



# What's Next for Reclamation?

## Joint Conference

April 9 - 13, 2017

Morgantown, WV

April 9-13, 2017

Morgantown, WV

# Appalachian Regional Reforestation Initiative History; Goals; Accomplishments, Future

**Jim Burger**

Professor Emeritus, Forestry and Soil Science, Virginia Tech

**Patrick Angel**

Senior Forester/Soil Scientist, OSMRE

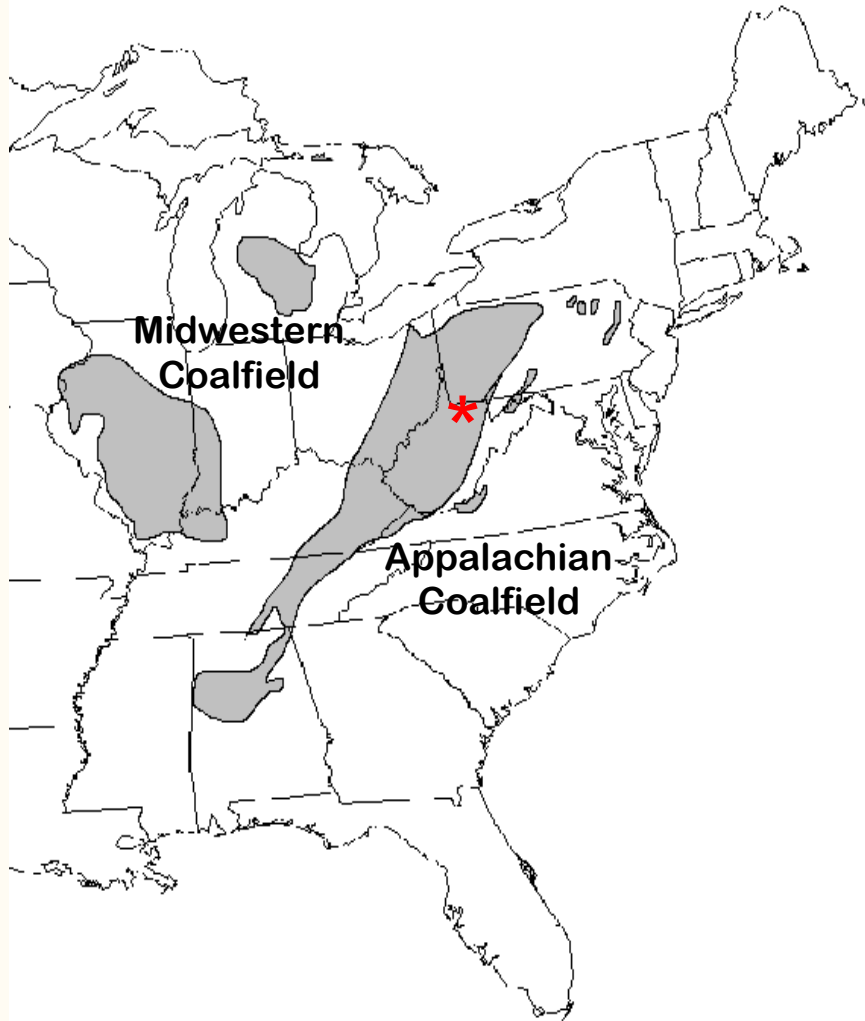
**Carl Zipper**

Professor, Crop and Soil Environmental Sciences, Virginia Tech



OFFICE of SURFACE MINING  
RECLAMATION and ENFORCEMENT  
U.S. Department of the Interior

# Eastern United States Coalfield Regions



## Native Hardwood Forest



## Surface Mining for Coal



1.4 million acres disturbed by mining  
in the Appalachian Region

# Appalachian Forestry Statistics

American Forest and Paper Asso. (2016)

(<http://www.afandpa.org/>)

## Wood Products

- PA, VA, MD, WV, KY, TN, OH
- 1,320 manufacturing facilities
- 190,200 people employed in forest industry
- Economic output: \$54 billion annually





# Forest Products & Services

- Wood Products
- Forest Services
  - Water quality & yield
  - Flood control
  - Carbon sequestration
  - Biodiversity
  - Wildlife habitat
  - Cultural uses

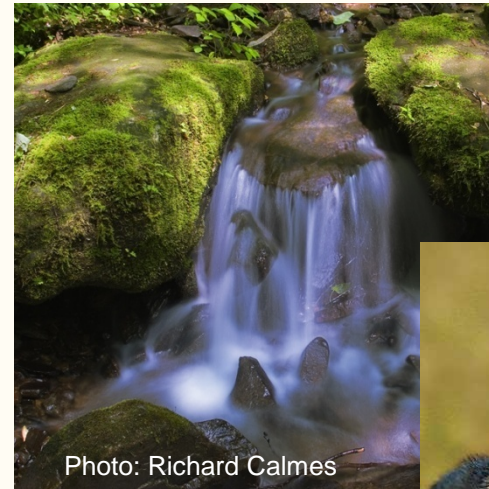


Photo: Richard Calmes

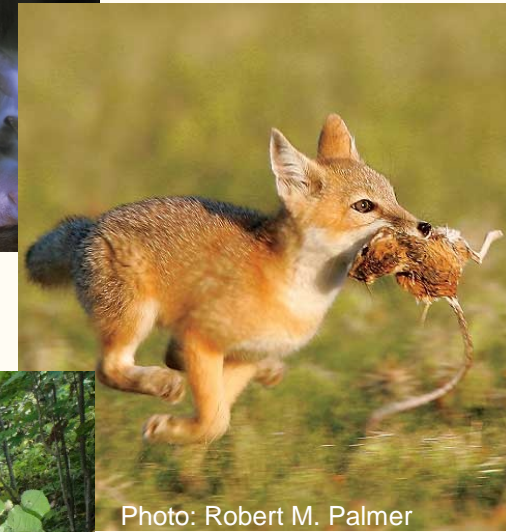


Photo: Robert M. Palmer



Photo: Bob Beyfuss

Constanza et al. 1997. Value of ecosystem services. *Nature*  
**(3 X products)**

