Ecological genetics of big sagebrush

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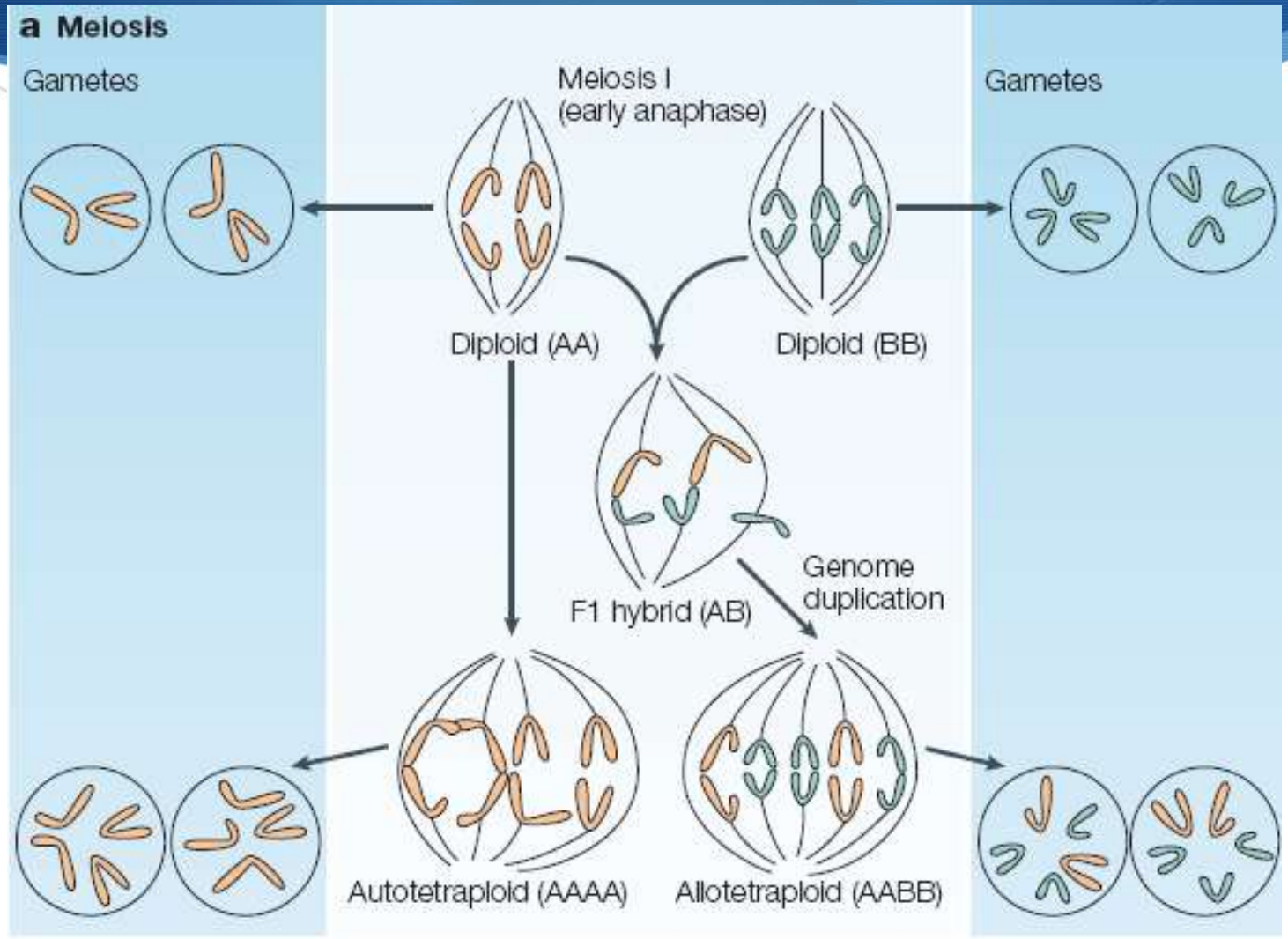
Big sagebrush morphological variation

vaseyana(2X) 4X 4X tridentata(2X)

