SERDP
Strategic Environmental Research and Development Program
Improving Mission Readiness Through Environmental Research

US Army Corps of Engineers

SERDP's SEMP

Ecosystem Management Project

CS-1114

Dr. Hal Balbach
U.S. Army Engineer Research
and Development Center (ERDC)

Technical Advisory Committee Meeting
18-19 July 2001

Outline

- SEMP Objectives and Organization (review)
- SEMP Framework (review)
- Status of Activities (FY 2000-2001)
  - Research (5 projects)
  - Monitoring
  - Repository
- Answers to Questions Raised
- FY2002 and Future Plans

Purpose of SEMP

- To Address Knowledge Gaps Related to Ecosystem Management on Military Lands
- To Design and Test a Long-Term Baseline Monitoring Program on DOD Lands
- To Infuse Outcomes into DOD Ecosystem Management Processes and Practices - Range Sustainability
- To Provide a Model for Similar Regional Programs (in other regions) where Military Installations Provide a Resource Base

Key Properties and Processes
(Form the Basis for SEMP Research)

Those for which fundamental understanding is required to ensure goals of sustainability can be met

- **Hydrologic flux and storage**
- **Biological productivity**
- **Biogeochemical cycling and storage**
- **Decomposition**
- **Maintenance of biological diversity**

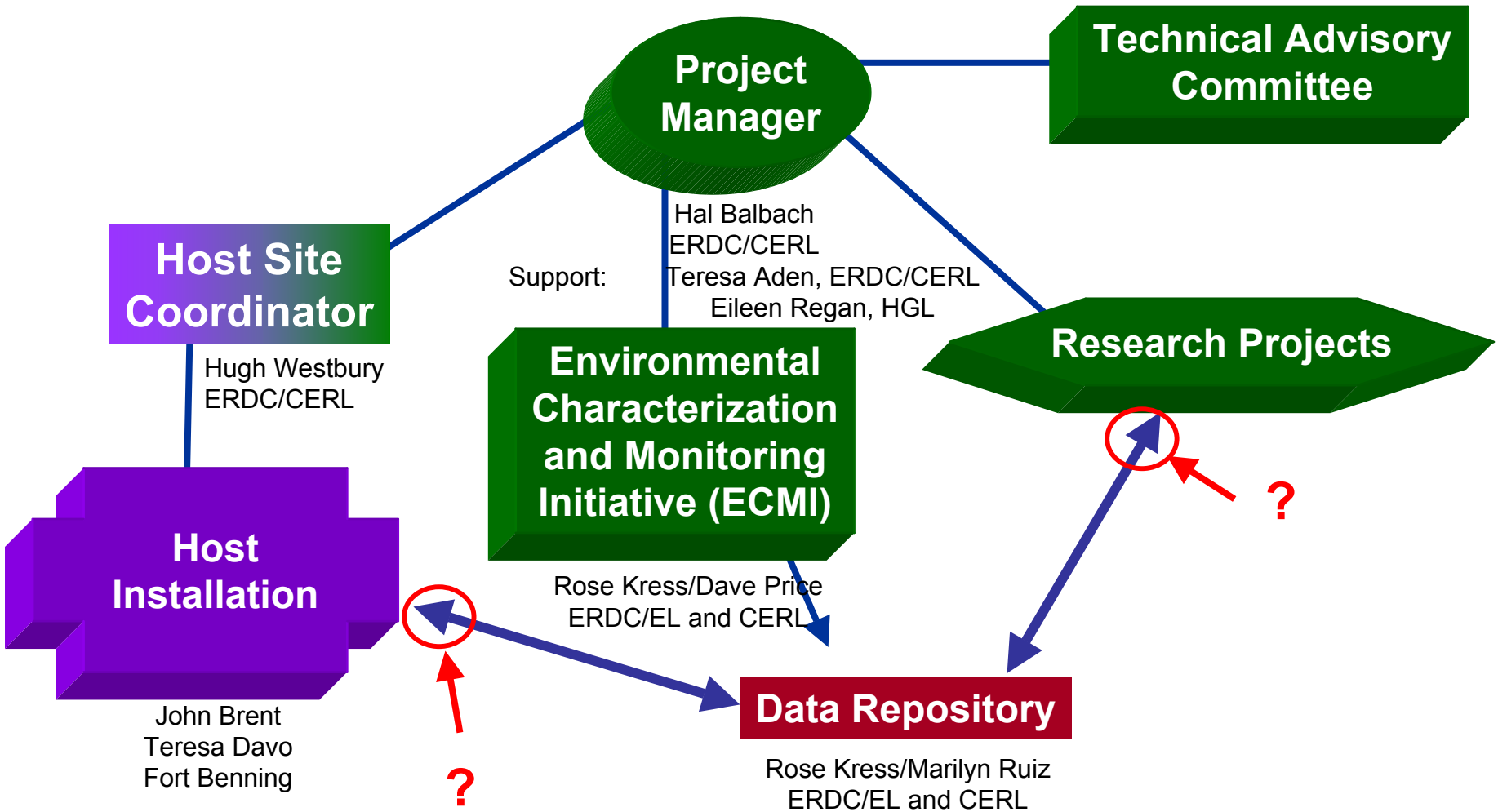
(Christensen, N.L. et. al. 1996. The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management. Ecological Applications 6(3):665-691.)