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# Office of Surface Mining Created: Appalachian Regional Reforestation Initiative (ARRI)



- **Goal:** Restore diverse, native hardwood forests on mined land
  - **How:** Use best reforestation practices:
    - **“Forestry Reclamation Approach”**
-

# Appalachian Regional Reforestation Initiative (began 2004)

- **Cooperative effort among**
  - U. S. Office of Surface Mining
  - State regulatory agencies
  - University & agency scientists
  - Coal industry
  - Non-governmental organizations





# ARRI Accomplishments (2005-2016)

## ■ Active mines

- ❑ Over 108 million trees planted on 159,000 acres
- ❑ Equivalent to 43% of the 430,000 acres of land reclaimed and bond-released





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**Wow!**

**Remarkable!**

**Amazing!**

# Early Reclamation History: pre-SMCRA

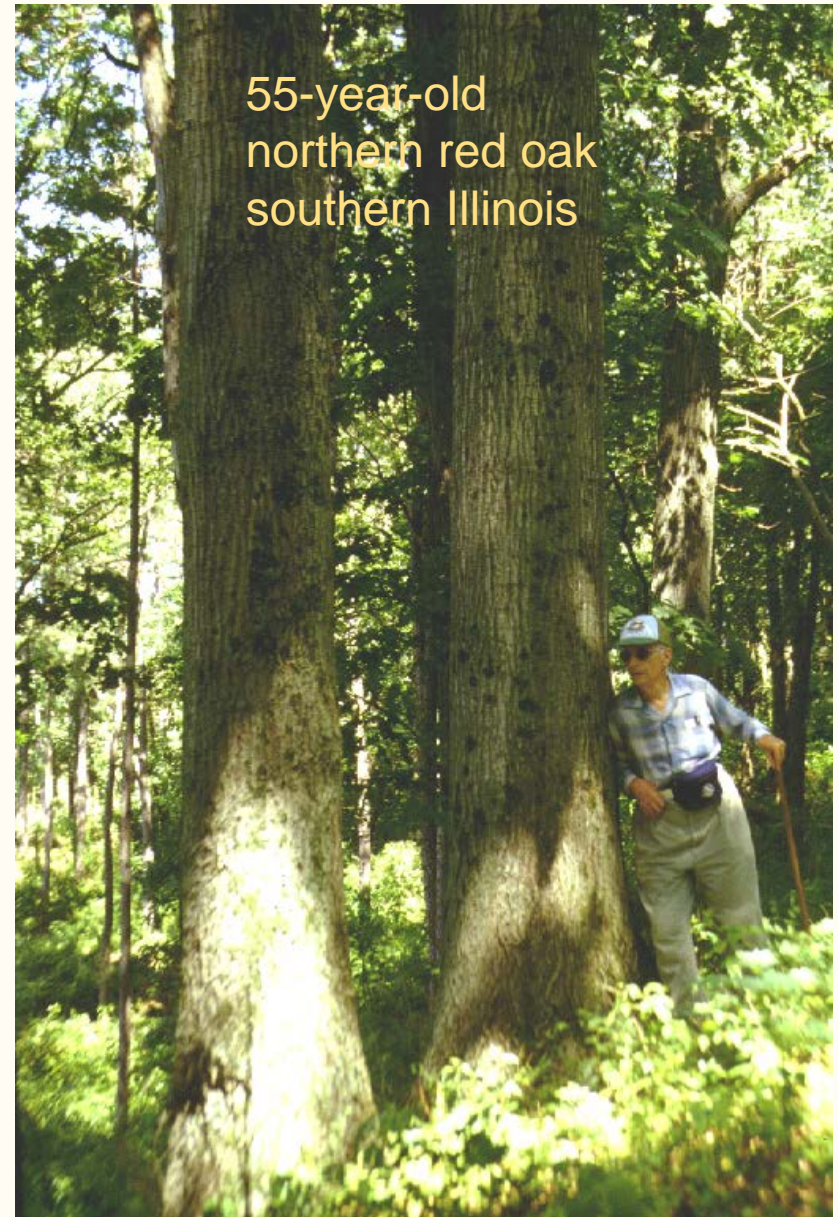
- **1928**, Indiana: first organized reforestation program begun
- **1939-1966**, most Appalachian and Mid-Continent states passed rudimentary reclamation laws
- Land **reclamation** and **tree planting** were almost **synonymous terms**
- State coal operator associations **enlisted aid of forestry researchers** (US For. Serv. , Ag. Res. Serv., Univ. Depts., Soil Conserv. Serv., TVA)
- **Mix** of successes and failures

(Medvick, 1980)





## Examples of Pre-SMCRA reforestation on un-graded overburden





**U. S. Surface Mining Control and Reclamation Act--1977**





## U. S. Surface Mining Control and Reclamation Act--1977

- Eliminate high walls, pits, subsidence--**yes**
- Improve human health and safety—**yes**
- Control sediment, acid mine drainage--**yes**
- Rebuild landscape to approximate original contour--**somewhat**
- Protect water quality, total salts--**somewhat**
- Restore land capability/productivity—**mostly no**

Mine operators “---shall return the land to its pre-mining use and capability.”

