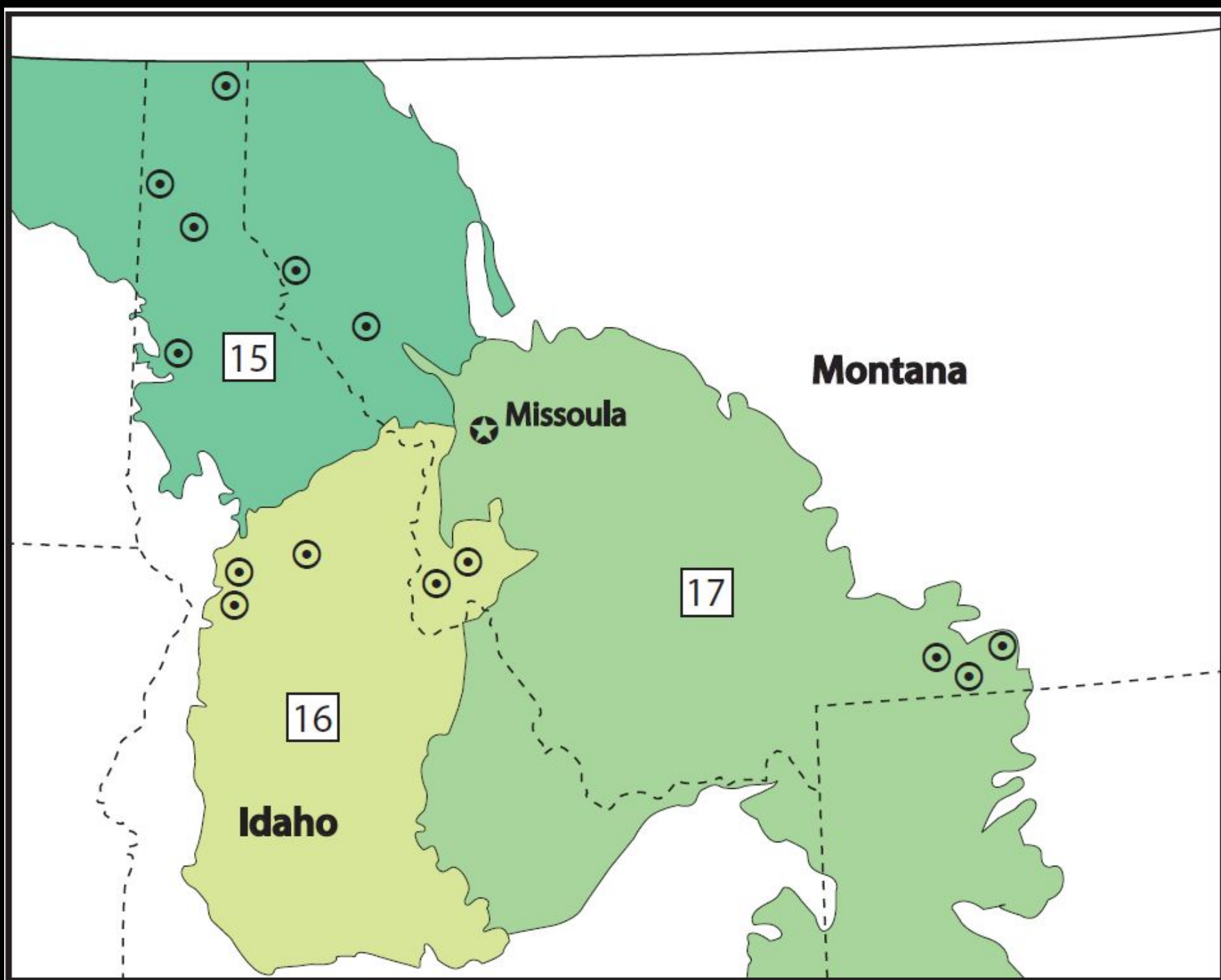


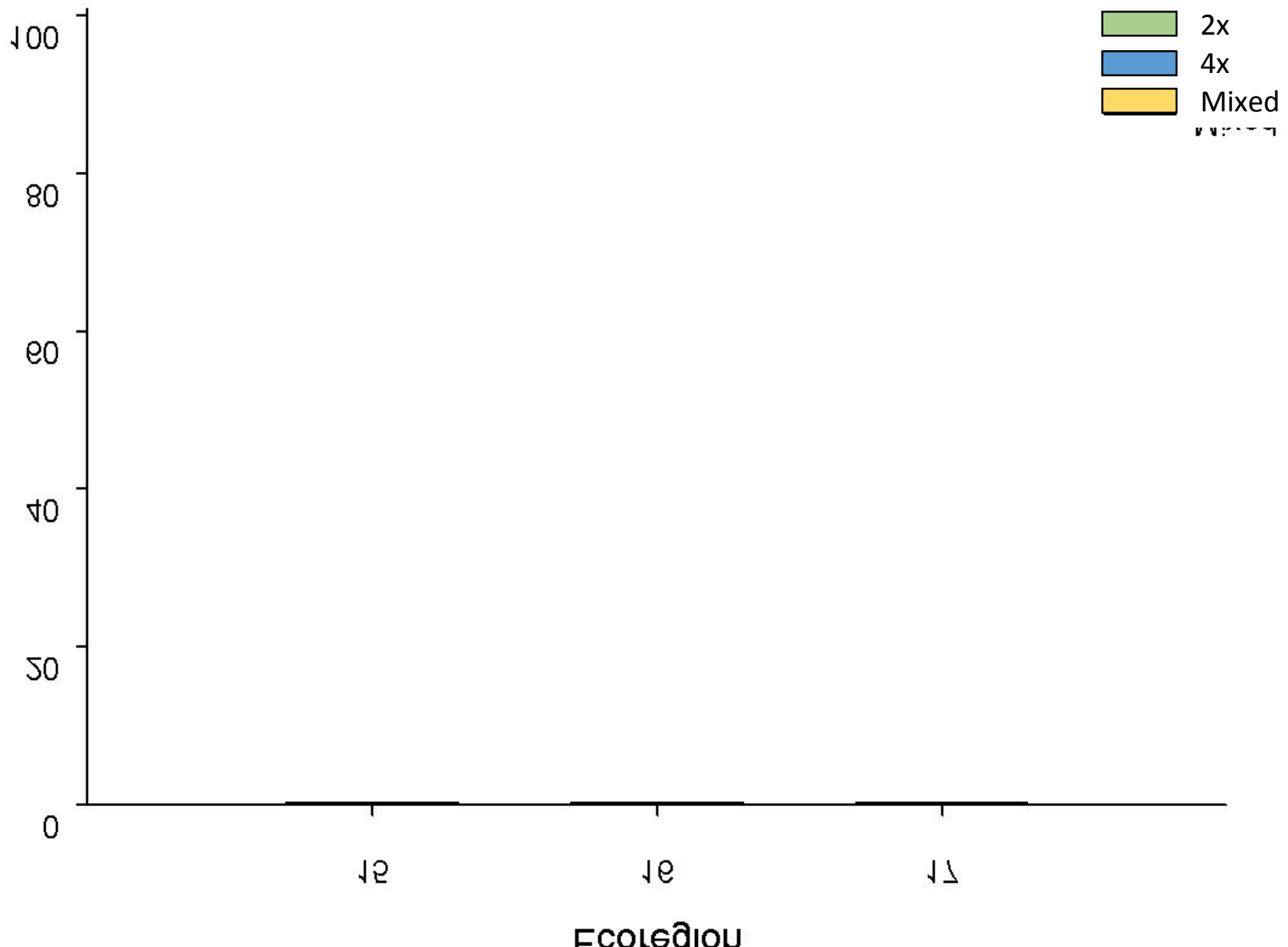
Bluebunch Wheatgrass

