

**“Forest Decline in the Southeastern United States: Assessment of the State of the Science”**  
**June 5-6, 2007 ♦ Atlanta, GA**  
**Workshop Report**

## **Background**

**Hal Balbach (US Army Engineer Research and Development Center)**

### **Forest Health and RCW Habitat Requirements: Why is Fort Benning Concerned?**

Fort Benning is concerned about the function of the forests in supporting endangered species, particularly the Red Cockaded Woodpecker (RCW). At Fort Benning, a majority of the RCW cavities use loblolly pine, and anecdotal observations suggest that too many mature loblolly pines are dying. Younger trees and longleaf pine may also be affected. Possible explanations for the health problem being seen at Fort Benning include:

- Pre-military land use history – agriculture (loss of topsoil, row crop farming on poor soils, nutrient depletion), commercial logging and railroads
- Military training disturbance – removal of soil materials
- Shortleaf pine decline/littleleaf disease – the symptoms seem to match but the causes may not be identical
- Beetle infestation and pathogen outbreak
- Poor soil quality – inadequate soil nutrients may not support growth of mature trees
- Carbon loss in unchecked fires – carbon and nitrogen lost to atmosphere in too frequent fires

The questions developed for the Workshop came from a workshop and brainstorming session held in January and February 2005 at Fort Benning. The issues presented here by no means cover all the possible questions associated with the topics. The Workshop breakout sessions should discuss what other possible questions there are.

Do we have to change completely what we think we can do so the forests can support the expanding needs of endangered species?

### ***Questions***

Workshop attendees asked if other military installations were experiencing the forest health problem. Balbach noted that some are seeing it to one degree or another. Bob Larimore noted that due to intense concern about RCW management capabilities, the issue is more obvious.

Another question was raised regarding the amount of peer reviewed research on this issue. Balbach noted that most research has not been published yet. Lee Mulkey noted that there are a fair number of publications describing experiments and data, but there has been no attempt to look at this data in relation to forest decline. Land use history and soil type were noted as important factors in looking at forest health, including the species age carrying capacity at a site.

**Rob Addington (The Nature Conservancy, Fort Benning Office)**

### **Assessment of the State of the Science**

In the early to mid 1990s, Fort Benning management began to focus on longleaf pine restoration to support RCW recovery. They are on a three year burning rotation now. The current condition

is still mostly loblolly. There is a higher representation of longleaf where military impact areas, which have seen a history of regular fire (1-2 year intervals), are located.

Data sources on the state of the forest include research projects, a plot monitoring program, and a forest inventory (the recent one was started in late 2005 and is ongoing. There are approximately 48,000 acres inventoried to date, mostly of the upland acres.)

The current statistics are:

- The mean stand age is 54 years
- Of the over 104,000 pine trees tallied, over 60,000 are loblolly
- The pine trees with greater than 14" diameter are the ones largely supporting the RCW population.
- there are 2.57 snags per acre (Snags were defined as any tree that is dead and greater than 10 feet tall and 10 inches in diameter.)
- 5.4% of the total trees tallied were dead. Is this normal?

The crown vigor assessment was qualitative but they tried to be consistent in ratings. There is no sense of how quickly trees are moving from fair to poor crown vigor. Shortleaf was the worst off on crown vigor health at the time of the inventory.

### ***Questions***

Workshop attendees asked if there is a quantitative rate of mortality. Addington stated that there is no good dataset showing the rate of mortality. Attendees were also interested in detailed data on what remained in the crowns of the dead trees, which Addington noted would be useful to include in data collection.

Attendees also question the random selection of the data points due to active military sites. Addington noted that none of the high impact stands were inventoried and that some of the stands were prioritized based on military projects that came up (like base realignment and closure). Addington does feel, though, that the size is a fairly representative sample.

Attendees asked if fire history and intensity data were being assessed in relation to mortality. Addington noted that fire intensity data is part of the monitoring program.

Attendees asked if there were any patterns related to the southern pine beetle outbreaks in 2000 and 2001. Addington said it would be useful to have a map of those outbreaks, but that he had not looked into that. Bob Larimore noted that Fort Benning has outbreaks every year but not to the large extent that occurred in 2000 and 2001. He also noted that there currently is no active suppression of beetles by Fort Benning. Don Imm noted that Fort Benning has open stands which the beetles do not prefer.

### **Don Imm (Savannah River Ecology Laboratory)**

#### **Forest Health Considerations**

Longleaf pine ecosystem restoration challenges include urban development, smoke management, spatial constraints, and military training.

The potential forest health dilemma involves the interaction of host species, pathogens (e.g. *Leptographium*), and environment (root health).

The risks of the forest health problem are in the eye of the beholder. If making money is your goal, then currently there is financial loss since trees are dying. For management of RCW, the greatest risk is loss of sustainability and flexibility. Risks to military training would limit future land-use opportunities.

Do we have a problem?

- Sporadic occurrences in Piedmont, Sandhill, and Appalachian plateau. (SE Arkansas to Alabama and North Carolina)
- Compacted, finer-textured soils have greater problem likelihoods. (*n.b.*, this is also the original habitat of the loblolly pine)
- Shortleaf pine and loblolly are most impacted, with some occurrences in longleaf pine stands.
- Local stand level problems have been attributed to multiple factors: insects, littleleaf disease, *annosum* root rot, blue stain.
- Some reports suggest “fading” of longleaf pine stands planted on abandoned farm land.
- Coastward reports are limited. Is potentially due to differences in;
  - soil texture and productivity,
  - weather pattern differences including salt deposition,
  - differences in land-use legacies, or
  - management activities (burning, harvest, herbicides).

Perhaps we have unrealistic expectations due to hard agricultural practices in past.