Criteria for Indicators*

- Are easily measurable
- Are sensitive to stresses of system
- Respond to stress in a predictable manner
- Signify an impending change in key characteristics of the ecological system
- Experience changes that can be averted by management actions
- Together with the full suite of indicators, provide a measure of coverage of the key gradients across the ecological systems (e.g., soils, vegetation types, temperature, etc.)
- Have a known response to natural disturbances and changes over time
- Have low variability in response

* Dale, V.H and Beyeler, S.C. 2001. Challenges in the development and use of ecological indicators. *Ecological Indicators*, v.1

SEMP Organization Chart



Technical Advisory Committee for SEMP

- Dr. Mary Barber, Ecological Society of America, SAB Member
- Mr. Peter Boice, Director of Conservation Programs, Office of the Deputy Undersecretary of Defense, Installations & Environment, TTAWG Member
- Dr. Neil Burns, US Environmental Protection Agency, Region 4
- Mr. George Carellas, Chief, So. Regional Env. Office, US Army Env Center
- Dr. Roger Dahlman, Program Manager, U.S. Department of Energy, TTAWG Member
- Dr. Mark Fenn, U.S. Department of Agriculture, Forest Service
- Dr. Penny Firth, National Science Foundation
- Dr. J. Whitfield Gibbons, Savannah River Ecology Lab and University of Georgia
- Mr. Bill Goran, Technical Director, ERDC/CERL, TAC Coordinator
- Dr. John Hall, The Nature Conservancy
- Mr. Richard McWhite, Natural Resources Chief, Eglin Air Force Base
- Dr. Doug Ripley, Headquarters, USAF National Guard, TTAWG Member
- Dr. James Spotila, Drexel University

SERDP
Strategic Environmental Research and Development Program
Improving Mission Readiness Through Environmental Research

US Army Corps of Engineers

Status of SEMP Research

- Three “Indicators” projects completing second year of study
- Two “Thresholds” projects completing first full year of study
- Research teams developing better understanding of local ecosystem processes and variations
- Integration of knowledge across teams has started through research coordination workshops
- Adaptive Management analysis of Ft. Benning procedures initiated
- Tech transfer and regional cooperation initiated

SEMP Research Projects
Responding to "Indicators" SON

Dr. W. DeBusk	Determination of Indicators of Ecological Change
Dr. T. Krzysik	Development of Ecological Indicator Guilds for Land Management
Dr. V. Dale	Indicators of Ecological Change