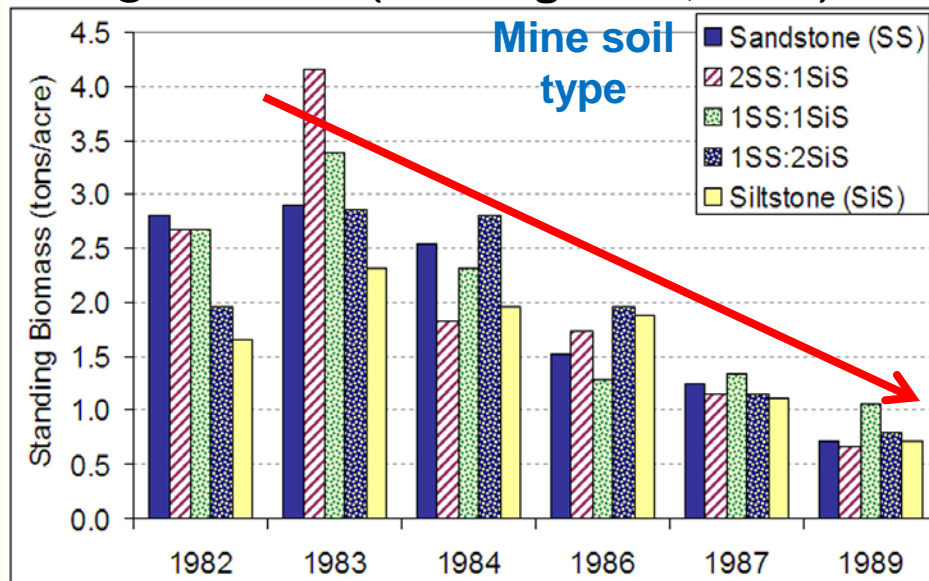




# Grassland Replacement Approach 1978-2005



Forage decline (Haering et al., 1990).

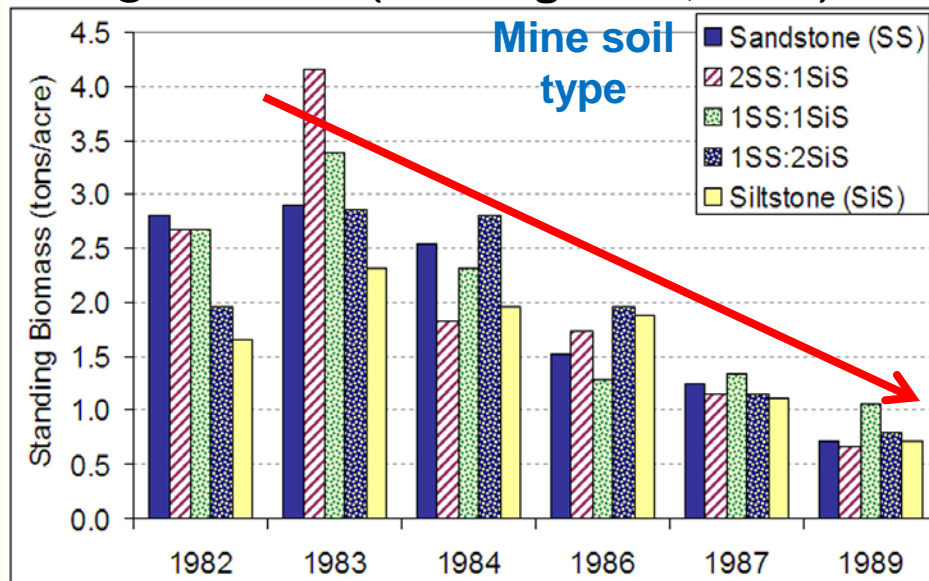




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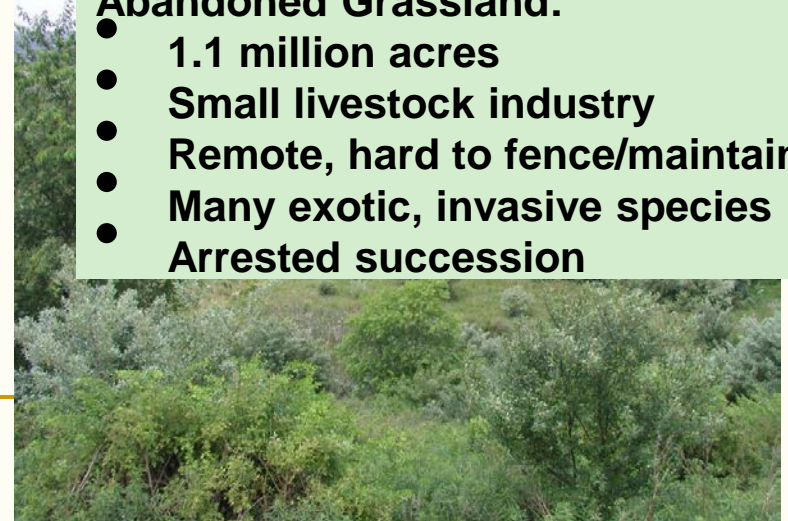


**Forage decline (Haering et al., 1990).**



## Abandoned Grassland:

- 1.1 million acres
- Small livestock industry
- Remote, hard to fence/maintain
- Many exotic, invasive species
- Arrested succession



20 years after tree planting in compacted mine soils with competitive ground cover





20 years after tree planting in compacted mine soils with competitive ground cover



**Mining community came under pressure  
to do something different**



# Mined Land Reclamation Research

- Goal: Post-Law Environment:  
Develop methods for restoring **land productivity** and **native forests** on mined land



# Mined Land Reclamation Research

- Goal: Post-Law Environment:  
Develop methods for restoring **land productivity** and **native forests** on mined land
- Science:  
Research in 7 Appalachian & Midwestern states
  - 30 years, 32 experimental sites
  - 17 M. S. and Ph. D. Theses
  - 100+ research publications
  - 15 extension publications
  - Numerous field trips and workshops
- Outcome:  
**Best Management Practices for Mined Land Reforestation**



Jim Burger



“Forestry Reclamation Approach”



Virginia Tech Univ.



# Reforestation Research Programs

Univ. Kentucky



Ohio University



West Virginia Univ.