Polyploid formation



Genetics review of big sagebrush

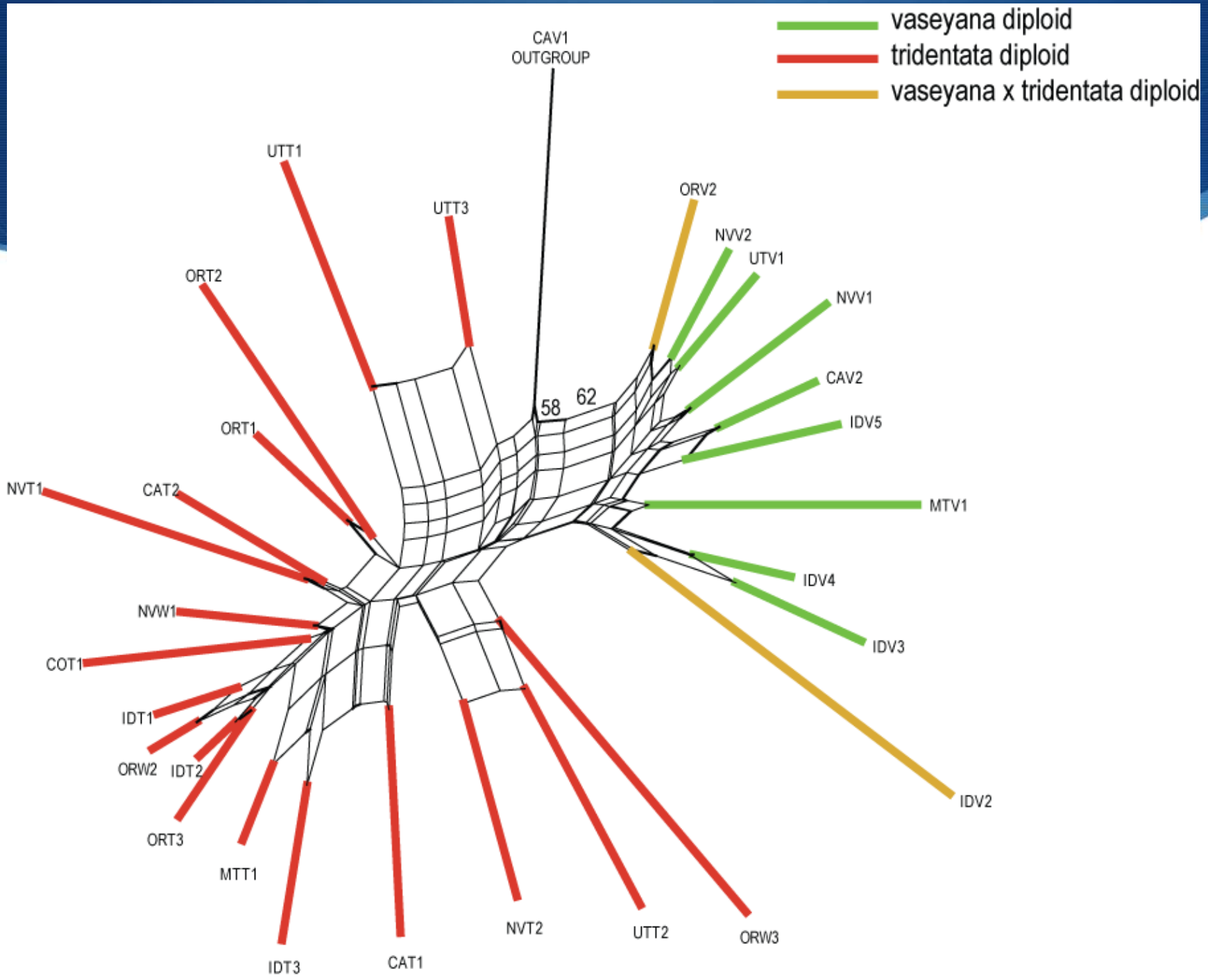
- Diploid ssp *tridentata* and *vaseyana* occupy different ecotypes
- Hybridize in ecotones, diploid hybrids are adapted to narrow ecotones, but not parental ecotypes (McArthur et al. 1981, 1988, Wang et al. 1997)
- Polyploids (tetraploids), including ssp. *wyomingensis,* are probably more abundant on the landscape than diploids
  - Approximately half of all sampled plants were tetraploids (McArthur and Sanderson 1999)

