# Spruce-fir Moss Spider: Another Beneficiary of Spruce/Fir Restoration


*Sue Cameron*
*US Fish & Wildlife Service*
*Aug. 22, 2013*

# Background

- Fir and spruce-fir forests important to many species including several that are endemic to high elevation forests of the southern Appalachians
- Two such species are federally listed as endangered
  - Carolina northern flying squirrel
  - **Spruce-fir moss spider**



# 2012 Spruce-fir Moss Spider Recovery Meeting

**Objectives:**

- Provide forum for information sharing
  - Review population status, threats, research and monitoring results, recovery actions
- Create a stakeholder-generated list of specific and prioritized recovery action items
  - Spruce-fir restoration identified as a need
  - First need to examine habitat quality and identify potential areas for restoration

# Spruce-fir Moss Spider Timeline

**1925:** spruce-fir moss spider described (Crosby & Bishop)

**1981:** paper redescribing spp. (Coyle)

**1985:** paper on mating behavior (Coyle)

**1989-1992:** declines observed at all known sites except Grandfather Mtn. (Harp)

**1989:** proposal submitted to list the species (Harp)

**1995:** spider listed as endangered

**1997:** status survey reveals viable pops in 4 areas of Mt LeConte

**1998:** recovery plan completed

**1999:** discovered on Roan Mtn during status survey (Coyle)

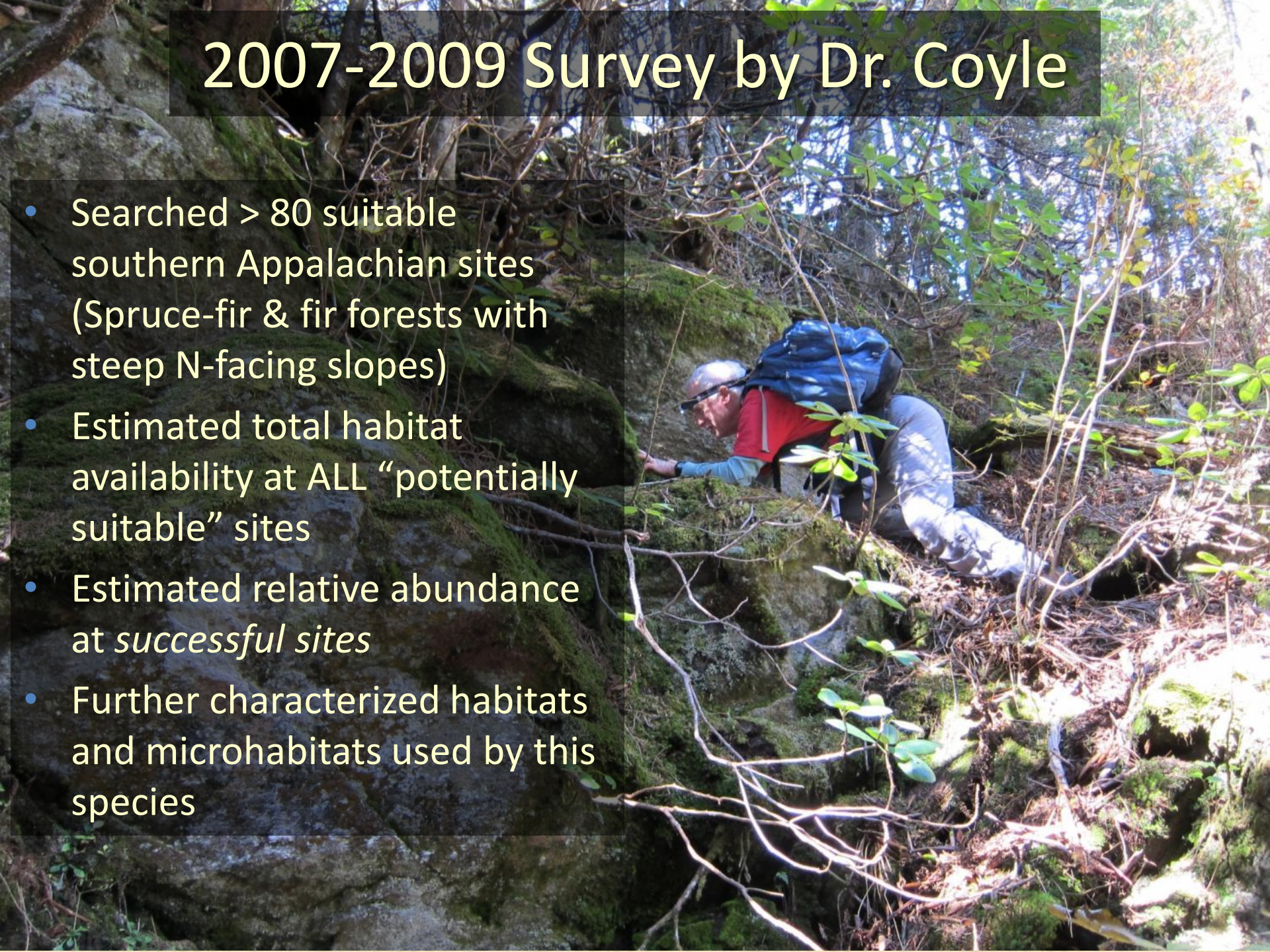
**2001:** critical habitat designated

**2004:** status survey in GSMNP increases # records from 7 to 15 locations (Coyle)

**2007-2009:** wide-ranging status survey reveals two more metapopulations (Coyle)

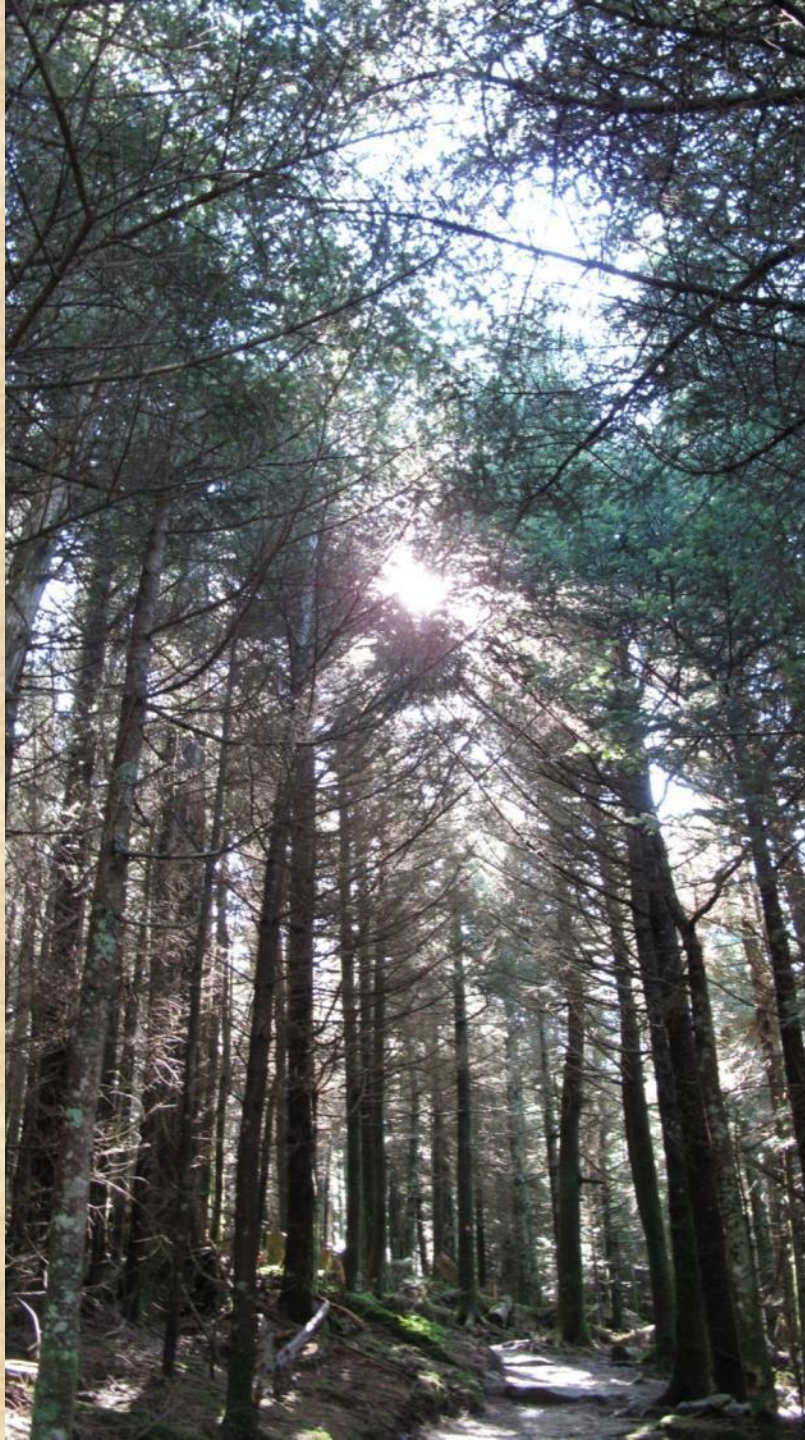
# 2007-2009 Survey by Dr. Coyle

- Searched > 80 suitable southern Appalachian sites (Spruce-fir & fir forests with steep N-facing slopes)
- Estimated total habitat availability at ALL “potentially suitable” sites
- Estimated relative abundance at *successful sites*
- Further characterized habitats and microhabitats used by this species