SEMP Research Projects
Responding to "Thresholds" SON

Mr. C. Garten, Jr.	Disturbance of Soil Organic Matter and Nitrogen Dynamics: Implications for Soil and Water Quality
Dr. B. Collins	Thresholds of Disturbance: Land Management Effects on Vegetation and Nitrogen Dynamics

DISTURBANCE OF SOIL ORGANIC MATTER AND NITROGEN DYNAMICS:

IMPLICATIONS FOR SOIL AND WATER QUALITY (CS-1114D)

C. T. Garten, Jr.
T. L. Ashwood

SERDP Strategic Environmental Research and Development Program
Improving Mission Readiness Through Environmental Research

US Army Corps of Engineers

Goal and Objectives

- PROJECT GOAL:

(1) determine effects of disturbance and land use on soil quality

(2) investigate thresholds to the potential for recovery of soil quality on disturbed land

(3) perform site-wide analysis of soil C and N dynamics as they affect soil quality and nonpoint sources of N loading to surface water drainages

- TECHNICAL OBJECTIVES FOR YEAR 1 AND YEAR 2:

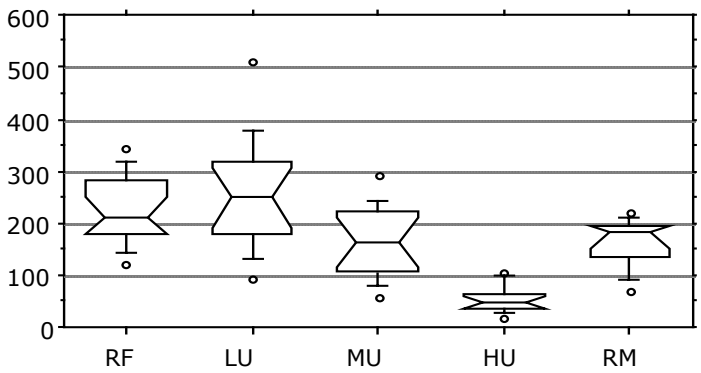
(1) characterize effects of heavy-vehicle disturbance and differences in land use on key measures of soil quality (FY 2000)

(2) investigate thresholds associated with disturbance that establish the potential for recovery of soil quality (FY 2001)

Soil C and N Dynamics

Disturbance of Soil Organic Matter and Nitrogen Dynamics: Implications for Soil and Water Quality *

- The goal of this project is to determine effects of disturbance and land use on soil quality, thresholds to the potential for recovery of soil quality, and site-wide analysis of soil carbon (C) and nitrogen (N) dynamics as they affect soil quality and nonpoint sources of N loading to surface water drainages at Fort Benning, GA

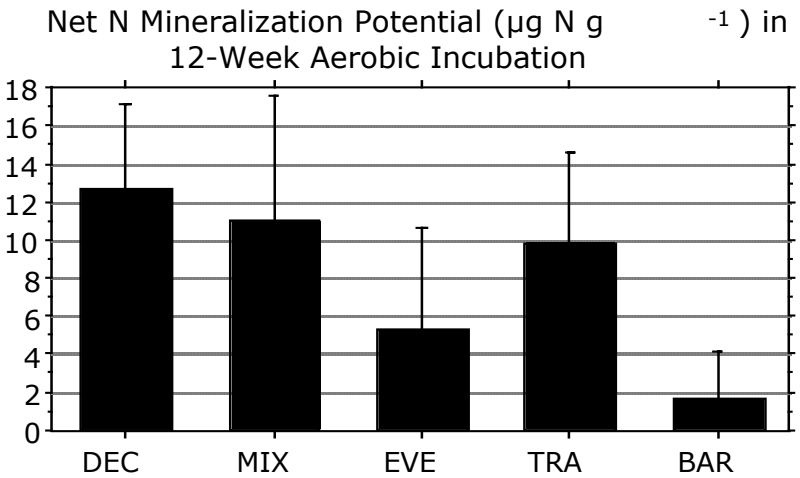


- Studies along disturbance gradients at Fort Benning indicated a decline in soil C stocks (and soil C/N ratios) with increasing levels of military disturbance as well as some recovery at remediated (RM) sites.