Potential sources of stress:

- Legacy land-use
  - 19th century agriculture, erosion, in some cases military training
- Nutrient and moisture limitations
  - Regional soil attributes and characteristics. Legacy impacts.
- Reintroduction of fire
  - An extended period w/o fire, then 3-7 fires during the past 20 yrs.
- Density and competition
  - Non-issue on military installations.
- Forest age and stand dynamics
  - A natural age structure sequence, most stands are ~60 years old.
- Forest management effects on below ground conditions.
  - Root damage, pathogen transfer & inoculation, etc.
- Off-site plantings
  - Original establishment focused on stabilization (CRP program)

Impact on RCW recovery:

- Further fragmentation would occur with the loss of loblolly or shortleaf stands.
- In many areas, loblolly & shortleaf forests are “placeholder” ecosystems for restoration.

- Loblolly & shortleaf pine stands are important for foraging. They currently harbor many of the existing RCW colonies.
- Loblolly systems are “cash cows” that indirectly pay for much of the longleaf restoration work.

#### Regional Risk:

- How will we detect a problem;
  - At an appropriate scale, traditional statistical approaches are unlikely to meet the challenge,
  - Is additional information needed beyond our current FIA/Forest Health Monitoring initiatives?
    - If so, who would do it? (USFS)?
    - How would proprietary information be protected?
    - How would QA/QC be adapted?
  - Adapt disease models or posterior inference approaches (e.g. maximum likelihood, Bayesian, etc.).
- What are the consequences;
  - Under-reaction: Continued spread of the problem at an unknown rate.
  - Hasty- or over-reaction: Unneeded loss of investment, market response, increased fire risk, and lost progress toward desired future conditions.

#### Needs:

- need to understand physiology of the problem
- different management action combinations
- share information across locations
- remote sensing
- management responses to various situations/conditions

## **Breakout Reports**

### **Breakout Topic #1: What is the forest health/decline problem and how widespread is it (scope/scale/magnitude)?**

Participants: Mary Ann Sword Sayer, Lori Eckhardt, Lindsay Boring, Todd Engstrom, Susan Ustin, Don Imm, Paul Mistretta, Ken McLeod, Tom Darden, Vic Ford, Bob Larimore, Steve Davis

Two main themes:

- 1) Is this health problem new, cyclic, or climate-related?
- 2) Where are the places/species/systems with these problems?

#### **Is this health problem new, cyclic, or climate-related?**

- 1) Better quantitative information is needed to address this question regionally and at other locales.

- 2) We suspect that the forest health problem arises from a novel set of stressors derived from legacy, current management, and/or cultural activities.
- 3) Climate change and cycles may be exacerbating the forest health problem.
- 4) Management of forest health may be limited by new environmental policies and land-use demands.

**Where are the places/species/systems with these problems?**

- 1) The potential problem may need elevated monitoring and feedback to improve/refine research questions.
- 2) Differential tree species mortality may be a critical component in interpreting the question.
- 3) The forest health question associated with loblolly pine and shortleaf pine may be a time-progression bottleneck related to stand development and RCW habitat.

**Identified needs:**

- 1) Assess monitoring needs, frequencies, and intensities with improved integration and model development.
- 2) Monitoring should be regionally integrated with established FIA/FHM and Eastern Forest Threat programs.
- 3) Effective use of remote sensing tools is needed
- 4) Evaluate management techniques, protocols, and implementation to reduce presumed stressors.
- 5) Quantification of flexibility of desired management “end points” and capacity to meet objectives.
- 6) Interaction study of management related effects on resources may be needed.
- 7) Management response thresholds are needed to determine when to initiate actions.
- 8) Determine if there is a new local or regional problem associated with an exotic *Leptographium* spp. on longleaf pine.
- 9) A better understanding of longleaf pine physiological response to interacting stresses (particularly climate induced).
- 10) Well developed list of geographic locales and health problems.
- 11) Develop scale-appropriate remote sensing technology that can be integrated with field monitoring information using GPS/GIS.
- 12) Expanded understanding of the spatial pattern, mortality spread rate and infection of tree species, and their relationships with local and regional stressors/conditions.

There seemed to be consensus that the problem at Fort Benning is not littleleaf disease. The symptoms of littleleaf disease are there but the causes are not.

Lori Eckhardt is researching the seven different fungi found in the area. Two new fungi species have been found and they are more pathogenic than the other species and seem to be invasive. Slash pine is the only species yet to be killed by injection of these new pathogens. The invasive *Leptographium* species have been found in Texas and all the way to South Carolina. Data is currently being analyzed.

Susan Ustin is working on a SERDP project to map invasive plant species, including at Fort Benning. The project data has also been used to look at forest decline. Preliminary data shows some evidence of damaged sites. The data has been combined with GIS layers, but more data points are needed. More imaging at Fort Benning is needed, and could be combined with other layers to look at decline. Past climate records could also provide insight to the changing forest health.

Longleaf has been determined to be the best forest system for military needs at Fort Benning, so regeneration of longleaf is important. Since the late 1980s, Fort Benning has been on a 2 to 3 year burning cycle to support longleaf and benefit military training, which inadvertently caused wildfires in the past. Prior to the 1980's, very little land was burned.

Much of the industry-owned land south of Fort Benning sees shorter crop rotations based on tree harvesting; thus the land managers have not been aware of the forest health problems. Most industry has also ceased to use prescribed burning as a tool, so there are different understory conditions. Industry is not managing for habitat and old growth.

Observations indicate that when declining tree stands reach 30 basal area, the decline levels off. These stands still provide the necessary cavity trees (a handful over a hundred acres) to support RCW populations. The concern is how long the 30 basal area stands will last.

Once infected, longleaf takes a shorter period of time to die, but the spread to other longleaf trees is less than in loblolly.