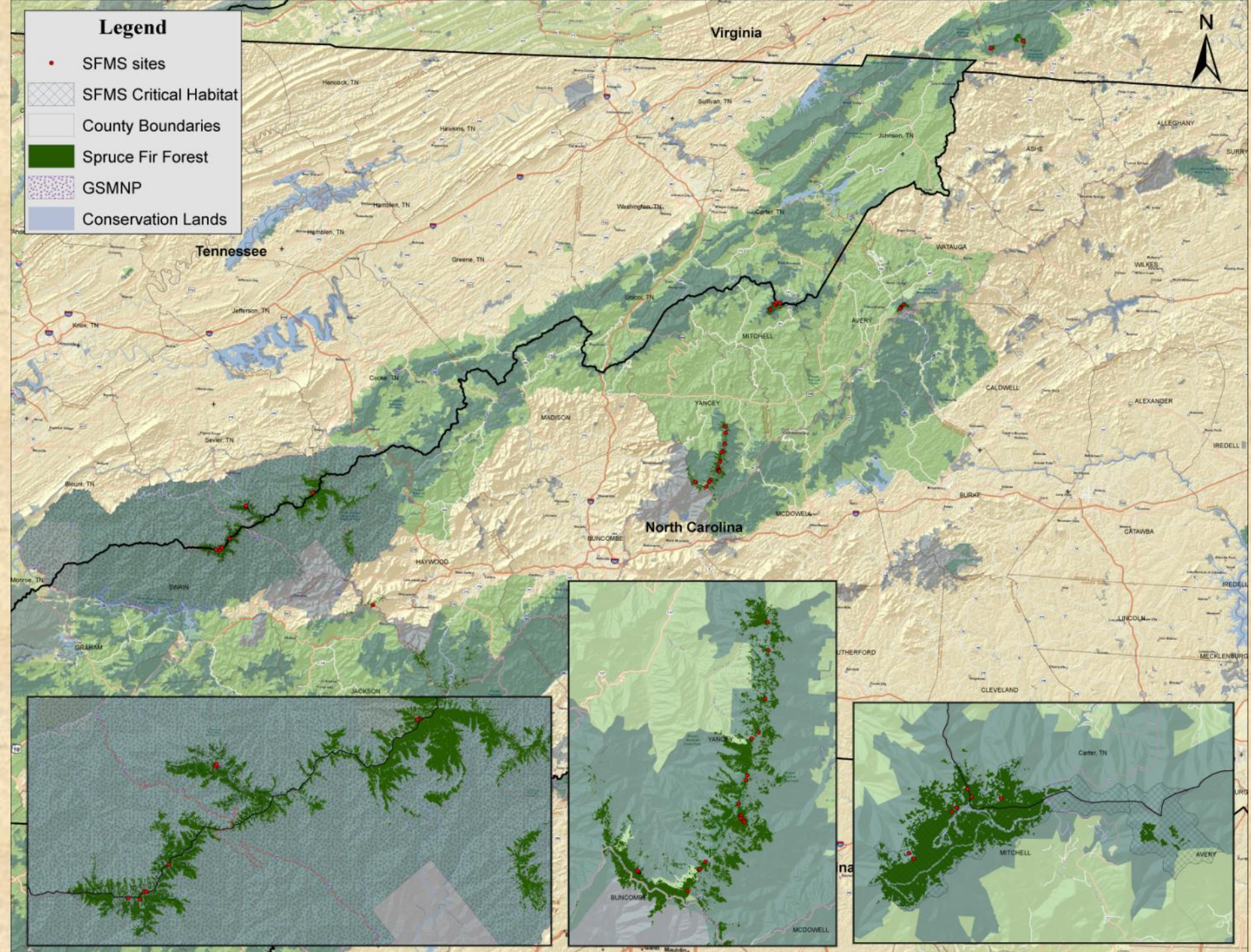
# 2007-2009 Survey Results

- Discovered populations on two new mountain ranges:  Plott Balsams and VA Whitetop
- 31 new locality records
- Number of known mountain peaks inhabited increased from 9 to 22
- Estimated a total of 255 hectares of suitable habitat in areas he visited in southwest VA, Grandfather Mtn., Roan Mtn. Black Mtns., Great Smoky Mtns., and Plott Balsams



# Distribution

- There were five known populations at the time of listing (Mt. Mitchell, Grandfather Mtn. and three in Great Smoky Mtns.)
- Today spider exists along six mountain massifs and these may represent six metapopulations (Virginia Balsams, Grandfather Mtn., Roan Mtn., Black Mtns., Plott Balsams and Great Smoky Mtns.)
- Failed to find the spider in WV or Great Balsams and little favorable habitat


Legend
SFMS sites
SFMS Critical Habitat
County Boundaries
Spruce Fir Forest
GSMNP
Conservation Lands
N
Virginia
Tennessee
North Carolina
Hancock, TN
Sullivan, TN
Hawkins, TN
Johnson, TN
Hamblen, TN
Washington, TN
Carter, TN
Greene, TN
Unicoi, TN
Jefferson, TN
Knox, TN
Cocke, TN
Sevier, TN
Blount, TN
Monroe, TN
SWAIN
GRAHAM
JACKSON
HAYWOOD
MADISON
YANCEY
MITCHELL
AVERY
WATAUGA
ASHE
ALLEGHANY
WILKES
ALEXANDER
CALDWELL
IREDELL
BURKE
CATAWBA
LINCOLN
CLEVELAND
MECKLENBURG
BUNCOMBE
MCDOWELL

# Habitat

- With few exceptions, the species lives on northerly facing rock outcrops in fir & spruce-fir zones
- Has been found at 5300-6600 feet in elevation
- Optimal habitat may be areas with old fir on north facing slopes

# Habitat & Microhabitat Requirements

- Most often found at interface of rock and moss in areas with humid, but well-drained bryophyte mats on sheltered, well-shaded rock outcrops
- **Fir is not necessary.** Favorable microclimates can be provided by shading by other trees or shrubs or the outcrops themselves

# Habitat & Microhabitat Requirements

- The preferred microhabitat is under or inside bryophyte mats dominated by *Dicranodontium* moss and/or *Bazannia* liverworts (75% of spiders were associated with such mats)