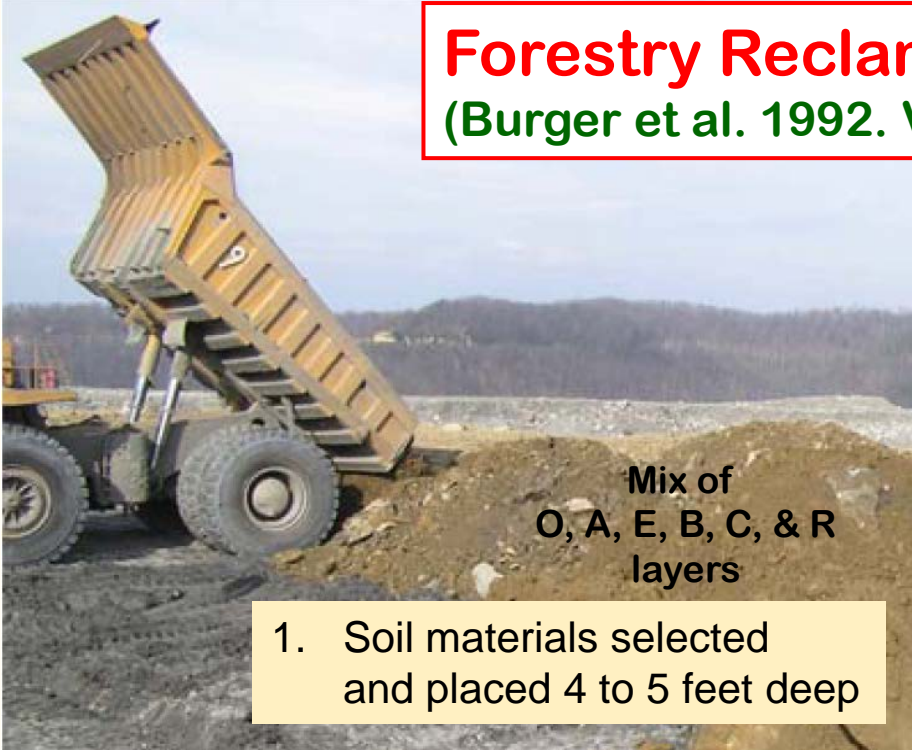
Univ. Tennessee





# Forestry Reclamation Approach

(Burger et al. 1992. VT Coop. Ext. Bull.)