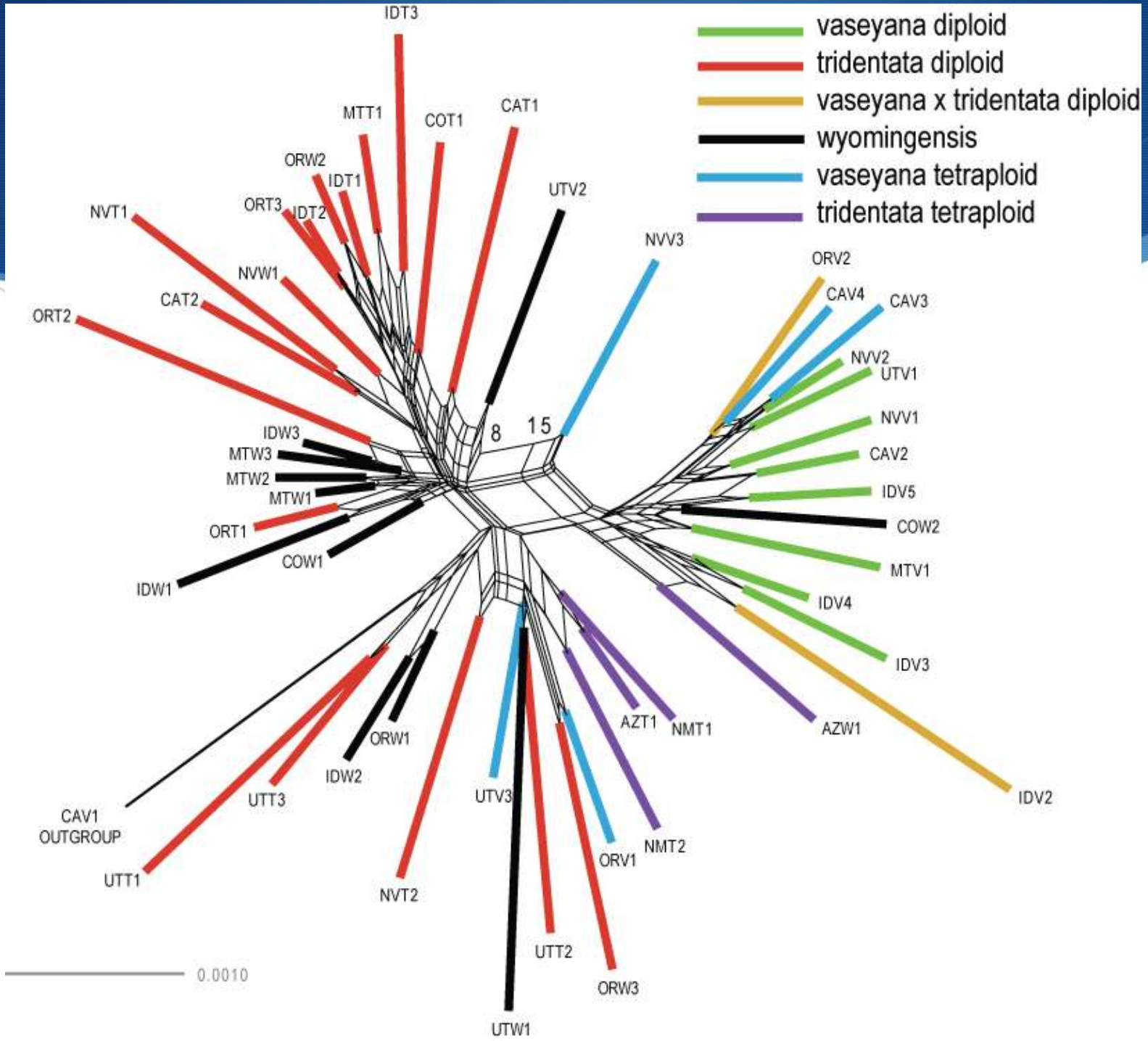
Objectives

- Elucidate phylogenetic relationships among subspecies
- Discern the origins of subspecies *wyomingensis* and other tetraploids
- Compare morphological characteristics to phylogenetic relationships

Methods

- Sequences obtain through next-generation transcriptome sequencing (Bajgain et al. 2011)
- 25 putative genes associated with secondary metabolite pathway were sequenced (~12,000 bp of data)
- 329 samples sequenced from 49 collection sites (7 samples per site)
- Phylogenetic analyses: Bayesian coalescence and neighbor-net network
- Genome size:flow cytometery (3 individual per site)


vaseyana diploid
tridentata diploid
vaseyana x tridentata diploid
CAV1
OUTGROUP
UTT1
UTT3
ORV2
NVV2
UTV1
NVV1
ORT2
CAV2
IDV5
58
62
ORT1
NVT1
CAT2
MTV1
IDV4
NVW1
IDV3
COT1
IDT1
IDV2
ORW2
IDT2
ORT3
MTT1
NVT2
UTT2
ORW3
IDT3
CAT1