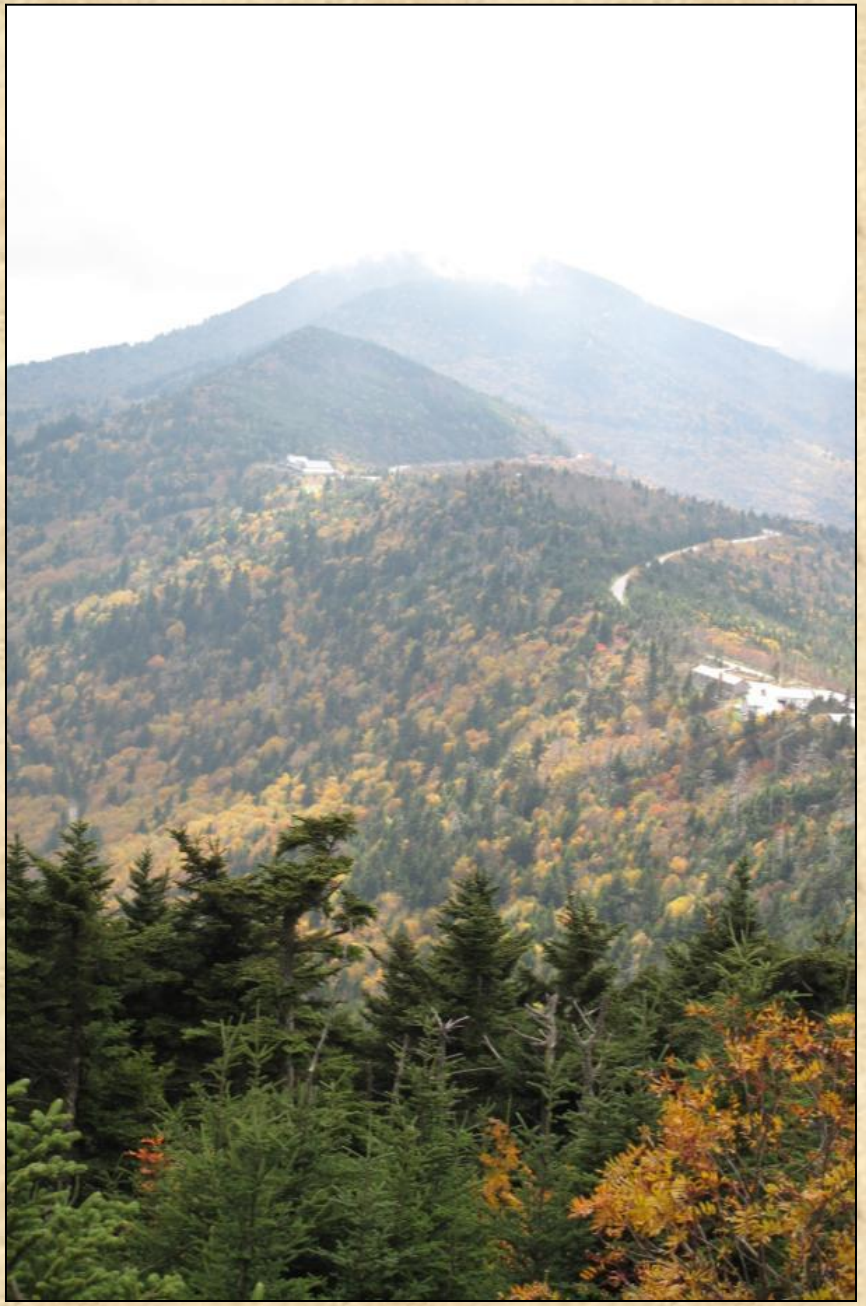
# Habitat & Microhabitat Requirements

The mystery of Mt. Rogers and Whitetop:

- Spider absent from Mt. Rogers despite a large area of favorable habitat & microhabitat; this site should be considered in any attempt to increase the number of populations
- Found in pure red spruce on Whitetop; no fir at this site

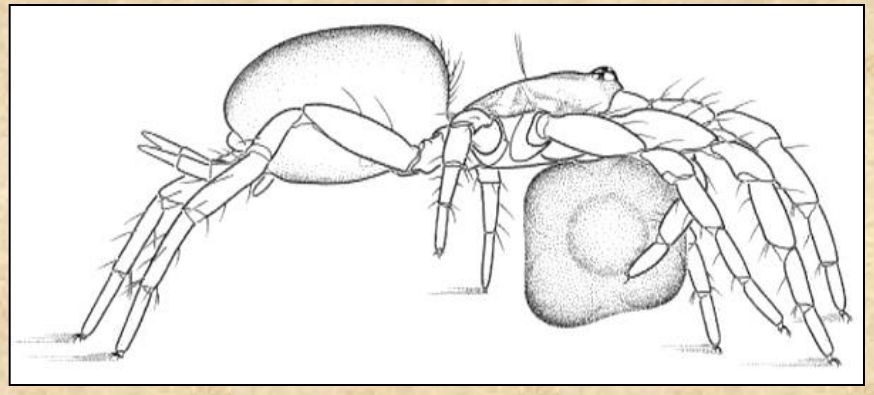
# Population Sizes

- Healthiest pops are in Black Mtns. & Great Smoky Mtns. (high relative abundance and largest areas of favorable habitat)
- The most precarious pops are in VA (low relative abundance) & Plott Balsams (little favorable habitat)
- No evidence of major pop declines in past 5-10 years