**ARRI  
Science Team**

**Landowner**

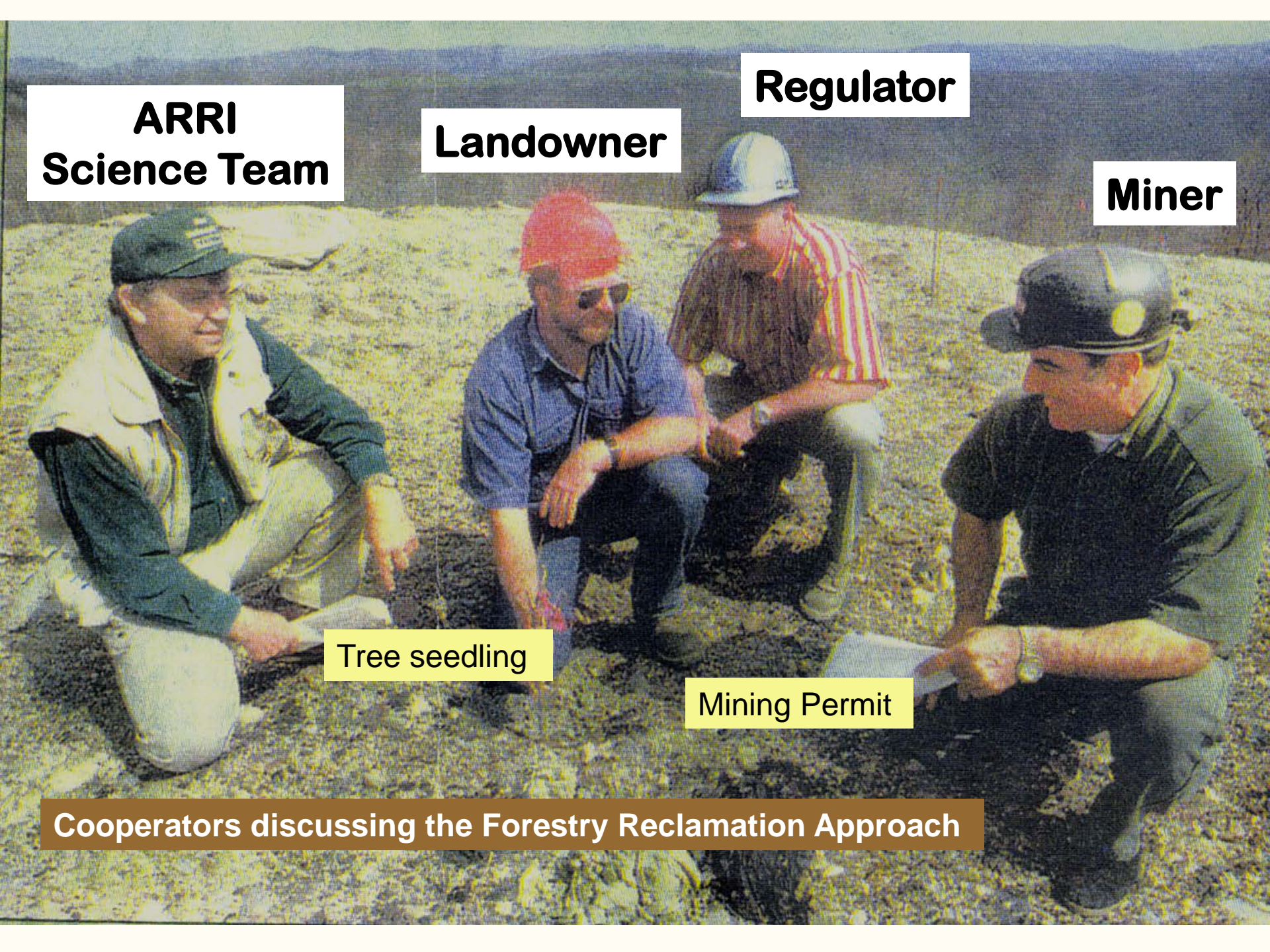
**Regulator**

**Miner**

**Tree seedling**

**Mining Permit**

**Cooperators discussing the Forestry Reclamation Approach**





# Office of Surface Mining Field Foresters

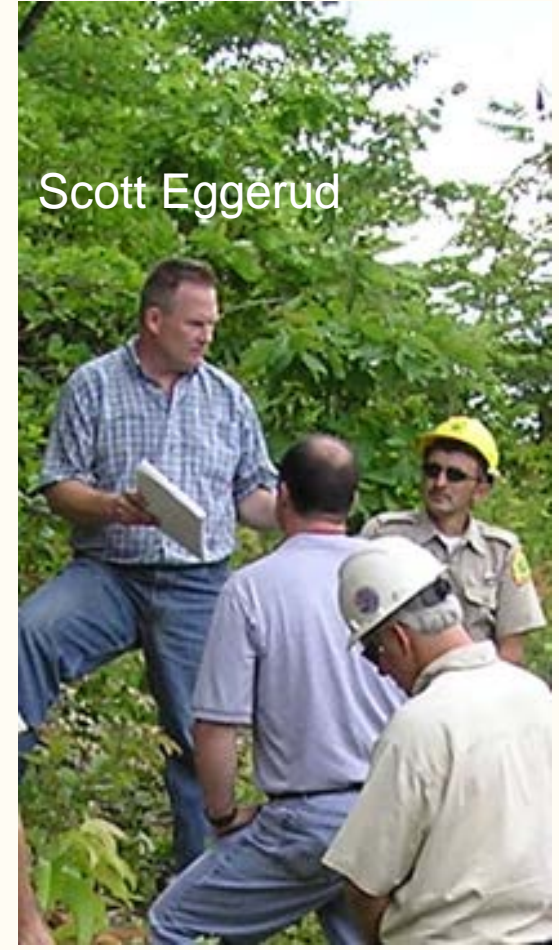
Patrick Angel



Victor Davis

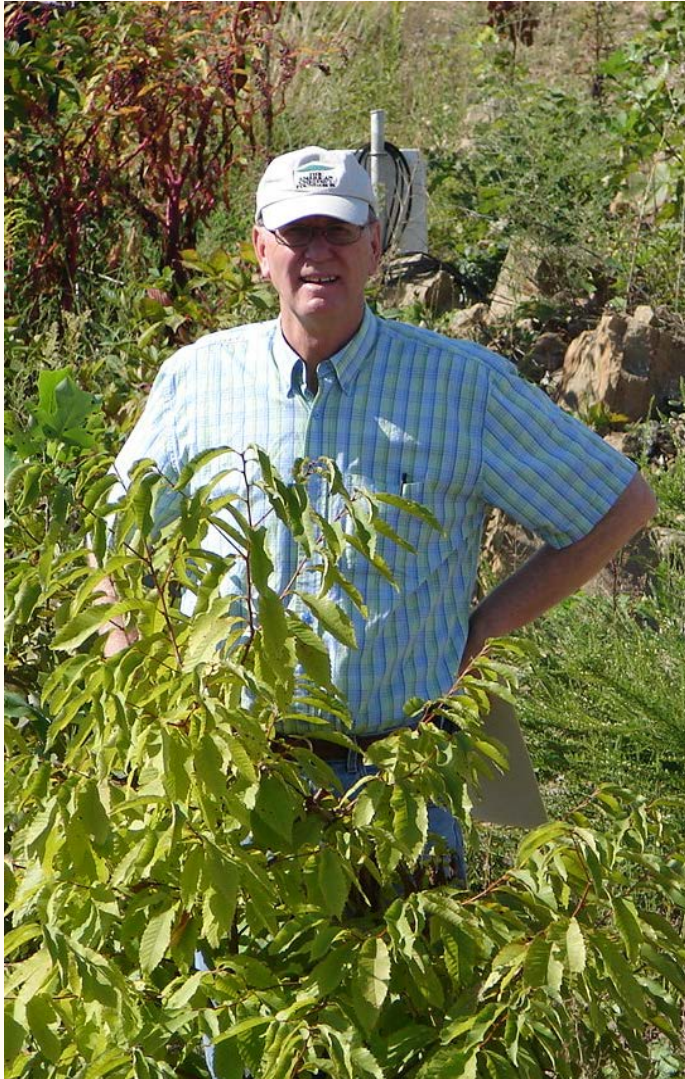


Scott Eggerud



# OSM Directors and colleagues provided vision and leadership for establishing ARRI

Brent Wahlquist



Joseph Pizarchik



## More OSM ARRI Champions:

- Mike Bower
- Jim Tate
- Lois Uranowski
- Tom Shope



# “Alignment of the Planets”

- Public pressure for reforestation
- Admission by OSM that abandoned grasslands covered by invasive species was not in the interest of any stakeholder
- Demonstrated success and cost-effectiveness of the **Forestry Reclamation Approach**
- Advocacy by forestry-trained OSM employees
- Vision and leadership by successive OSM Directors

# Appalachian Regional Reforestation Initiative (began 2004)

- **Core Agency Team**
  - U. S. Office of Surface Mining
  - State regulatory agencies
- **Science Team**
  - University & agency scientists





