Analysis of nuclear DNA from *Sclerocactus glaucus and S. parviflorus* to determine hybridization.

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Introduction

Sclerocactus glaucus is an endangered native Colorado cactus which occurs in relatively small populations in western Colorado. There is concern that *S. glaucus* is hybridizing with the closely related and common *S. parviflorus,* which may be detrimental to the continuation of this rare species. *Sclerocactus glaucus* numbers have been estimated at approximately 10,000, however, recent studies suggest that numbers may be much lower. If pristine populations of *S. glaucus* are identified, conservation efforts and land management plans can be made so this rare Colorado native cactus may be preserved.

Sclerocactus glaucus

Sclerocactus parviflorus

http://www.flickr.com/photos/traveling wild/2411882759/

http://picasaweb.google.com/106015119884397756091/Kaktusy2011

Purpose

To analyze the genetic structure within and among *Sclerocactus* populations to determine the extent of introgression and level of gene flow between *S. parviflorus* to *S. glaucus*.

Methods

• Acquire tissue samples collected by Denver Botanic Gardens field researchers
• Develop microsatellite library using chemioluminescent biotin tagging and cloning techniques
• Develop 15 loci to use for genetic analysis which includes:
  ✓ Primer development with florescent tags
  ✓ Primer optimization
• DNA extraction from all individuals among the 35 populations
• Size fragments on an ABI 3730 Genetic Analyzer
  ✓ Analysis of loci with all individuals in all populations using Peak Scanner program
• Analyze data using STRUCTURE
• Determine levels of diversity within populations
• Determine levels of gene flow between populations

Expectation

These two species are hybridizing in many areas but there may still be some populations of *S. glaucus* which are isolated and are not hybridizing with *S. parviflorus*.

Results

#	Population	Species	# ind.	Loc.	Ho	He	A	FIS
1	Uruvan	*S. parviflorus*	31	SW	0.26	0.59	6.6	0.56
2	Rabbit Valley	*S. parviflorus*	28	NW	0.57	0.75	8.4	0.24
3	Kings Estate	*S. parviflorus*	14	NW	0.55	0.69	5.9	0.28
4	White Water	*S. glaucus*	26	C	0.61	0.71	9.2	0.15
5	Adobe Hills	*S. glaucus*	29	SE	0.61	0.82	10.9	0.26
6	Powerline	*S. glaucus*	28	SE	0.45	0.78	8.9	0.42
7	Escalante 1	*S. glaucus*	12	SE	0.50	0.71	5.6	0.29
8	Escalante 2	*S. glaucus*	5	SE	0.33	0.65	2.9	0.49
9	Atwell Gulch	*S. glaucus*	30	NE	0.39	0.66	6.9	0.42
10	Horse Mountain	*S. glaucus*	29	C	0.33	0.65	6.6	0.50
11	T-junction	*S. glaucus*	16	NE	0.54	0.75	6.8	0.28
12	Pond Site	*S. glaucus*	29	NE	0.38	0.65	6.2	0.41
13	Mile Post	*S. glaucus*	24	NE	0.24	0.62	4.8	0.60
14	Red Hill	*S. glaucus*	25	NE	0.43	0.62	6.9	0.31
15	East Basin	*S. glaucus*	22	NE	0.47	0.68	7.2	0.31