## **Breakout Topic #2: What are the underlying causes and do these differ across the region?**

Participants: Hal Balbach, Bill Otrosina, Michele Burton, Rob Addington, John Hall, Ken Outcalt, Soung-Ryoul Ryu, Susana Sung, Ben Wigley, and Jim Cobb.

How may we characterize the suite of possible causes and influences?

- Agriculture, soil erosion, similar land use histories/ land disturbance with different variations
- Change in soil characteristics, composition and nutrient balance
  - May affect root architecture
- Changes in duff layer characteristics
- “Exotic ecosystem”
- Interacting factors must be considered, no single approach will work

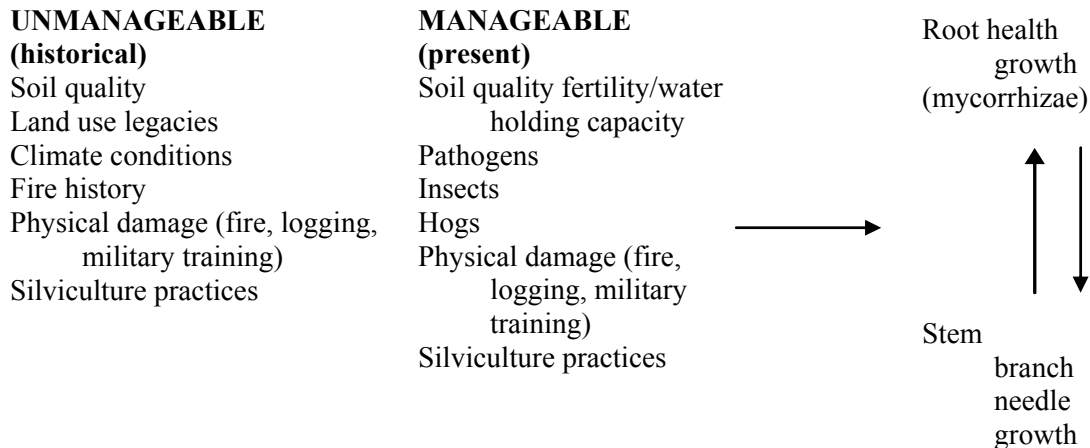
Stress is a common theme. Need to think at the system level. Are current management techniques doing more damage than good?

Early detection techniques:

- More research is needed to determine causality and mortality patterns (locally and regionally)

- Remote sensing and other survey techniques (Susan Ustin work, can we correlate declining trees with hyper-spectral signatures)
- Normalized Difference Vegetation Index (NDVI) to determine needle change over time (maybe too coarse...30m resolution...since we seem to be dealing with scattered individual trees, rather than an “outbreak”)
- Tree coring to see if growth increment has been reduced prior to crown showing symptoms

Diagnostic flow diagram:



Climate also affects present conditions and is not manageable.

Do some systems and locales have greater susceptibility?

- Independent of land use history and current land management
  - Piedmont/ Fall line- may be more susceptible
  - Coastal plain- forest decline is not as evident (anecdotal)?

May need to conduct surveys to determine extent and species affected. First-level surveys could be very rapid, and focus on presence/absence information only.

Likelihood that “decline” is primarily caused by an invasive species

- Are pathogens or conditions novel?
  - Fungal component is opportunistically attacking stressed trees?
  - Novel conditions may favor the spread of native species?
  - Was it always there or are there unique conditions or sets of conditions that are conducive to disease?
  - Or are there species that have been introduced to the system? Need more research
  - Other pathogens not just *Leptographium* complex (e.g. *Heterobasidion annosum*)? Or insects?
    - Consider potential emerging threats and interactions

New Questions

- When do we consider a stand “in decline”? Are there any applicable criteria?

- Temporal and spatial patterns need to be considered
- There are other pathogens that may be affecting trees but have not been studied
  - Need more research to determine biology of *Leptographium* species
  - May be accelerated by silvicultural practices (e.g. uneven aged management)

#### Unanswered Questions

- Is longleaf also declining? Same pattern of decline as loblolly? (anecdotally, no)
- *Leptographium* has been found in longleaf roots but not clear if it causes longleaf mortality
- Need surveys to determine true extent (include on- and off-site conditions)
- Need to determine rates of mortality
- Other pathogens, insects, and factors need to be considered
- Are conifers becoming more susceptible to disease because increased stress due to global climate change?
- Is there something we can do to extend the life of RCW trees to avoid a bottleneck? (e.g. fertilize individual trees?)

#### Recommendations

- Identify the questions
  - Is it that off-site pine is declining as expected OR is off-site pine declining faster than expected? Is there decline in loblolly that occur on their original, ‘natural’ sites?
  - Is longleaf also declining/ affected? Should be studied in conjunction with loblolly pine
- Use preventative measures (best management practices) to reduce introduction/spread of other pathogens and insects (e.g. borax on stumps, sanitation)
- Determine causality of mortality
- Need manipulative studies? (e.g. inoculation experiments, determine what combinations of stressors are at higher risk of causing mortality) - can be site specific

### **Breakout Topic #3: Are there management actions that can be taken immediately that would help minimize the impact of a potential forest health problem?**

Participants: Craig Hedman, Mark Hains, Lee Mulkey, Scott Cameron, Michelle Cram, John Doresky, Chelcy Ford, Kier Klepzig, Tim Marston, Casey Newton

Jeopardy opinion: In 1994, Fort Benning was given a “Jeopardy opinion” [under Endangered Species Act regulations] that said, if the current training and management prescriptions continue, then the RCW population will be in jeopardy. The mandate then was that they institute a burning program to restore the longleaf pine. The template or management strategy that they adopted was the burn frequency of the longleaf pine Coastal Plain at the season of burn and intensity required to sustain the RCW. The current main tool to manage for the RCW is the “Matrix” tool, which allows a land manager to assess before and after forest structure and assign an index to the RCW

habitat suitability. One factor that contributes positively to the forest suitability for RCW habitat is warm season burns that are intense.