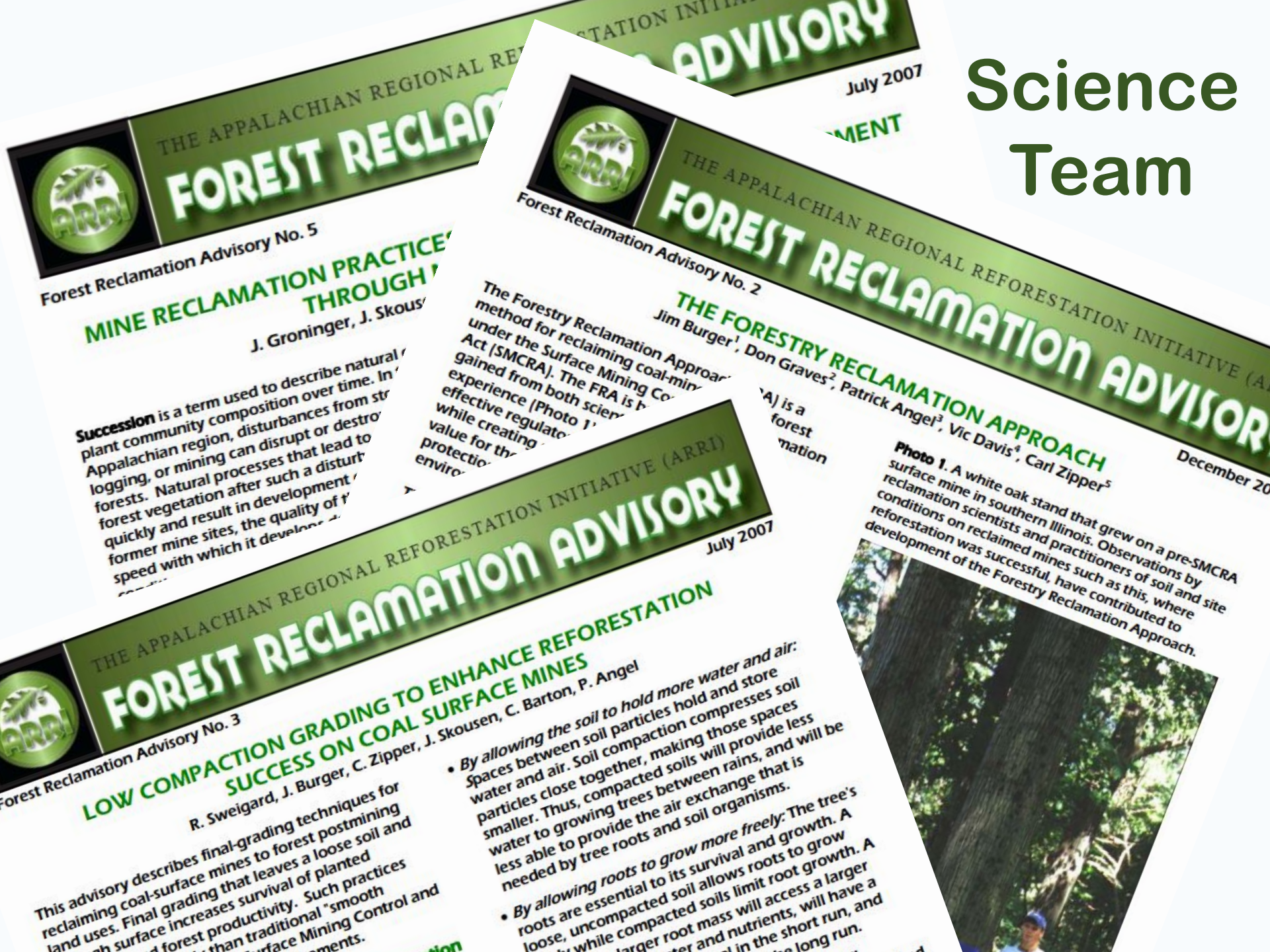
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# **Core Team:**

## **OSM and State regulators**

- **Studied and implemented rules changes encouraging reforestation**
  - **Held tech transfer sessions with coal operators and inspectors**
  - **Sponsored & held Arbor Day events**
  - **Judged and presented reclamation awards to coal operators**
  - **Held an annual ARRI conference updating reforestation progress**
-

# Science Team



## THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE (ARRI) FOREST RECLAMATION ADVISORY

July 2007

Forest Reclamation Advisory No. 5

### MINE RECLAMATION PRACTICES THROUGH SUCCESSION

J. Groninger, J. Skousen

**Succession** is a term used to describe natural plant community composition over time. In the Appalachian region, disturbances from strip logging, or mining can disrupt or destroy forests. Natural processes that lead to forest vegetation after such a disturbance quickly and result in development of former mine sites, the quality of the soil and the speed with which it develops.



## THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE (ARRI) FOREST RECLAMATION ADVISORY

MENT

Forest Reclamation Advisory No. 2

### THE FORESTRY RECLAMATION APPROACH

Jim Burger<sup>1</sup>, Don Graves<sup>2</sup>, Patrick Angel<sup>3</sup>, Vic Davis<sup>4</sup>, Carl Zipper<sup>5</sup>

December 2007

The Forestry Reclamation Approach is a method for reclaiming coal-mining sites under the Surface Mining Control and Reclamation Act (SMCRA). The FRA is based on experience from both scientific and practical (Photo 1) and has been an effective regulatory tool while creating value for the land and protecting the environment.

**Photo 1.** A white oak stand that grew on a pre-SMCRA surface mine in southern Illinois. Observations by reclamation scientists and practitioners of soil and site conditions on reclaimed mines such as this, where reforestation was successful, have contributed to development of the Forestry Reclamation Approach.



## THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE (ARRI) FOREST RECLAMATION ADVISORY

July 2007

Forest Reclamation Advisory No. 3

### LOW COMPACTION GRADING TO ENHANCE REFORESTATION SUCCESS ON COAL SURFACE MINES

R. Sweigard, J. Burger, C. Zipper, J. Skousen, C. Barton, P. Angel

This advisory describes final-grading techniques for reclaiming coal-surface mines to forest postmining land uses. Final grading that leaves a loose soil and rough surface increases survival of planted trees and forest productivity. Such practices are more effective than traditional "smooth" final grading. Surface Mining Control and Reclamation Act (SMCRA) requirements.

- *By allowing the soil to hold more water and air:* Spaces between soil particles hold and store water and air. Soil compaction compresses soil particles close together, making those spaces smaller. Thus, compacted soils will provide less water to growing trees between rains, and will be less able to provide the air exchange that is needed by tree roots and soil organisms.
- *By allowing roots to grow more freely:* The tree's roots are essential to its survival and growth. A loose, uncompacted soil allows roots to grow more freely, while compacted soils limit root growth. A larger root mass will access a larger volume of water and nutrients, will have a greater impact in the short run, and will be more resilient in the long run.