Mineralization Affected by Disturbance

Disturbance of Soil Organic Matter and Nitrogen Dynamics: Implications for Soil and Water Quality *

- If it is hypothesized that measures of soil quality can be used to discern thresholds for disturbance, then it is necessary to improve our understanding of natural variability in measurements of soil quality in the context of land use and land cover at Fort Benning, GA



Land cover differences in soil N availability at Fort Benning (DEC = deciduous forest, MIX = mixed forest, EVE = evergreen forest, TRA = transitional land, BAR = barren land)

- Land use/land cover potentially affects soil N availability and soil organic matter
- Land use history is also an important but little understood source of variation that affects measures of soil quality
- There are land use/land cover differences in soil carbon and nitrogen dynamics at Fort Benning that have implications for the sustainability of ecosystems and the determination of soil quality thresholds

Results from Year 1 Field Studies

- There are significant differences in key measures of soil quality along disturbance gradients associated with heavy vehicle use at Fort Benning that deserve further study
- Measurements of soil bulk density (soil compaction), and soil C and N appear to be good indicators for use in follow-up studies of thresholds in soil quality (these measurements are sensitive to change, easy to measure, and predictable)
- There is some indication of a recovery in soil quality at remediated sites (this will be investigated further in Year 2)
- Multivariate statistical methods are a promising approach to a better understanding of land use/land cover differences in measures of soil quality (these techniques provide an empirical basis for assessing site disturbance and recovery potential)
- Land use history is a potentially important but little understood source of variation that affects soil quality

FY01 Milestones

Disturbance of Soil Organic Matter and Nitrogen Dynamics: Implications for Soil and Water Quality (CS-1114D-00)

Milestone	Scheduled Completion Date	Actual Completion Date
Participate in Fort Benning Workshop and SSSA Meeting	Nov-00	Nov-00
Presentation to SERDP Technical Advisory Committee	Nov-00	Nov-00
Establish new study sites along disturbance/recovery gradients	Jun-01	
Prepare open-literature publication from first year's work	Jun-01	
Preliminary analysis of soil measurements along the gradients	Oct-01	
Progress reports and annual reports	Oct-01	

SERDP
Strategic Environmental Research and Development Program
Improving Mission Readiness Through Environmental Research

The University of Georgia
Savannah River Ecology Laboratory

Thresholds of Disturbance:

Land Management Effects on Vegetation and Nitrogen Dynamics

CS-1114E-00

Beverly Collins

Savannah River Ecology Laboratory

PERFORMERS

Savannah River Ecology Lab

Dr. J Vaun McArthur
Microbial Ecology

Dr. John Seaman
Soil Chemistry

Dr. Chris Romanek
Geochemistry

Dr. Rebecca Sharitz
Plant Ecology

Dr. Peter White
University of North Carolina
Disturbance Ecology

Dr. Mary Cadenasso
Institute of Ecosystem Studies
Landscape Ecology

PROBLEM STATEMENT

DoD (Fort Benning) land must sustain the military training mission. A second land management goal at Fort Benning is sustainable upland forests, including longleaf pine forest, which provides economic benefits and supports the endangered red-cockaded woodpecker.

Fort Benning managers need information to determine what combinations of land management practices - due to military training and longleaf pine forestry - exceed thresholds beyond which upland ecosystems are not sustainable (will not recover or continue desired trajectory).