SERDP (Strategic Environmental Research and Development Program) is a DOD-wide \$70 million per year program that funds environmental research on military installations. The SERDP Ecosystem Management Project (SEMP) is a facilitator especially for Fort Benning that funds characterization studies to help longleaf pine/RCW restoration goals.

Before we can identify short-, medium-, and long-term management actions we need to know:

1. Characterization of decline: decline terminology will follow the conceptual model of Manion (1981, Bioscience) in which trees may be exposed to:
  - i. A predisposing stress: is a condition or habitat or event that puts a tree or a stand in a situation that would expose it to further stress (e.g., off-site planting (off-site loblolly is the loblolly that was planted in clayey slopes or seeded back in with fire suppression) or soil type or age)
  - ii. An inciting stress: is one that tips the health of the tree in a downward spiral towards death and is the primary causative killing agent (e.g., drought or fire)
  - iii. A contributing stress: is one that is peripheral to the main killing agent but nonetheless contributes to the tree's mortality (e.g., blue stain fungus, bark beetle)

We specifically need to have data for the decline:

- a. Spatial and within stand and across the landscape, and within other military installations
  - b. Potential influential variables (e.g. slope, aspect, land-use history, mortality, pathogens, burn regime), baseline or acceptable mortality rates for each species in decline
  - c. Values and data for (b) above
2. Integrated stand management unit database (1-stop shop... send out an RFP and get a professional to build this quickly). This will integrate stand history and management. Need vital information before triage can be done. This is a product and needs to be invested in before other medium and long term goals can be undertaken. Eglin AFB has one of these, and perhaps that can be used as a template.
  3. For Fort Benning we need to bridge the gap for RCW populations:
    - a. Decrease the mortality rate of colony trees using adaptive fire management (e.g., decrease the intensity, don't conduct warm season burns, and perhaps decrease the frequency of fires). Decreasing fire frequency won't help restore longleaf pine, though. On Fort Benning, the best RCW/ longleaf pine habitat (as defined by the matrix) is in the impact zones where fires are regular and disturbance is the norm.
    - b. Increase the suitability of longleaf pine host trees for RCW colonies: place artificial cavities in younger trees, inoculate trees with heart-rot fungus
    - c. Relocate the RCW colonies to off-site forest stands that are suitable

Although we don't know if the forest decline we are talking about is regional (e.g., southeast wide) or if it is location-specific (e.g., Fort Benning) there is a consensus in the room that it is not region wide. Yet Mark Hains says that he has seen the same loblolly decline in frequently burned tracts in the southeast. Decline is usually location- or management-specific and we could use Fort Benning as a case study to lay out the logistics of addressing forest decline.

4. For short-term management of loblolly pines, USDA's Forest health Protection unit (FHP) recommends borax (Sporax®) and/or summer thinning to control *annosum* root disease on high hazard soils. High hazard soils for *annosum* root disease have 65% sand to a depth of 12 inches (30 cm) or more without poor internal drainage or high seasonal water. If *annosum* is currently active in a stand and partial harvest or salvage is required, then do not use borax and cut in the summer (July-August best) when spore production of *H. annosum* is low. *Hylastes* is most active in April-May, so it is not recommended to thin at that time. Considering multiple pest interactions, it might be best to thin during the winter and treat stumps with borax. Mechanical damage of roots and trees should also be minimized.

### Summary

- 1) Need an integrated database across disciplines (Eglin AFB example)
- 2) What can we do if causal agents are correctly identified?
  - a. Fire (see 3a above)
  - b. Harvesting (clear cutting, thinning, see 4 above)
  - c. Pests (timing of management)
  - d. Regeneration (instead of planting 1,000 AC → 3,000 AC)
  - e. Herbicide (release, hardwood control)
- 3) Research (see 1 and 2 above)
- 4) Monitor & modify
- 5) Adapt
- 6) Policy (exceptions)
- 7) Worst case scenario – collapse of necessary habitat (temporary offsets as mitigation)

Science should inform all steps above, but in the short-term, some of the possible solutions could be implemented.

One essential short-term solution is the need to hire a fire restoration ecologist to critically think about, design, and publish the results of the longleaf pine/RCW restoration program and to take ownership of the database onsite.

A paper published in 1994 (Skelly et al. in Plant Disease) reviews many declines by tree species (littleleaf, sand pine decline, etc.). Other data or sites showing a similar pattern in mortality are from the Okmulgee District of the Ouachita National Forest.

We need mortality rates of tree species. One data set at Fort Benning is a long-term record of cavity trees and when they die. Along with these data is the burn history (e.g., when burns occurred in the cluster trees). This data set could be used along with the database described above to inform:

1. burn regime (frequency)
2. given mortality rates, it could inform the rate of which planting new longleaf pine needs to happen
3. do a risk assessment of RCW potential cavity trees

The Southern Forest Resource Assessment (<http://www.srs.fs.fed.us/sustain/>) may have mortality by state, region, or ecosystem. This may help in answering the question as to whether the decline at Fort Benning is abnormal or if it is normal given the mortality rates in the region. In the draft report in 1989 and 1999, the mortality rate of natural loblolly-shortleaf pine was 59.2 and 113.4 million cubic feet. Where does Fort Benning fall in this? Is it normal or abnormal? We should expect forest health issues. We need to identify the context and the relative degree of the severity and answer for ourselves “How much can be tolerated?”

An Adaptive Management approach is necessary. Factors change: fire regime, pests – timing of management, regeneration, harvesting, herbicide application, etc.