# Science Team

## Forestry Reclamation Advisories

- ARRI goals and objectives
- FRA methods and techniques
- Low compaction grading
- Soil selection and placement
- Tillage techniques for compacted mine soils
- Non-competitive ground covers
- Tree planting techniques
- Tree species selection
- Habitat for wildlife
- Planting legacy lands
- American chestnut recovery on mined land
- Tree/shrub selection Midwest Region
- Natural succession principles
- Pollinator habitat creation on mined lands



**Succession** is a term used to describe natural plant community composition over time. In the Appalachian region, disturbances from strip mining, logging, or mining can disrupt or destroy forests. Natural processes that lead to forest vegetation after such a disturbance quickly and result in development of former mine sites, the quality of the soil and the speed with which it develops.



This advisory describes final-grading techniques for reclaiming coal-surface mines to forest postmining land uses. Final grading that leaves a loose soil and a smooth surface increases survival of planted trees and forest productivity. Such practices are more productive than traditional "smooth surface" grading. This advisory is part of the Surface Mining Control and Reclamation Act of 1977.



**Scott Eggerud  
Office of Surface Mining Forester  
With Coal Operators**



**Tech Transfer  
Outreach  
Field Trips  
Conferences**







**Dr. Carl Zipper**

**Director Powell River Project  
With VA State inspectors**



APPALACHIAN REGIONAL REFORESTATION INITIATIVE



## 2013 ARRI Conference in Flatwoods West Virginia

Hosted by West Virginia Univ. & WV Dept. Environmental Protection

Photos by Dr. Jeff Skousen





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# Forestry Reclamation Approach

## Benefits to Industry

- **Reduced costs**
  - ❑ Virtually eliminated perimeter ditch and sediment pond cleanout
  - ❑ Much less dozer grading
  - ❑ Less fertilizer and grass seed
  - ❑ Faster bond release
- **Social license to operate**
  - ❑ More favorable outcomes from hearing officers/judges
  - ❑ Greater value for landowners
  - ❑ Arbor Day sponsorship etc.
  - ❑ Public good will





# Outcome:

## APPALACHIAN REGIONAL REFORESTATION INITIATIVE



## ARRI Regional Excellence in Reforestation Award



**Tom Shope presenting the Regional Excellence Award to Fola personnel. Left to right: Eric McGlothlin, Superintendent Fola Operations; Mike Brown, Mine Planning Engineer; Fola Operations, Davis Bays, Compliance Engineer, Fola Operations and Tom Shope, Appalachian Regional Director, Office of Surface Mining.**

# Excellence in Reforestation Awards: Industry Operators

<http://arri.osmre.gov>



## DRC Coal, LLC wins the Regional ARRI Excellence in Reforestation Award

by: Chris Miller, OSMRE



At right: Dave Hartos (left, Deputy Regional Director, OSMRE) presents Dean Chambers (middle, Reclamation Supervisor, DRC Coal, LLC) and Phil Boggs (right, engineering consultant, Mark V Mining and Engineering, Inc.) the Regional ARRI – Excellence in Reforestation Award.





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## ■ Legacy Mines

- ❑ Laid groundwork for:
- ❑ **Green Forests Work, [501(c) (3)]**
- ❑ Directed by Dr. Chris Barton, University of Kentucky
- ❑ Managed by Michael French & others



# Green Forests Work (2009-2016)

<http://www.greenforestswork.org/>

- Partners with coal operators, agencies, watershed groups, land owners, universities, school groups & others
- 260 planting projects
- 1,358 partner organizations
- 13,841 volunteers
- 1,831,000 trees planted



