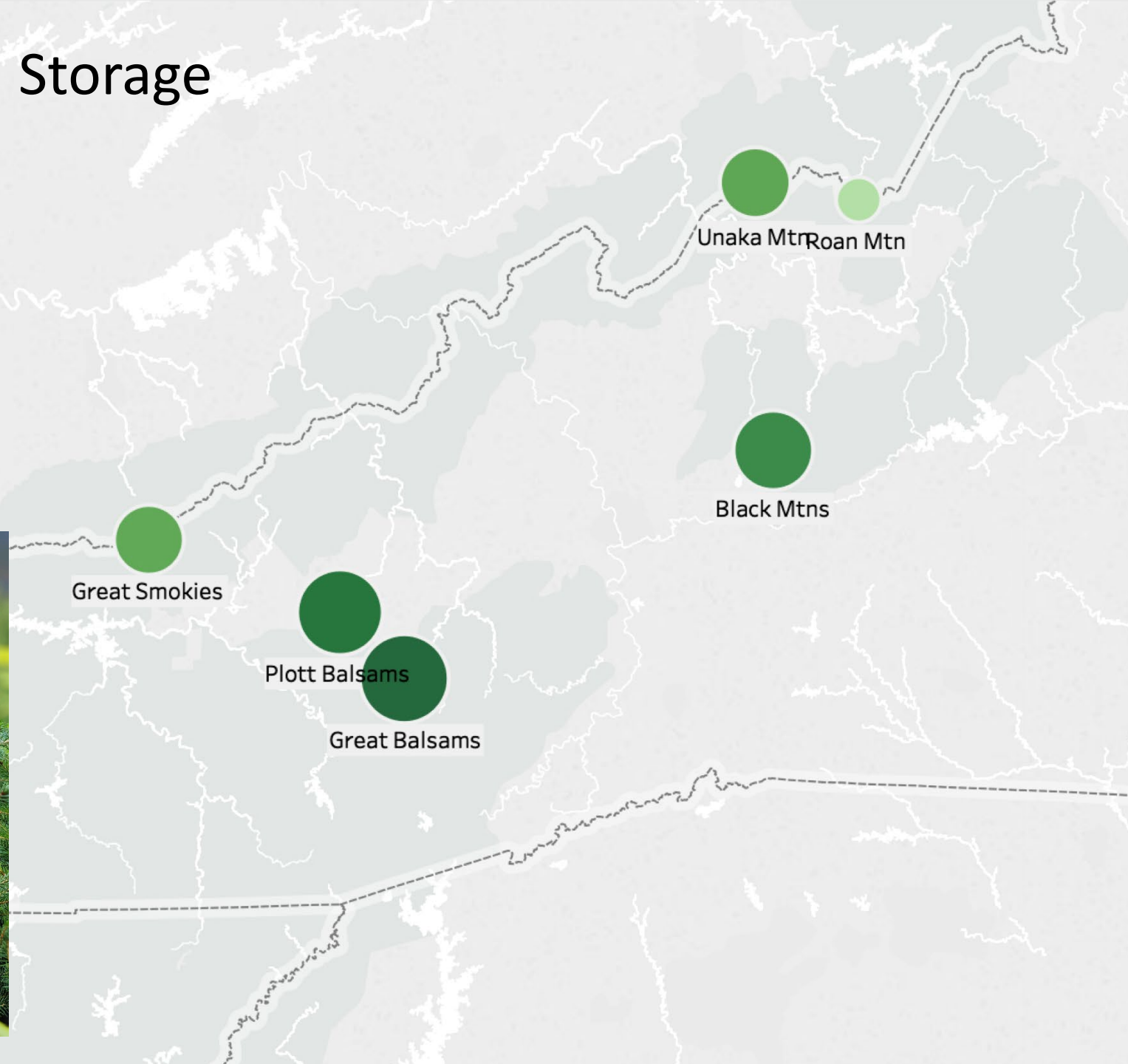
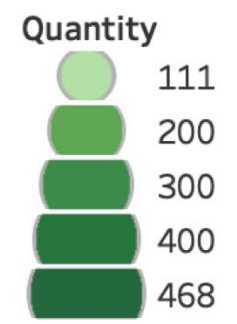