vaseyana diploid
tridentata diploid
vaseyana x tridentata diploid
wyomingensis
vaseyana tetraploid
tridentata tetraploid
IDT3
MTT1
COT1
CAT1
ORW2
IDT1
ORT3
IDT2
UTV2
NVT1
NVV3
NVW1
ORV2
CAT2
CAV4
CAV3
ORT2
NVV2
UTV1
8
15
NVV1
IDW3
MTW3
CAV2
MTW2
IDV5
MTW1
COW2
ORT1
MTV1
COW1
IDW1
IDV4
IDV3
AZT1
NMT1
AZW1
ORW1
IDW2
IDV2
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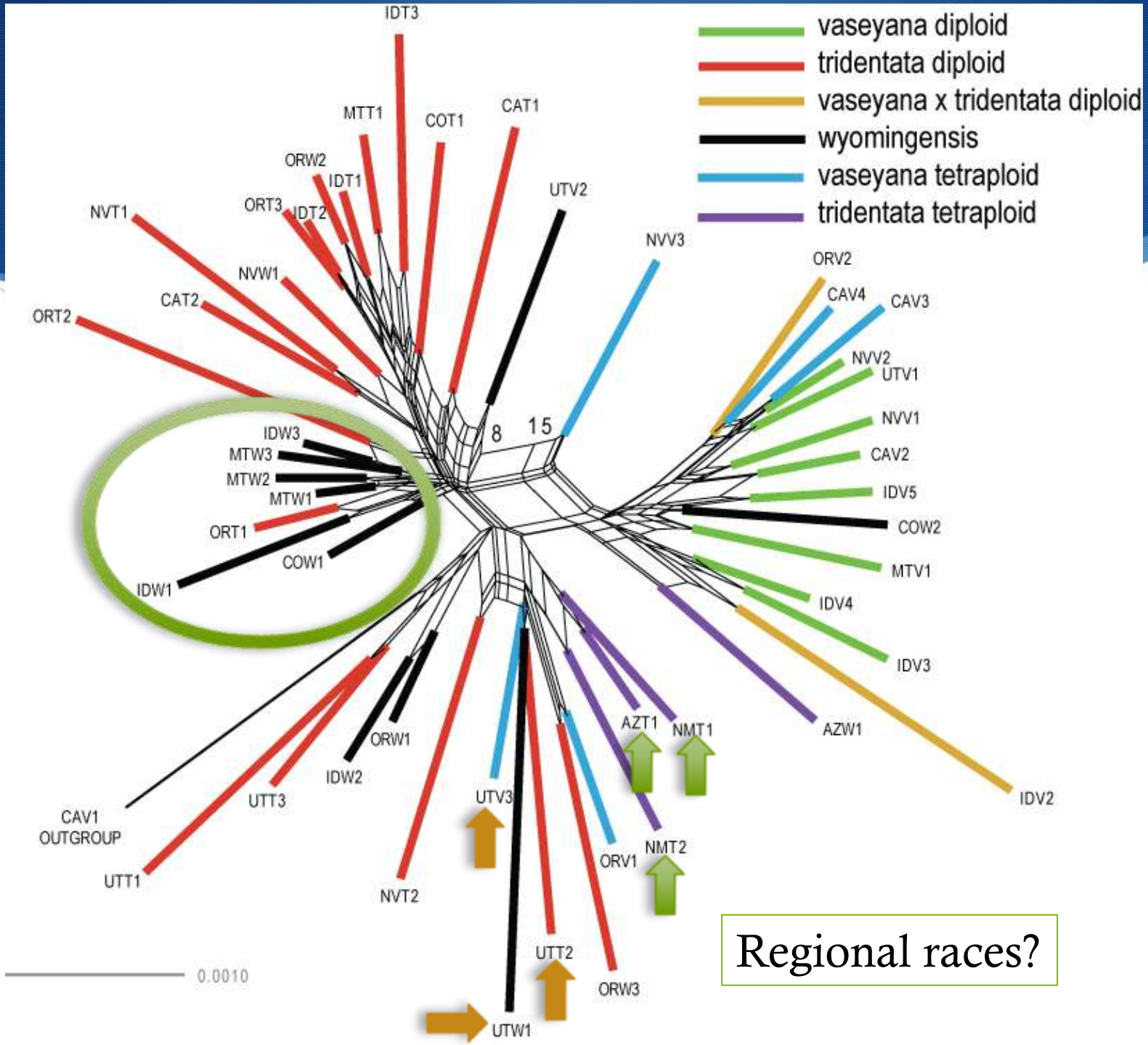
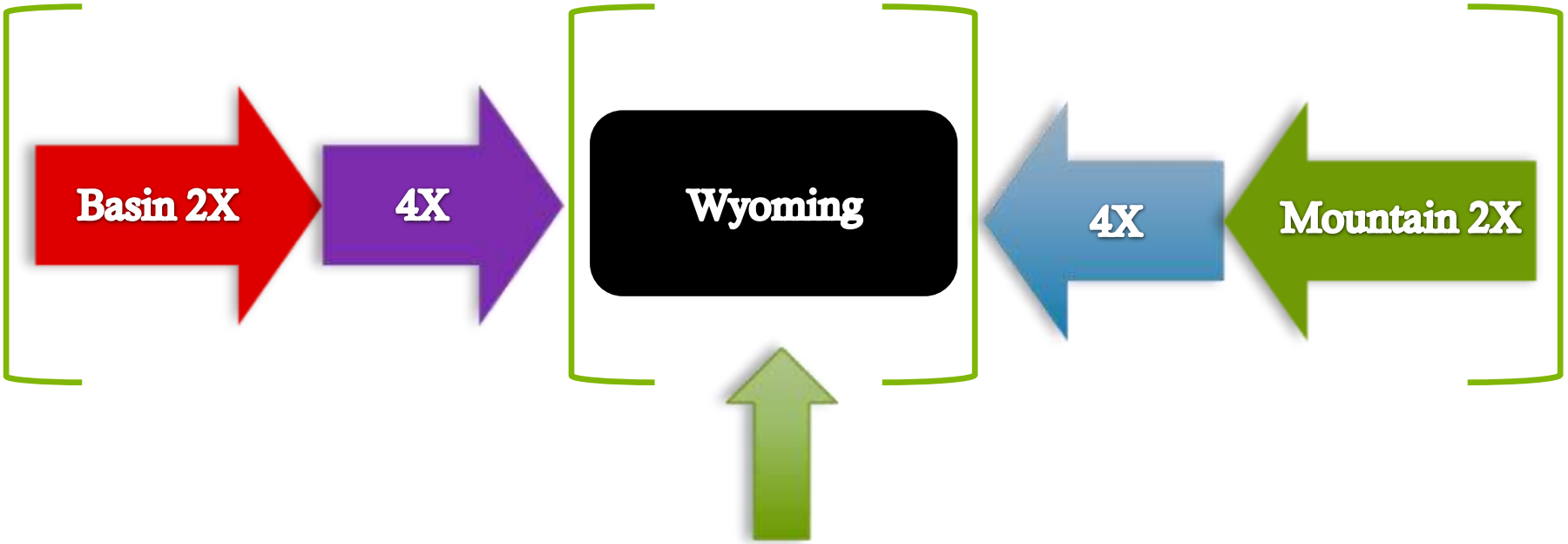