# Life History

- Take 3-4 years to reach sexual maturity
- 5-8 eggs per year
- Has tubular silk retreat under bryophyte mats
- Females show parental care
- Diet? (spring-tails & mites?)
- Aerial dispersal?



# Threats to Continued Existence

- Loss of Fraser fir and red spruce
  - Forest pests
  - Air pollution
  - Past land use practices
  - Climate change

# Spruce-fir Forests in Recent Decline

TIME

**1920s** Logging

**1950s** Balsam Woolly Adelgid
Air Pollution

**now** Climate Change

- Fraser fir considered globally imperiled (NatureServe G2)
- soAPP spruce-fir forests *second most endangered* ecosystem type in United States (Noss & Peters 1995)

*from Hedin 2013 AAS Mtg. Presentation*

# Threats to Continued Existence

- Loss of Fraser fir and red spruce
  - Forest pests
  - Air pollution
  - Past land use practices
  - Climate change
- Trampling as a result of recreation and other disturbances
- Residential and recreational development
- Habitat fragmentation – small/isolated populations (concerns over genetic health, catastrophic events)

# 2012 Spruce-fir Moss Spider Recovery Meeting

**Objectives:**

- Provide forum for information sharing
- Create a stakeholder-generated list of specific and prioritized recovery action items
  - Two additional actions were identified as high priority during meeting – genetics work and microclimate work

# Current Research

**Genetics**

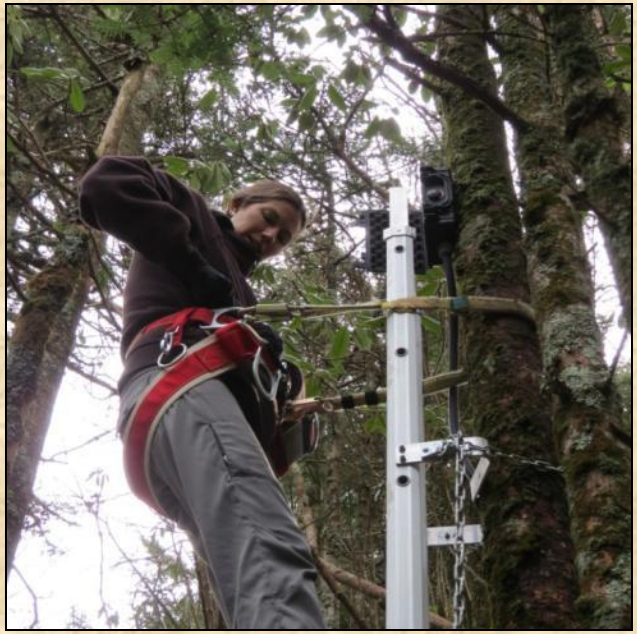
Dr. Marshal Hedin at SDSU, Dr. Fred Coyle and Dr. Jason Bond at Auburn

- Do males & females show similar patterns of gene flow & genetic structuring?
- Mountain *ranges* are expected to be genetically unique, *outcrops within ranges* less so. Is this prediction verified?
- => Ultimately, use data to inform conservation decisions, particularly in face of environmental change.

# Current Research

## Microclimate

- Graduate student at WCU looking at conditions within moss mats using ibuttons
- USFWS placing HOBO data loggers at spider sites