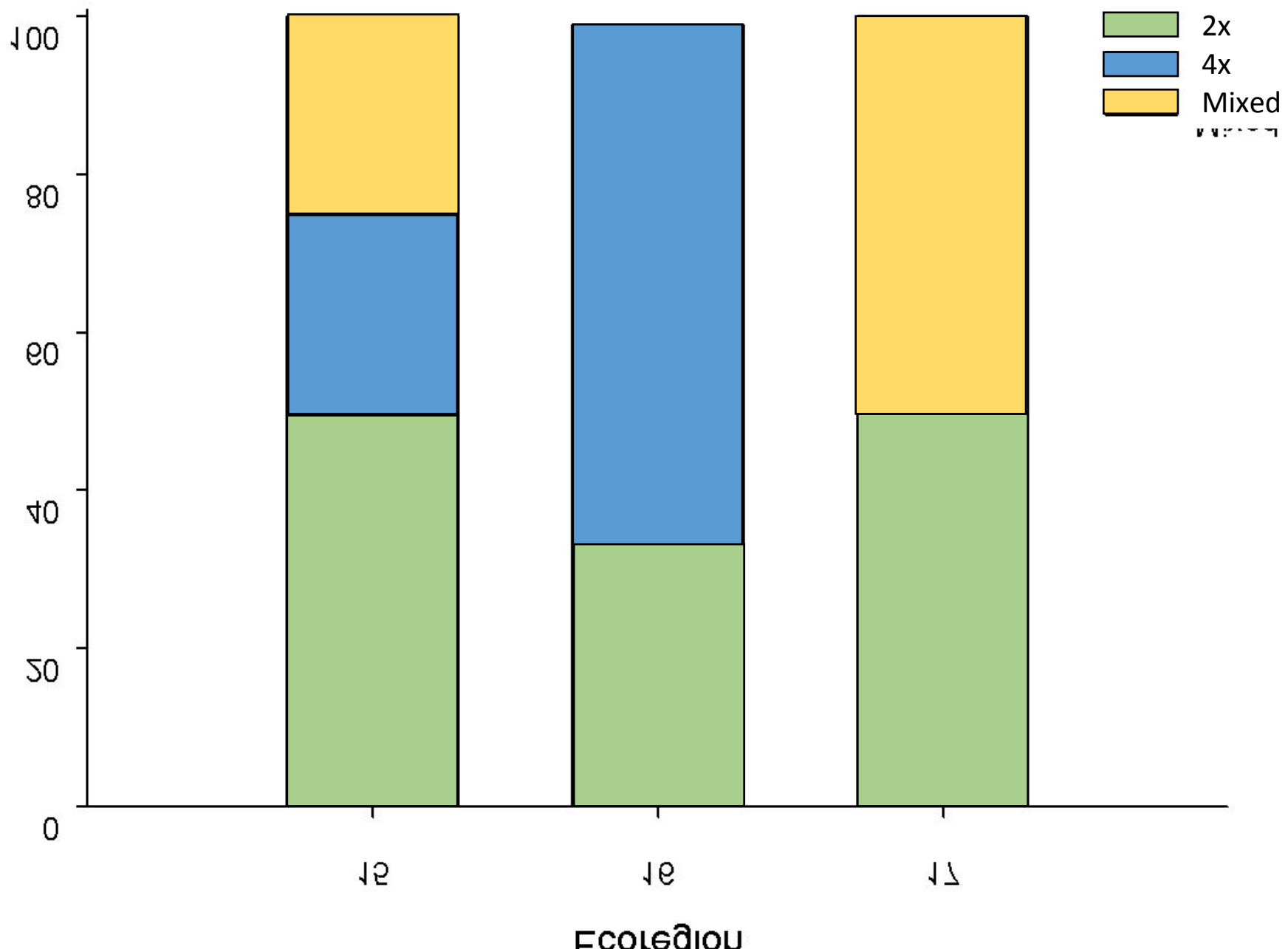
- Most populations diploid (2x)
- Tetraploid (4x) in northern range (Larson 2004)