Regional races?

A. tridentata polyploid complex



Summary

- Big sagebrush represents a polyploid complex in which tetraploids, including *wyomingensis,* have formed numerous times
- Tetraploids appear to be of local or regional origins
- Under a genetic and evolutionary context, *wyomingensis* is not a subspecies
- Morphology and UV fluorescence is diagnostic for diploids, but not for tetraploids

Future research

- What are the geographic distributions of tetraploids lineages?
- Are these lineages adapted to particular environments?
- Is there interspecific hybridization with *A. nova* or other sagebrush species?
- How frequent do polyploids develop? Is it in response to environmental stimuli?

E-nose technology

Applications of E-nose technology for the sagebrushes

- E-nose (Electronic nose) is a device that can differentiate different volatile chemicals
- Polymer coated membranes react uniquely to different volatiles
- An electrical current is past over the membrane. Changes in conductance, caused by the way the polymer reacts to the volatile are recorded

E-noses for the seed industry

- Could rapidly detect aromatic differences between big sagebrush or between sagebrush species
- Works on seeds or leaves
- A means of certifying seed to subspecies or ecotype?

Preliminary results

Taxa	Taxa	Seed Volatile QF	Leaf Volatile QF
A.t. tridentata	*A.t. vaseyana*	2.83	3.259
tridentata	*wyomingensis*	1.207	2.307
vaseyana	*wyomingensis*	2.291	2.065
A. arbuscula	*A. nova*	-	11.035
A. arbuscula	*A. tridentata ssp.*	-	5.019-6.678
A. nova	*A. tridentata ssp*	-	4.756-5.861

Values > 2.0 are significantly different ($p < 0.05$)

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