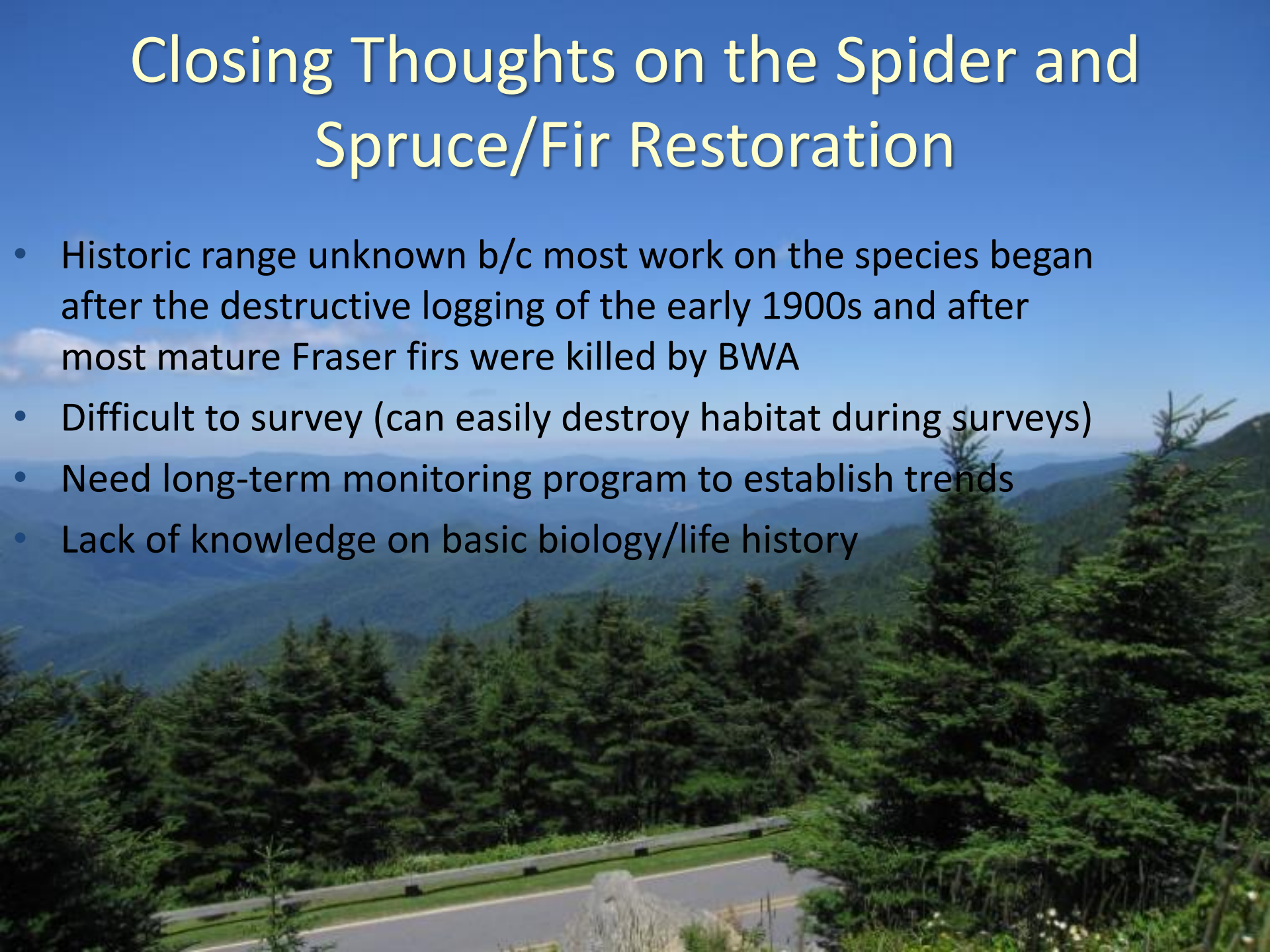
# Current Research

## Moss Propagation

- Great Smoky Mountains NP and University of TN (Jennifer Franklin and Doug Kaylor) working on moss propagation
  - Three selected sites near Clingmans Dome have been planted with moss propagated in situ
  - Lab moss propagation is underway in the incubators at UT