**Figure 1: Our answer to question (c)**

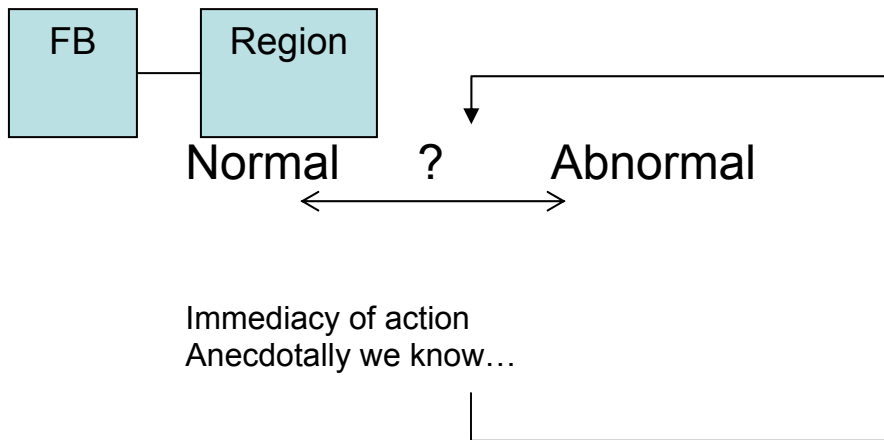
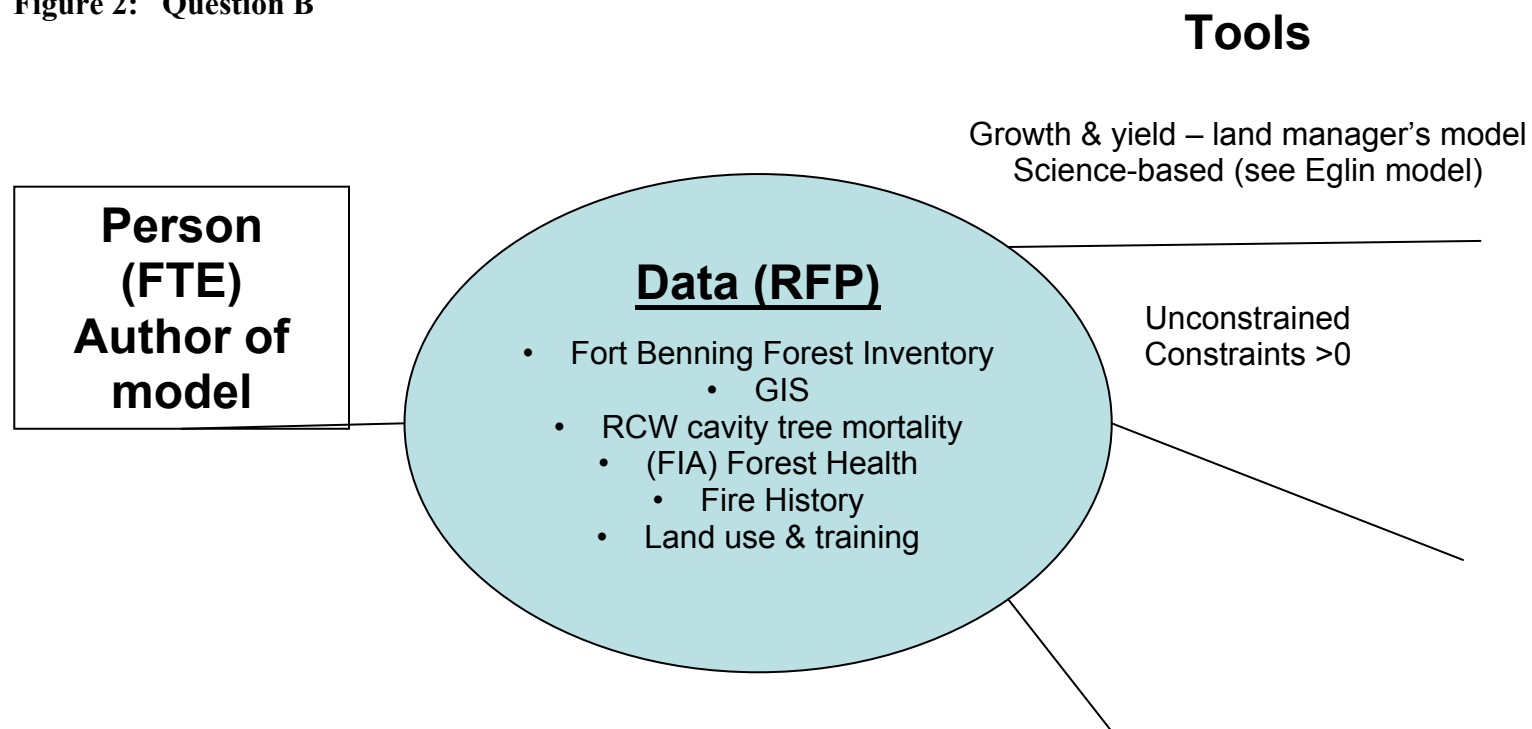


Figure 2: Question B



This is similar to the Eglin model. Gulf States has also modeled loblolly decline. But, industry is reluctant to share this information in general. Figure 1 above is our answer to question (b).