Table 1: (above) Depicts the data from the genetic analysis of the 348 individuals from 15 populations for 9 loci. Population numbers are assigned to each of the populations with species name, the number of individuals in the sample population, relative location in the sampling area (see figure 6), observed heterozygosity (Ho), expected heterozygosity (He), average number of alleles (A) and the inbreeding coefficient (FIS) .
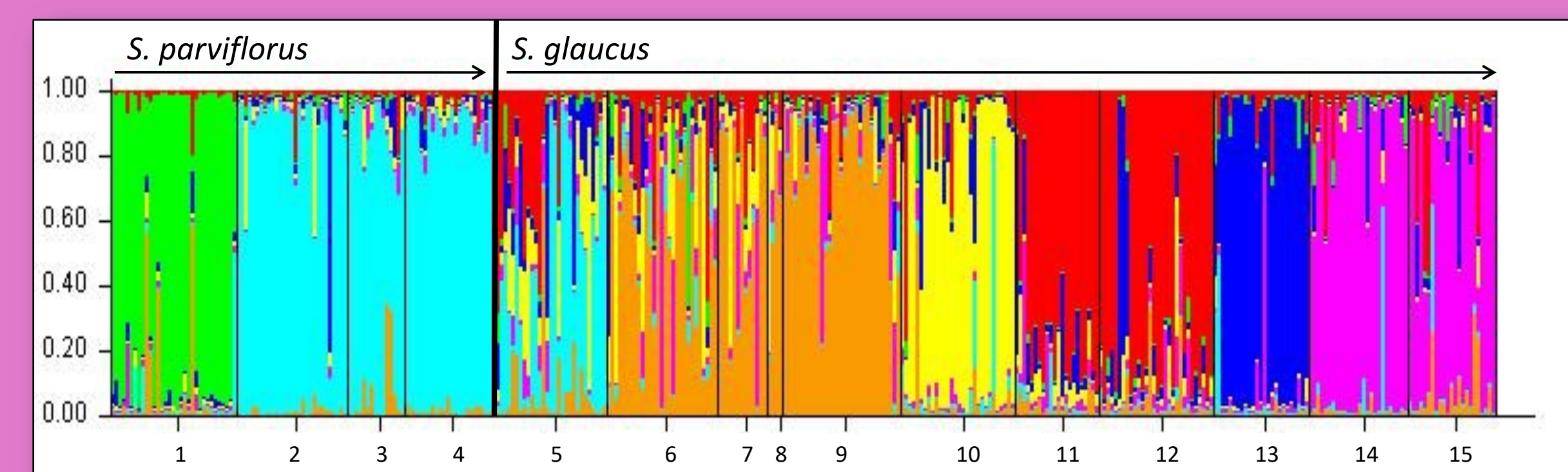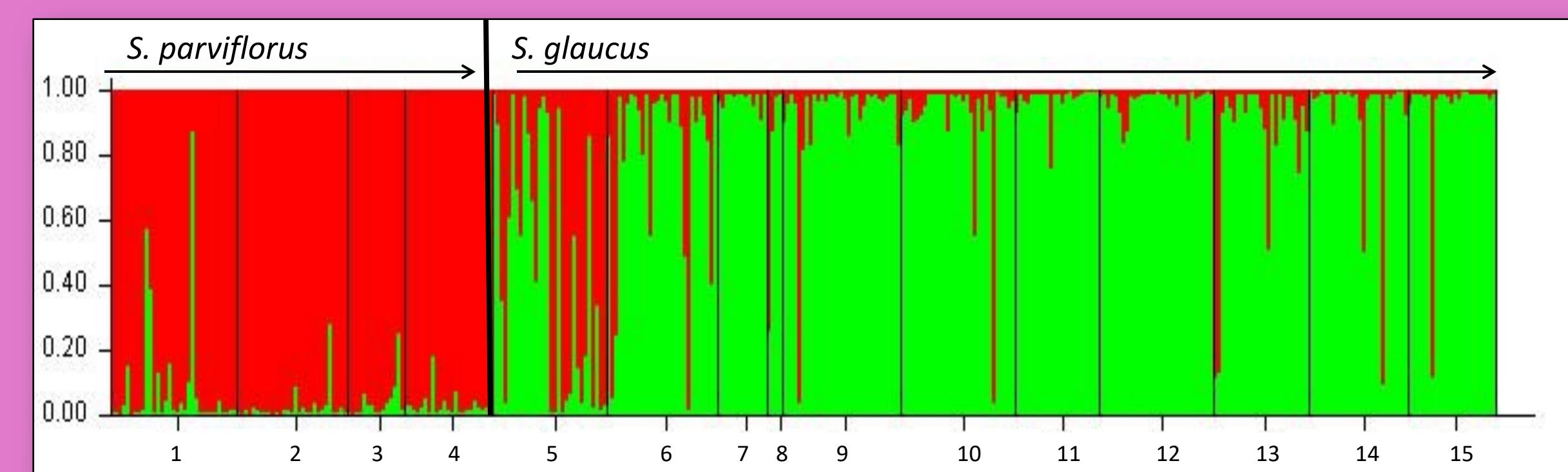