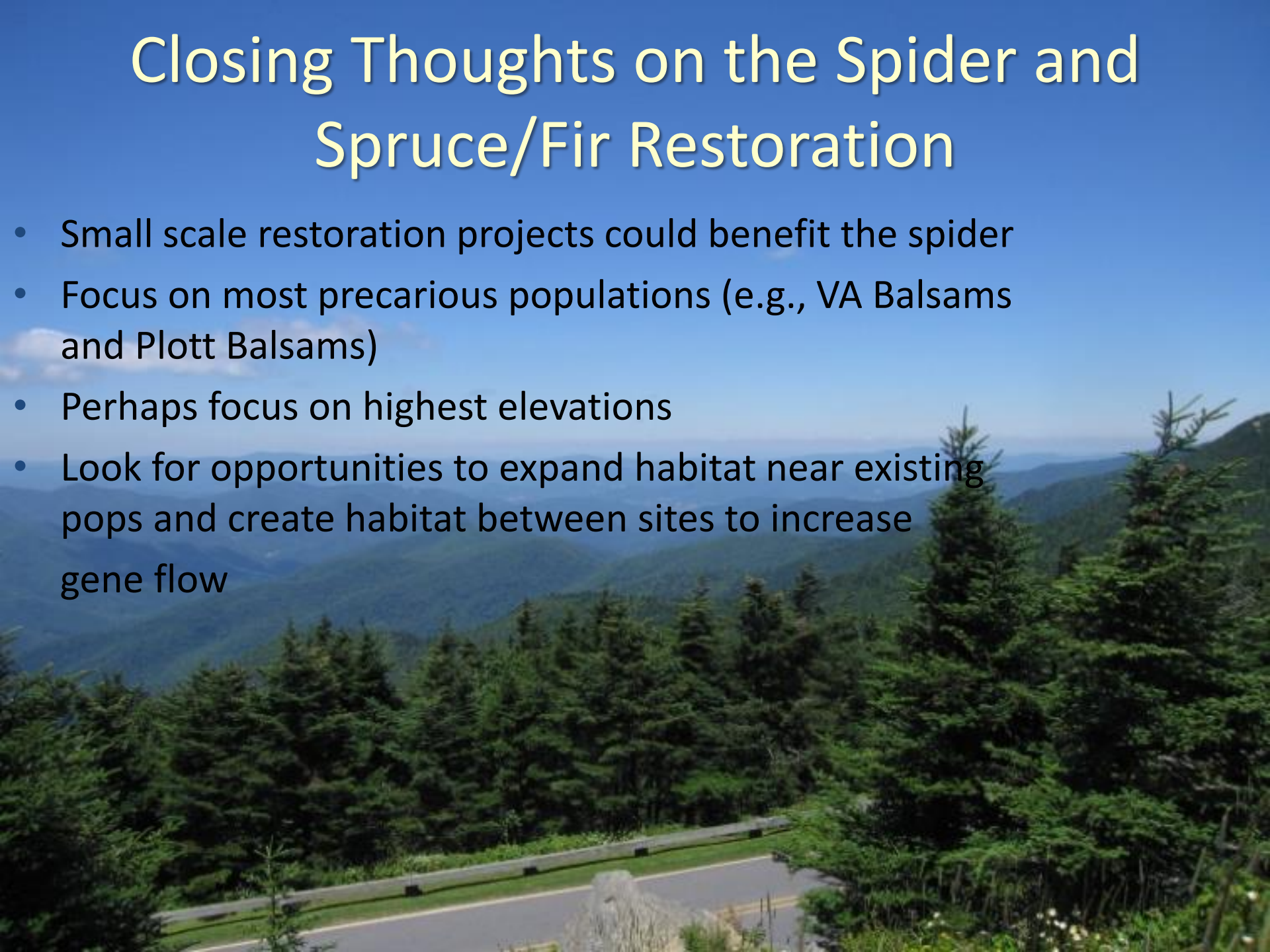
# Closing Thoughts on the Spider and Spruce/Fir Restoration

- Historic range unknown b/c most work on the species began after the destructive logging of the early 1900s and after most mature Fraser firs were killed by BWA
- Difficult to survey (can easily destroy habitat during surveys)
- Need long-term monitoring program to establish trends
- Lack of knowledge on basic biology/life history



# Closing Thoughts on the Spider and Spruce/Fir Restoration

- Small scale restoration projects could benefit the spider
- Focus on most precarious populations (e.g., VA Balsams and Plott Balsams)
- Perhaps focus on highest elevations
- Look for opportunities to expand habitat near existing pops and create habitat between sites to increase gene flow




Questions?