## Management Actions

### Defining the “worst-case scenario” (our answer to question (a))

- a. Habitat declines at a faster rate
- b. RCW population declines

So we would recommend (in order of priority):

1. If the worst case is that the clusters start to die off, the first priority is to move the clusters to healthy habitat (e.g., move them off-site, stop-gap measure or “organized retreat”)
  - a. On-base mitigation—loss of habitat and clusters in training areas offset the clusters within the impact area; move RCW populations to other restored areas on the base
  - b. Off-base mitigation—purchase land (fee simple) adjacent to base to provide a buffer for encroaching urban and suburban land use-land change (LULC); conservation easement; move RCW off site and/or purchase mitigation credits
2. If clusters are not immediately at risk, then several opportunities exist to improve forest health, (adaptive management approach “plan>act>measure/monitor>adjust>repeat) including:
  - a. Decrease the intensity of fire in the loblolly pine stands, or burn in the cooler season in “weakened” stands
  - b. In the “weakened” stands although they are using the 1-3 year return interval to restore longleaf pine, maybe they should use 3-5 yr return interval (which is the burn interval for loblolly)... this solution may be less desirable than the intensity issue because of fuel buildup over 5 years may cause more intense fires even if they are in the winter.
  - c. In the “weakened” stands, decrease the root/soil disturbance—use cut-to-length harvesting operation only (don’t skid)
  - d. Bring more habitat online — To jump-start the longleaf pine savanna structure, use mechanical and herbicidal treatments to restore the structure in stands that don’t have the structure yet... then use burning to maintain that structure
  - e. Increase the longleaf pine regeneration effort: put cavities in smaller trees, inoculate trees with heart-rot fungus
  - f. *Annosum*→ identify high hazard areas based on soils and species (loblolly on sandy soils) if you thin those sites then do it in the summer and also treat the stumps with sporax by hand. *Hylastes* is most active in April-May, so you don’t want to thin during this time. Considering multiple pest interactions, might be best to thin during the winter and treat stumps.

## Research Needs—Statement of Need

### Study #1

The RCW matrix model says that you need to take out many of the stems less than 10” and favor keeping the larger stems, but if we take those out (and they are age xx) then given the lifespan of

the loblollies under current conditions and the mortality rates of the loblollies under the current conditions, then is this matrix as a management tool sustainable?

We can experimentally test whether the Henry model (the old model for RCW habitat restoration) or the matrix model is the better management tool for RCW under current conditions.

#### **Breakout Topic #4: How would a significant forest health problem affect achievement of long term plans (desired future conditions, red cockaded woodpecker recovery, troop readiness, etc.)?**

Participants: Bob Mitchell, Jeff Walter, John Blake, Wade Harrison, Sharon Hermann, Frank Lands, Roger Menard, Lisa Samuelson, Tim Schowalter, Stan Simpkins, Ralph Costa, Elizabeth Keane

Longleaf issues

- At this point it is unclear whether longleaf is at risk.
- If longleaf is affected, there are serious long-term implications.
- Understanding the vulnerability of longleaf to the forest health problem, including examination of mortality patterns in longleaf, should be a high priority.

Implications of longleaf decline

- Desired future conditions cannot be achieved for affected stands
- Long term RCW recovery would be uncertain
- Training conditions would be altered
- Mission flexibility would be compromised

Loblolly issue

- Forest health issue is likely a manifestation of poor performance of “off-site” pines
- Past land use, age structure, landscape attributes and management may contribute to stress on loblolly pines
- Consequently the remainder of the presentation is focused on loblolly

A. Can or should the consequences of forest decline be prioritized, and if so on what basis?

- Yes, on the basis of
  - Impact on:
    - Desired future conditions
    - RCW recovery
    - Troop readiness
  - And whether we can do something about the impacts and how quickly we can do it.

What are the consequences of forest decline?

- Change in forest structure & composition
  - Potential impacts:

- Rate of RCW recovery
- Other cavity-users associated with pine habitats
- Mission training flexibility
  - See question B
- Loss of fuel for fire may be an issue for low basal area stands
- Undesirable forest age structure
- Desired future conditions not greatly affected
- Accelerated longleaf restoration could decrease Gopher Tortoise habitat

Desired future conditions don't really matter because either way longleaf pine will be planted at Fort Benning.

B. Do the consequences affect mission fitness and troop training capability?

- No direct impact on training as low basal area stands are desirable for training
- Indirect consequences due to loss of flexibility because of restrictions associated with declining RCW
- Accelerated longleaf restoration could reduce training land base

C. If there is a “point of no return,” how far are we from it and how rapidly are we progressing toward it?

- With respect to RCWs “points of no return” are (a) population below viable size and (b) managed stability foraging habitat standard for the territory:
- At the territory scale distance to point of no return is uncertain.
  - There may be a point of no return for RCWs at the territory level, a point at which basal area falls to a sufficiently low level that territory sizes expand.
  - Identifying this point at a territory level is a research need
- At the population scale not likely to get to point of no return.
- Cannot say for affected stands
- To answer the question these are the information needs:
  - Identifying patterns of mortality within and between stands (which trees are dying, where & how fast)
  - Using that to develop a stand dynamics model (e.g., as Eglin has done)
  - This will require identifying appropriate baseline mortality patterns against which to compare across the region.

D. If the problem continues to progress, what will the future economic and planning impacts be?

- There could be a period of RCW decline, leading to a loss of mission flexibility.
- There may be an undesirable effect on the age structure of the forest which could affect the economics of the timber program as well as mission flexibility.
- Pace of longleaf conversion
  - Short term: increase in underplanting at current rate of tree mortality
  - Long term: increase in stand conversion at accelerated rate of tree mortality
- Ability to plan for addressing the effects of forest decline is limited.
- An appropriate planning tool that incorporates inventory and monitoring data, and constraints such as limits on the amount of training land that can be tied up in longleaf regeneration, is needed.

- The need for additional planning efforts (INRMPs & component plans) may increase if mortality rate increases.

E. Including regeneration, what are the implications as related to longleaf pine recovery and desired future condition expectations?

- Few long term implications:
  - desired end state can still be achieved despite the forest health problem, although the methods may change.
- The long term objective is unaffected.