GREEN  
FORESTS  
WORK

a non-profit organization





**ARRI Outcomes:**  
Diverse, native, species  
on high quality sites





## Outcome: Restored land capability

*White pine* on mined land  
Site Index 120 ft at age 50

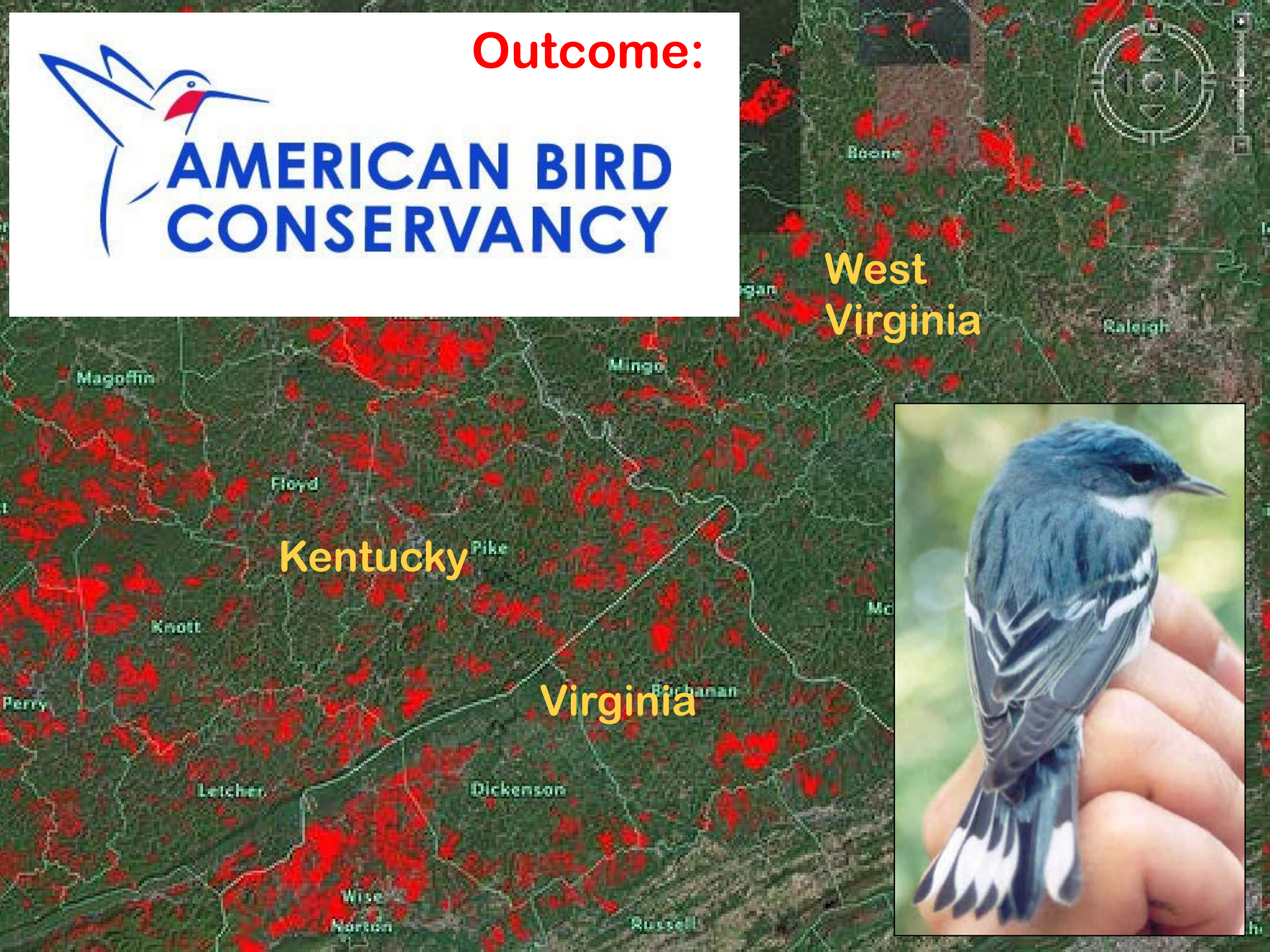






**AMERICAN BIRD  
CONSERVANCY**

**Outcome:**



**West  
Virginia**

**Kentucky**

**Virginia**



# Outcome: Species Recovery and Preservation



OFFICE OF THE SECRETARY  
**U.S. Department  
of the Interior**

[www.doi.gov](http://www.doi.gov)

## News Release

WASHINGTON, D.C.

May 5, 2011

--Secretary of the Interior Ken Salazar announced:

**Presidential Migratory Bird  
Federal Stewardship Award**

In recognition of OSM's  
Appalachian Regional Reforestation Initiative.



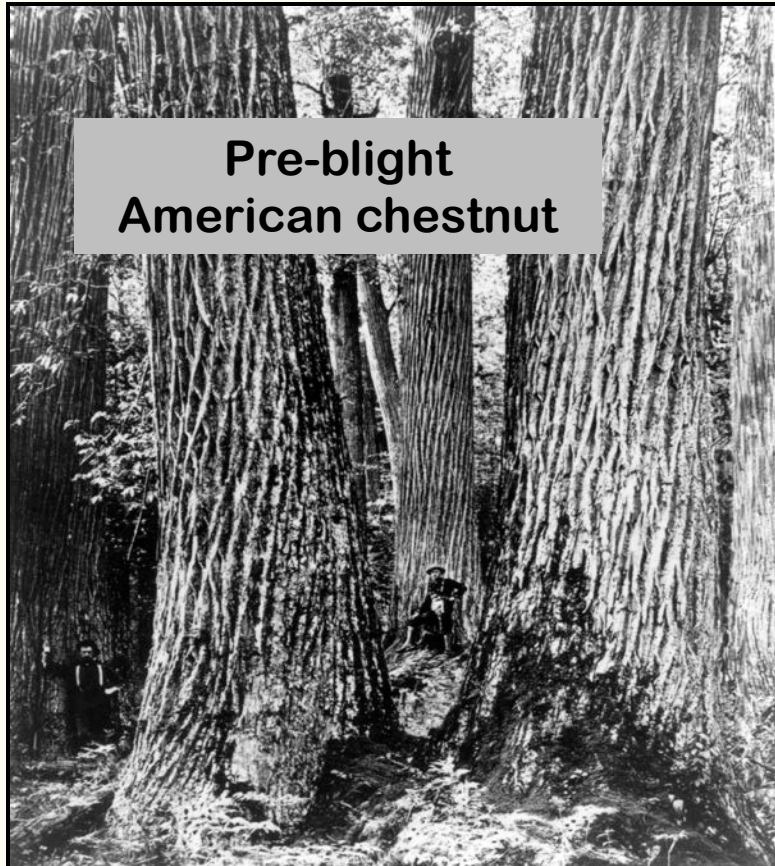
**Cerulean Warbler**



# Outcome: American Chestnut Restoration

## “Operation Springboard”

- The American Chestnut Foundation
- The National Mining Association
- Appalachian Regional Reforestation Initiative



Pre-blight  
American chestnut



One-year-old Chestnut hybrid  
on mined land



# Forest Lands Leadership Award (2011)





# ARRI's Flight 93 Reforestation Project

Wins Dept. of Interior's Partners in Conservation Award (2013)

## ■ Tree planting

- ❑ 125 acres planted
- ❑ 90,000 trees
- ❑ 20 native species

## ■ Cooperators

- ❑ 1,500 volunteer planters
- ❑ PA Bureau of Forestry
- ❑ Green Forests Work
- ❑ Arborgen
- ❑ Am. Chestnut Foundation
- ❑ Office Surface Mining
- ❑ Other ARRI Partners





# What's Next for Reclamation?

## Joint Conference

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# Ecosystem Reclamation Approach

## Geomorphic landform design



## Replace topsoil



## Stream reconstruction



## Reforestation





*“Those who plant trees love others besides themselves.”*

----Thomas Fuller