- *Gibson, Fishman, and Nelson. 2016. Restoration Ecology.*









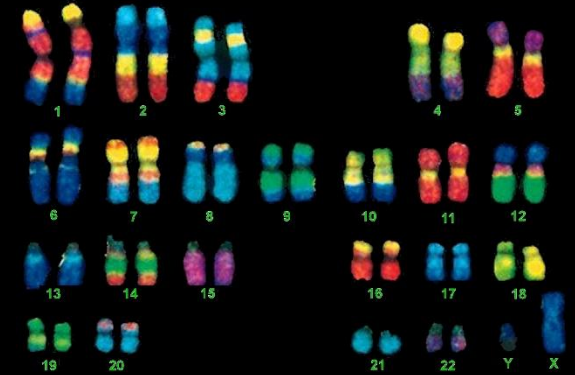
Mixing it Up

- Environment does not divide cytotype
- Seed transfer zones will not prevent mixing (Severns et al. 2013)



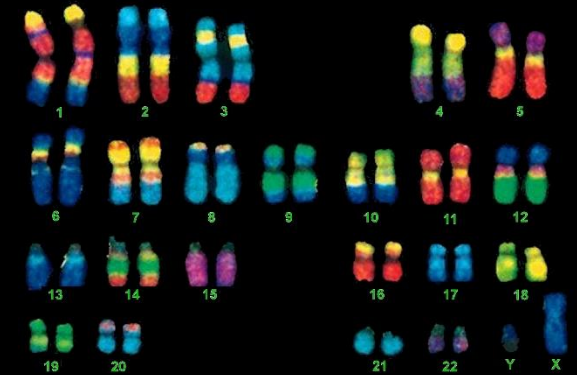
Conclusions

- Soils during transfer zone development
 - Impact on number, type, and distribution of ecotypes expected



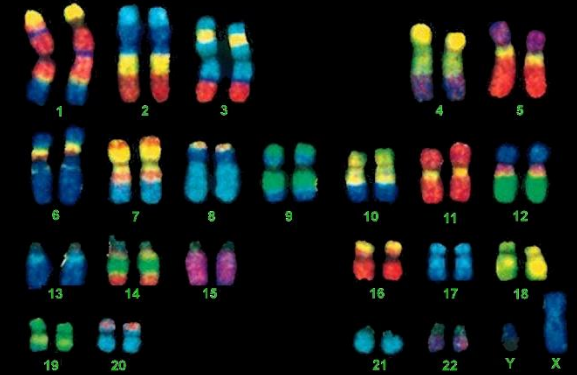
Conclusions

- Soils during transfer zone development
- Polyploidy considered pre-development
 - Better information on presence of cytotypes
 - Location of cytotypes



Conclusions

- Soils during transfer zone development
- Polyploidy considered pre-development
- Cytotypes considered post-transfer zone development
 - Rare species and isolated populations





“Make it look like natural selection.”



The preceding presentation was delivered at the

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This and additional presentations available at <http://nativeseed.info>