Cause of forest health problems

- Understanding the cause of forest health problems in loblolly/shortleaf has a use in long term planning as a means to identify the mechanism of mortality.
- Methods to predict rate of decline:
  - First determine the rate and pattern of mortality: if different from expected, then
  - Derive from that investigation hypotheses about mechanisms.
  - Finally, build models that predict future mortality based on identified mechanisms.

Information needs

- Understanding potential vulnerability of longleaf to the forest health issue
- For loblolly pine:
  - Identifying patterns of mortality with comparison to appropriate baseline
  - Develop a stand dynamics model
- For RCW:
  - Determine how fitness, territory size, and territory loss are related to changes in forest structure and composition.
- Planning tools that integrate inventory data, monitoring data, modeling, and restoration strategies
- Synthesizing state of knowledge about causes of forest health decline

## **Next Steps**

Workshop Report

- ESA will send around a draft for comments in mid/late June.
- ESA will incorporate comments and finalize report by the end of July.

White Papers

- Will be used by Lee Mulkey for SERDP Science Advisory Board meeting in September.
- Will be submitted to an ESA journal (Ecological Applications) or some other journal.
- Will identify research needs and inform local managers and their decisions.

Non-technical Summary

- ESA will develop a non-technical summary of the white papers by the end of the summer.
- Will identify research needs and inform local managers and their decisions.

#### Key Research Questions

- SERDP is interested in statements of need based on the key research questions identified by the workshop. Must show that the Department of Defense needs to have the question addressed and that the question demands research. All recommendations for statements of need should be provided to Lee Mulkey by early July.

**“Forest Decline in the Southeastern United States: Assessment of the State of the Science”**  
**June 5-6, 2007 ♦ Atlanta, GA**  
**Workshop Attendee List**

Rob Addington  
Forest Ecologist  
The Nature Conservancy, Fort Benning Office  
P.O. Box 52452  
Fort Benning, GA 31995  
706-544-7515  
raddington@tnc.org

Harold Balbach  
Certified Senior Ecologist, Installations Division  
US Army Engineer Research and Development  
Center  
PO Box 9005  
Champaign, IL 61826-9005  
217-373-6785  
Hal.E.Balbach@erdc.usace.army.mil

John I. Blake  
Assistant Manager Research  
USDA Forest Service, Savannah River  
P.O. Box 700  
New Ellenton, SC 29809  
803-725-8721  
j.blake@srs.gov

Lindsay Boring  
Director  
Joseph W. Jones Ecological Research Center  
Route 2 Box 2324  
Newton, GA 39870  
(229) 734-4706  
Lindsay.Boring@jonesctr.org

Michele Burton  
Fort Benning Land Management/Conservation  
Branch  
Bldg 5889, First Division Rd  
Fort Benning, GA 31905  
706-544-7300  
michele.l.burton@us.army.mil

R. Scott Cameron  
Advanced Forest Protection, Inc.  
120 Arlington Court  
Richmond Hill, GA 31324  
912-756-5514  
rscameron@prodigy.net

Jim Cobb  
US Army Installation Management Command,  
Southeast  
1593 Hardee Avenue, SW  
Fort McPherson, GA 30330  
404-464-0713  
cobbj@forscom.army.mil

Ralph Costa  
USFWS Clemson Field Office  
Department of Forestry and Natural Resources  
Clemson University  
261 Lehotsky Hall  
Clemson, SC 29634  
864 656-2432  
ralph\_costa@fws.gov

Michelle Cram  
Plant Pathologist  
USDA Forest Service, Forest Health Protection  
320 Green Street  
Athens GA 30602  
706-559-4233  
mcram@fs.fed.us

Tom L. Darden  
Director, Cooperative Forestry  
USDA Forest Service, Southern Regional Office  
1720 Peachtree Road, NW, Suite 850  
Atlanta, GA 30309  
404-347-7200  
TLDarden@fs.fed.us

Steven R. Davis  
Forest Service Liaison  
US Army Environmental Command  
410-436-6456  
steven.robert.davis@us.army.mil

John Doesky  
USFWS West Georgia ES Sub Office  
P.O. Box 52560  
Fort Benning, Georgia 31995  
706-544-6030  
john\_doesky@fws.gov

Lori G. Eckhardt  
Assistant Professor, Forest Pathology &  
Entomology  
Forest Health Dynamics Laboratory  
3301 School of Forestry and Wildlife Sciences  
Auburn University  
Auburn, AL 36849-5418  
334-844-2720  
eckhalg@auburn.edu

R. Todd Engstrom  
309 Carr Lane  
Tallahassee, Florida 32312  
850-668-8703  
engstrom@bio.fsu.edu

Chelcy R. Ford  
USDA Forest Service Coweeta Hydrologic Lab  
Southern Research Station  
828-524-2128, ext. 118  
crford@fs.fed.us

Victor L. Ford  
MeadWestvaco  
1000 Broad Street  
P.O. Box 520  
Phenix City, AL 36868  
334-448-6336  
victor.ford@meadwestvaco.com

John A. Hall  
Sustainable Infrastructure Program Manager  
SERDP/ESTCP  
901 N. Stuart St., Suite 303  
Arlington, VA 22203-1853  
703-696-2125  
john.hall@osd.mil

Mark J. Hains  
Research Coordinator  
The Longleaf Alliance  
12130 Dixon Center Rd.  
Andalusia, AL 36420  
334-427-1029  
hains@alaweb.com

Wade Harrison  
Chattahoochee Fall Line Project Director  
The Nature Conservancy  
Fort Benning Office  
PO Box 52452, Fort Benning, GA 31995  
706-682-0104  
wharrison@tnc.org

Craig W. Hedman  
Environmental Scientist  
Ecology and Environment, Inc.  
1974 Commonwealth Lane  
Tallahassee, FL 32303  
850-574-1400 ext. 3923  
chedman@ene.com