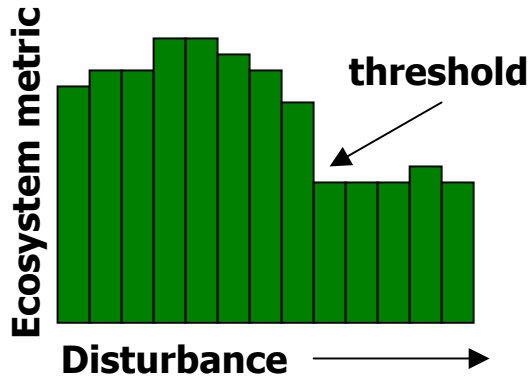
TECHNICAL OBJECTIVE

To evaluate the ecological effects of military training and forest management for longleaf pine at Ft. Benning, to determine if there are thresholds beyond which upland ecosystems cannot sustain the combined effects of these land use disturbances.

TECHNICAL BACKGROUND

- Disturbances

  - can be key to ecosystem management



- Intensity and frequency of land management-derived disturbances

  - can influence ecosystem composition, structure, trajectory

- Combinations of disturbances greater than some intensity/frequency

  - cause ecosystems to not recover, lose species, or change trajectory

  - systems are not sustainable

TECHNICAL BACKGROUND

At Fort Benning…..

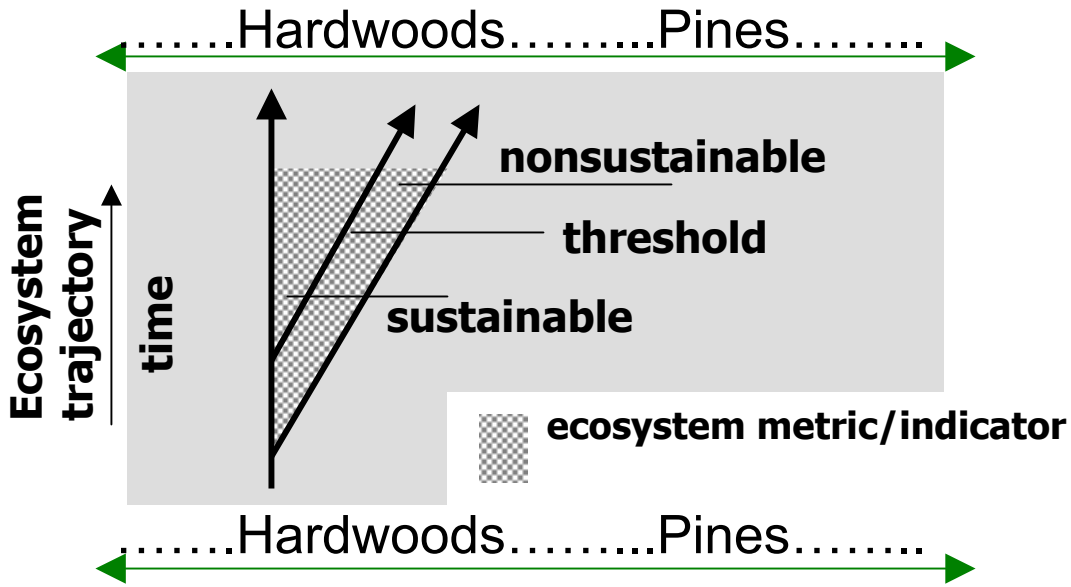
Time / space

Soil type, topography

Canopy opening and soil disturbance due to:

military training; forest thinning, burning

TECHNICAL BACKGROUND



Disturbances due to land use practices (military training, forest management)