Figure 3: (top, K=2) Structure analysis of 348 individuals across the 15 listed populations comparing 9 loci. Red indicates *S. parviflorus* genotypes and green indicates *S. glaucus* genotypes.
Figure 4: (bottom, K=7) Structure analysis of 348 individuals across the 15 listed populations comparing 9 loci. There are 7 colors indicating differences in genotypes.
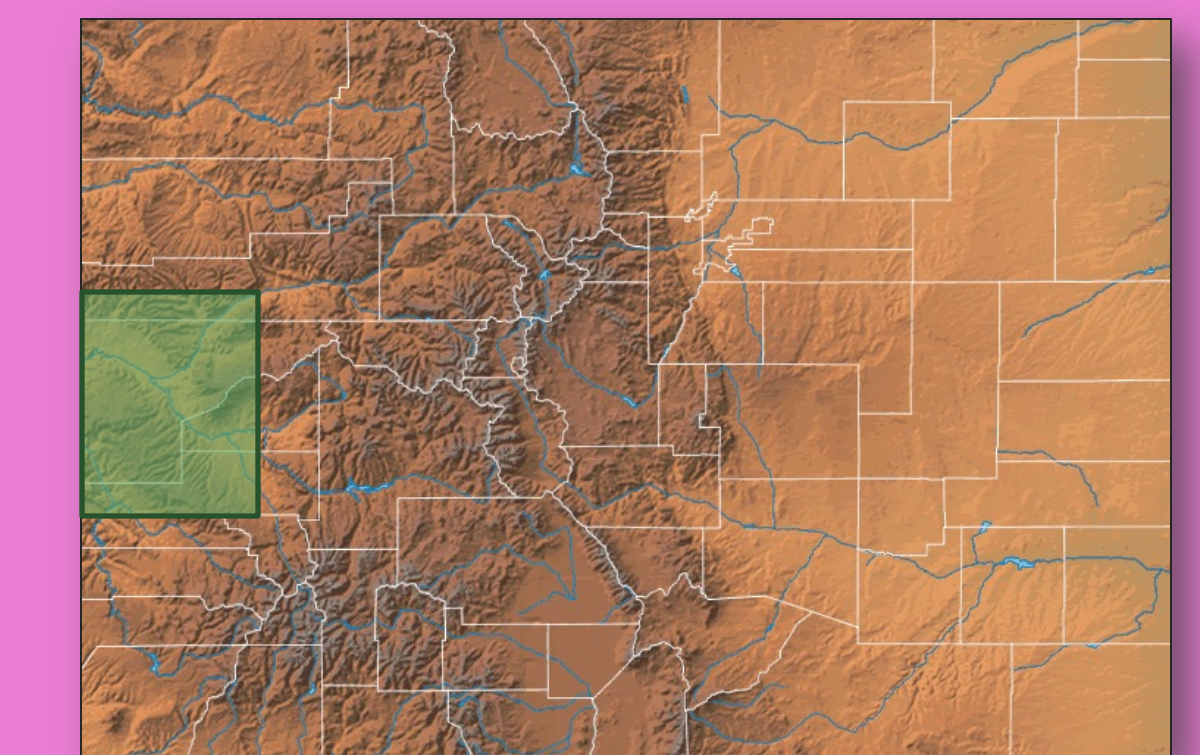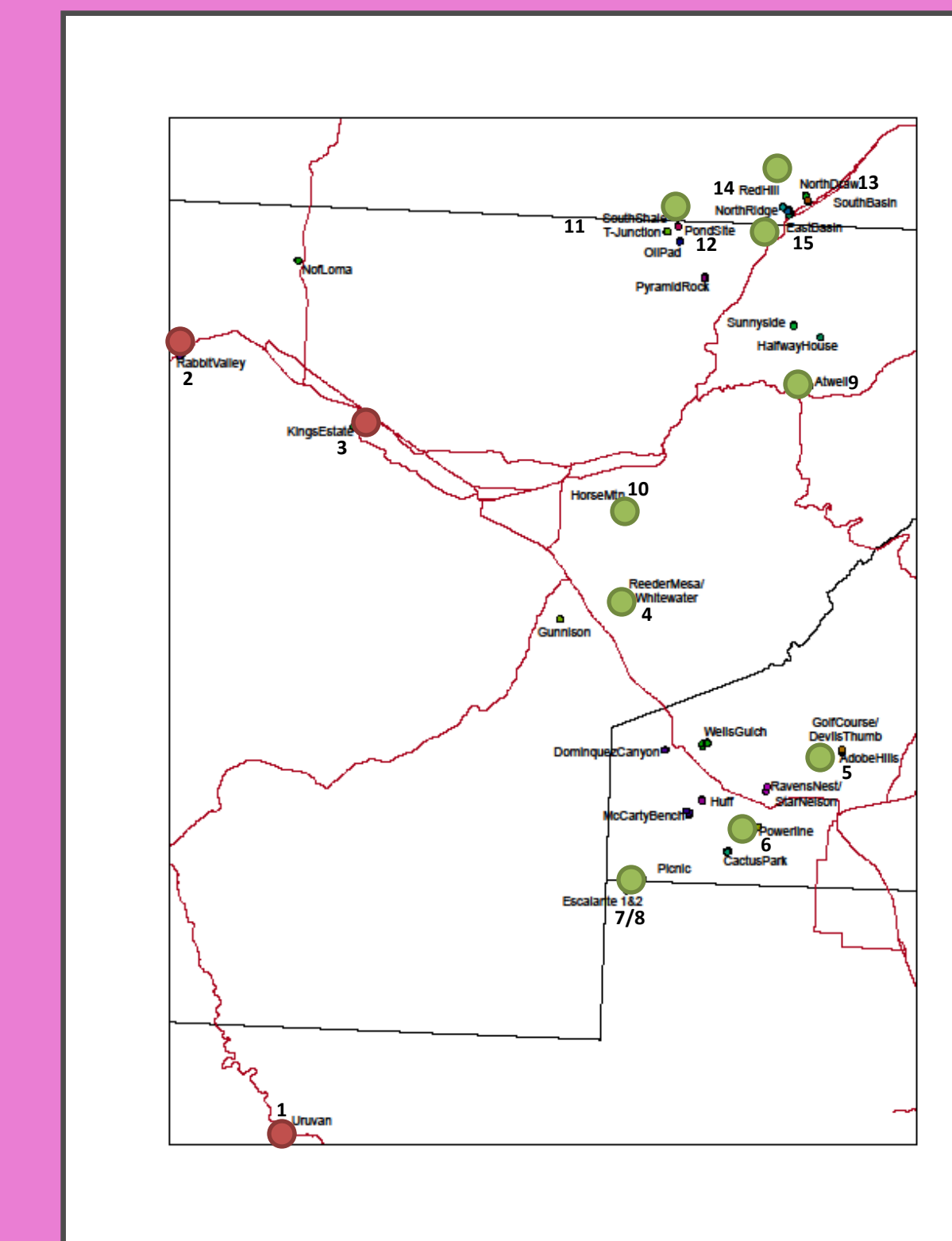

Figure 5: (above) Map of Colorado indicating rivers and county lines. All populations included in the study are located within the green area.

Figure 6: (left) Detailed view of collection area with populations indicated. Red populations have been identified as *S. parviflorus* , green populations have been identified as *S. glaucus*.

Conclusions

• White Water appears to be more similar genetically to *S. parviflorus* despite being identified as *S. glaucus*. Reasons for this may be:
  • Misidentification
  • Gene flow from *S. parviflorus* has completely permeated this *S. glaucus* population.
• Adobe Hills has a characteristics of both *S. parviflorus* and *S. glaucus* indicating this population is hybrid
• There is gene flow between *S. parviflorus* and *S. glaucus* populations
• There are populations of *S. glaucus* which have minimal introgression from *S. parviflorus*

Future Research

• Continue development of remaining 6 loci and analyze data for the remaining individuals and populations

• Analyze chloroplast DNA and determine directionality of hybridization as chloroplast DNA lineages are inherited through the maternal parent via seed.

• Use chloroplast DNA results to determine the historical evolutionary pattern for the White Water population

Acknowledgements