SOUTHERN HIGHLANDS RESERVE

Native Plant Arboretum | Research Center

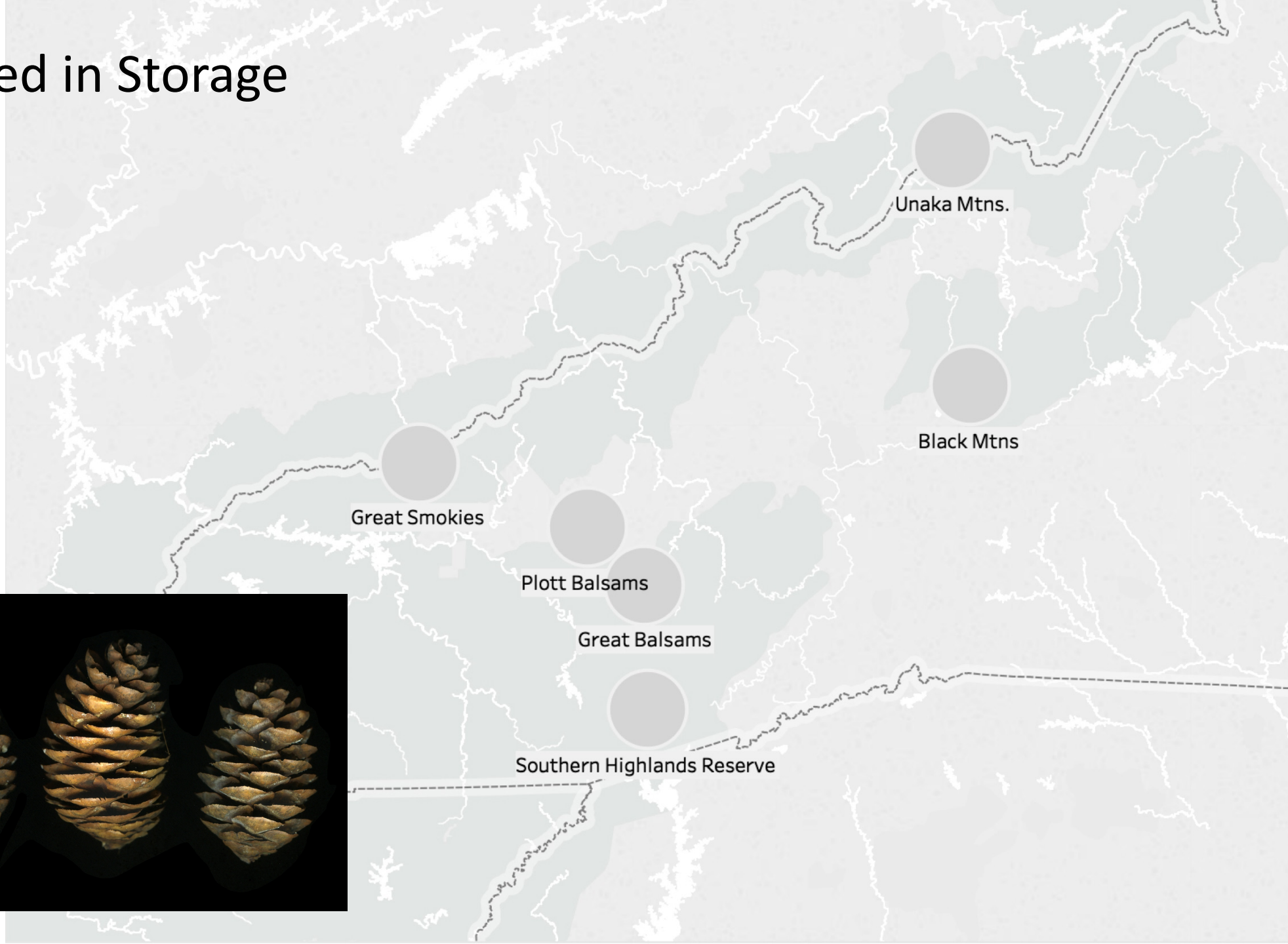
1 Gallon in Storage



SOUTHERN HIGHLANDS RESERVE



Seed in Storage



Inventory

Origin	Type	Quantity
Great Balsams	Gallon	468
Plott Balsams	Gallon	433
Black Mtns	Gallon	371
Unaka Mtn	Gallon	288
Great Smokies	Gallon	281
Roan Mtn	Gallon	111
		1,952
Unaka Mtns.	Seed	
Southern Highlands Reserve	Seed	
Plott Balsams	Seed	
Great Smokies	Seed	
Great Balsams	Seed	
Black Mtns	Seed	

Production of *Picea rubens* for Southern Appalachian Restoration Initiatives



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Southern Appalachian Spruce Restoration

Introduction

The spruce-fir (*Picea rubens* and *Abies fraseri*) forests of the southern Appalachian Mountains once dominated the upper elevations of the southeastern United States. Today, however, these mountain-top communities only occur at seven locations throughout southern Virginia, western North Carolina, and eastern Tennessee (Figure 1; Berry and Smith, 2013). Causes for this widespread decline have been traced to stress factors such as logging, acid rain, attacks from invasive insects [e.g., balsam wooly adelgid (*Adelges piceae*)], and alteration of the environment due to climate change (White and Cogbill, 1992).

These forests have become isolated from boreal forests of the northern United States and Canada. Many species of plants and animals found in this community type have evolved here, isolated from their northern cousins. Therefore, many priority species are associated with the spruce-fir forests (Table 1). Targeted initiatives have been developed, including the Southern Appalachian Spruce Restoration Initiative (SASRI), to restore and replant *Picea rubens* in ecologically appropriate locations throughout the Southern Blue Ridge ecoregion.