Sharon M. Hermann  
Department of Biological Sciences  
Funchess Hall  
Auburn University  
Auburn, AL 36849  
334-844-3933  
hermasm@auburn.edu

Donald W. Imm  
SEMP Tech. Infusion Coord.  
Savannah River Ecology Laboratory  
and Univ. of Georgia  
Bldg. 5889  
Harmony Church Complex, 1st Div. Rd.,  
Fort Benning, GA 31905  
706-544-6447  
imm@srel.edu

Elizabeth Keane  
US Army Engineer Research and Development  
Center  
PO Box 9005  
Champaign, IL 61826  
217-373-6785  
Elizabeth.L.Keane@erdc.usace.army.mil

Kier Klepzig  
Project Leader  
USDA Forest Service, Southern Research Station  
Insects, Diseases and Invasive Plants (IDIP)  
2500 Shreveport Hwy  
Pineville, LA 71360  
318-73-7238  
kklepzig@fs.fed.us

Frank Lands  
US Army Installation Management Command,  
Southeast  
1593 Hardee Avenue, SW  
Fort McPherson, GA 30330  
404 464-1645  
Frank.w.lands@us.army.mil

Bob Larimore  
Chief, Land Management Branch  
US Army IMSE-BEN-PWE-L  
Fort Benning, Georgia 31905  
706-544-7076  
robert.larimore@us.army.mil

Tim Marston  
Wildlife Biologist, Conservation Branch  
US Army Infantry Center, IMSE-BEN-PWE-C,  
Bldg. 5888, Hwy 27/280 @ 1st Division Rd  
Fort Benning, GA 31905  
706-544-7069  
Timothy.G.Marston@us.army.mil

Ken McLeod  
Savannah River Ecology Laboratory  
P. O. Drawer E  
Aiken, SC 29802  
803-725-5309  
mcleod@srel.edu

Roger D. Menard  
Plant Pathologist  
USDA Forest Service, Forest Health Protection  
2500 Shreveport Hwy  
Pineville, La. 71360  
318-473-7298  
rmenard@fs.fed.us

Paul Mistretta  
Pesticide Specialist & Staff Forest Pathologist  
USDA Forest Service, Forest Health Protection  
1720 Peachtree Road NW, Rm. 846N  
Atlanta, GA 30309  
404-347-2229  
pmistretta@fs.fed.us

Robert Mitchell  
Scientist  
Joseph W. Jones Ecological Research Center  
RR 2 Box 2324  
Newton GA 39770  
229-734-4706  
Robert.Mitchell@jonesctr.org

Lee A. Mulkey  
PO Box 480  
Demorest, GA 30535  
706-754-4226  
leemulkey@hotmail.com

Casey H. Newton  
Natural Resource Program Manager  
US Army Installation Management Command, SE  
J.M. Waller Associates  
100 Merrie-Woode Rd.  
Sapphire, NC 28774  
864-506-5682  
cnewton@CLEMSON.EDU

William J. Orosina  
Research Eco-Plant Pathologist, Team Leader  
USDA Forest Service  
320 Green Street  
Athens, GA 30602  
706 559 4295  
wotrosina@fs.fed.us

Kenneth W. Outcalt  
Research Fire Ecologist  
USDA Forest Service  
320 Green St.  
Athens, GA 30602  
706-559-4309  
koutcalt@fs.fed.us

Soung-Ryool Ryu  
Silviculture and Ecology Laboratory  
Department of Forestry and Natural Resources  
Room# G12E, Lehotsky Hall, Clemson University  
Clemson, SC 29634-0317  
864-656-4860  
soungr@CLEMSON.EDU

Lisa Samuelson  
Professor  
School of Forestry & Wildlife Sciences  
Auburn University  
Auburn, AL 36849-5418  
334-844-1040  
samuelj@auburn.edu

Timothy D. Schowalter  
Professor and Head  
Department of Entomology  
Louisiana State University Agricultural Center  
Baton Rouge, LA 70803  
225-578-1634  
tschowalter@agcenter.lsu.edu

Stan Simpkins  
USFWS Ecologist  
Panama City Field Office  
1601 Balboa Ave.  
Panama City, Florida 32405  
850-769-0552 x234  
Stan\_Simpkins@fws.gov

Shi-Jean Susana Sung  
Research Plant Physiologist Restoring Longleaf  
Pine Ecosystems  
USDA Forest Service, Southern Research Station  
2500 Shreveport Highway  
Pineville, LA 71360  
318-473-7233  
ssung@fs.fed.us

Mary Anne Sword Sayer  
Research Plant Physiologist  
USDA Forest Service  
Southern Research Station  
Pineville, LA  
318-473-7275  
msword@fs.fed.us

Susan L. Ustin  
Professor of Resource Science  
CSTARS/The Barn  
Department of Land, Air, and Water Resources  
University of California  
One Shields Avenue  
Davis, CA 95616  
530-752-0621  
slustin@ucdavis.edu

Jeffrey R. Walters  
Department of Biological Sciences  
Virginia Tech  
Blacksburg, VA 24061-0406  
540-231-3847  
jrwalt@vt.edu

T. Bently Wigley  
National Council for Air and Stream Improvement,  
Inc. (NCASI)  
PO Box 340317  
Clemson, SC 29634-0317  
864-656-0840  
wigley@clemson.edu

## ESA Staff

Clifford S. Duke  
Director, Office of Science Programs  
Ecological Society of America  
1707 H Street NW, Suite 400  
Washington, DC 20006  
202-833-8773 ext. 202  
csduke@esa.org

Mindy K. Destro  
Science Programs Manager  
Ecological Society of America  
1707 H Street NW, Suite 400  
Washington, DC 20006  
202-833-8773 ext. 209  
mdestro@esa.org