Table 1. Priority species associated with spruce-fir forest.

Group	Scientific name	Common name	State status (Federal status)
Birds	<i>Accipiter striatus</i>	Sharp-shinned hawk	SR
	<i>Aegolius acadicus</i>	Northern Saw-whet Owl	T
	<i>Carduelis pinus</i>	Pine Siskin	
	<i>Certhia americana</i>	Brown Creeper	SC
	<i>Dendroica magnolia</i>	Magnolia Warbler	SR
	<i>Dendroica pensylvanica</i>	Chestnut-sided Warbler	
	<i>Loxia curvirostra</i>	Red Crossbill	SC
	<i>Picoides villosus</i>	Hairy Woodpecker	
	<i>Poecile atricapilla</i>	Black-capped Chickadee	SC
	<i>Wilsonia canadensis</i>	Canada Warbler	
Mammals	<i>Glaucomys sabrinus</i>	Northern Flying Squirrel	E (E)
	<i>Microtus chrotorrhinus</i>	Rock Vole	SC
	<i>Mustela frenata</i>	Long-tailed Weasel	
	<i>Sorex cinereus</i>	Masked Shrew	
	<i>Sorex dispar</i>	Rock Shrew	SC
	<i>Sorex fumeus</i>	Smoky Shrew	
Amphibians	<i>Desmognathus wrighti</i>	Pigmy Salamander	SR
	<i>Plethodon glutinosus sensu stricto</i>	Northern Slimy Salamander	
	<i>Plethodon welleri</i>	Weller's Salamander	SC

T = Threatened, E = Endangered, SC = Special Concern, SR = Significantly Rare

Restoration Setbacks

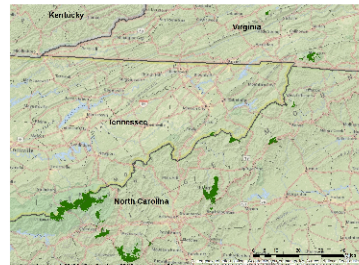


Fig 1. Southern Appalachian areas where red spruce may be found.

Procurement of *Picea rubens* for restoration has been difficult, as the success of young life stages of plants, such as tree saplings, is critical to establishment, especially in harsh environmental conditions. *Picea rubens* saplings tend to have distinct physiological and morphological differences compared to adult plants, such as increased photosynthetic capacity, carbon allocation, and unique xylem considerations (Niinemets 2002). As a result, juvenile age classes are generally considered more sensitive to environmental stress than mature trees (Greenwood et al. 2008) and difficult to produce. Therefore, a propagation and production system were developed by Southern Highlands Reserve (SHR) to increase both production and transplant success.

Red Spruce Production

Spruce cones are collected throughout the Southern Appalachians in early September and stored in brown paper bags until they mature and dry (Fig. 2).

Seeds are removed from the cones and germinated in a propagation flat (Fig. 3).

Following germination and root development, seedlings are transplanted into a 2" Rootmaker® 32-count tray with a bark-based substrate and grown for an additional six to nine months until roots are fully developed (Fig. 4).

Finally, seedlings are transplanted into 1gal. Rootmaker® pots utilizing bark-based substrate and top-dressed with slow release fertilizer. Plants are grown for an additional one to two years until 12 to 18 inches tall (Fig. 5).

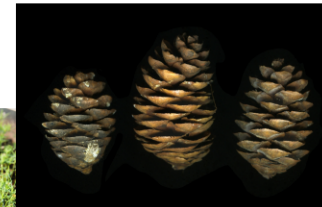


Fig 2. Red spruce cones

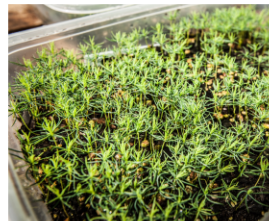


Fig 3. Red spruce seedlings



Fig 4. Two inch sapling

Fig 5. Transplanting into one gallon containers

Planting



When trees are ready to be planted, sites are identified and labor is mustered for the job. The year 2017 saw multiple large plantings. One occurred on the Pisgah National Forest, near the popular Black Balsam. Staff from the USFWS, USFS, NCWRC; volunteers from non-profit conservancies and agencies; local residents; and students from area community colleges and universities put over 900 trees in the ground.

Conclusion

Utilizing this system, success rates for both production and restoration have a 90% reported success rate. Other contributing factors include elevation, topography, and climate of the production site, mimicking conditions at final restoration sites, and thereby reducing transplant shock. Further research into production techniques and population genetics-based hardiness of *Picea rubens* would further elucidate the production and restoration process.



Join Us!

Want to learn more or contribute to red spruce restoration, production, and research? Contact Lauren Garcia Chance: lgchance@southernhighlandsreserve.org