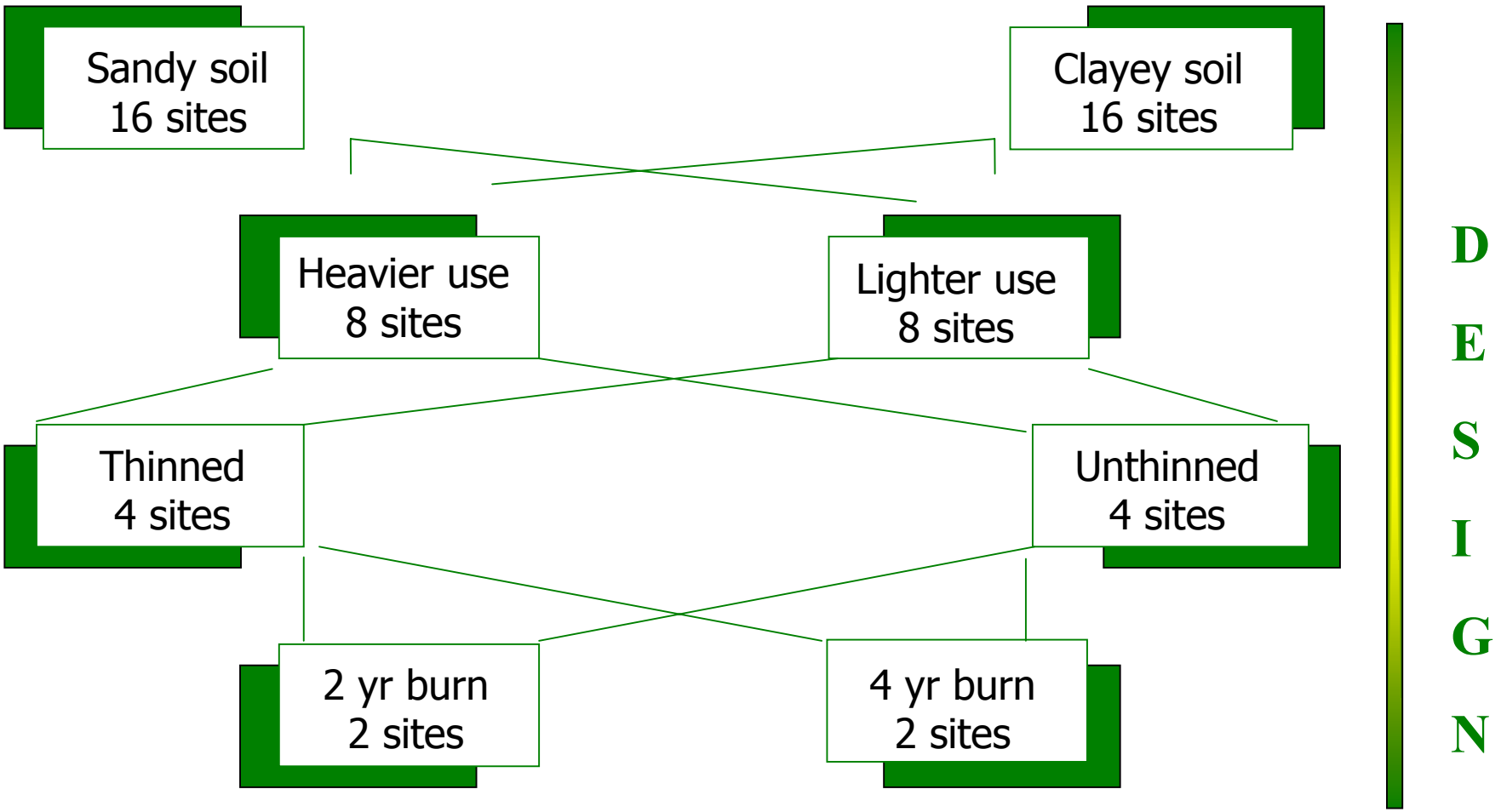
- can modify natural or management-defined ecosystem trajectory beyond sustainability threshold

TECHNICAL APPROACH

Hypothesis: underlying soil type partly determines forest composition and dynamics; influences the disturbance threshold for sustainability

- Experimental approach
  - metrics: biogeochemical (nitrogen, carbon) cycling, plant species diversity, vegetation dynamics and structure
- Sites with sandy vs. clayey soil, combinations of
  - forest management for longleaf pine: (2 yr vs. 4 yr burn cycle; thinned vs. unthinned)
  - lighter vs. heavier military training

TECHNICAL APPROACH



ACCOMPLISHMENTS

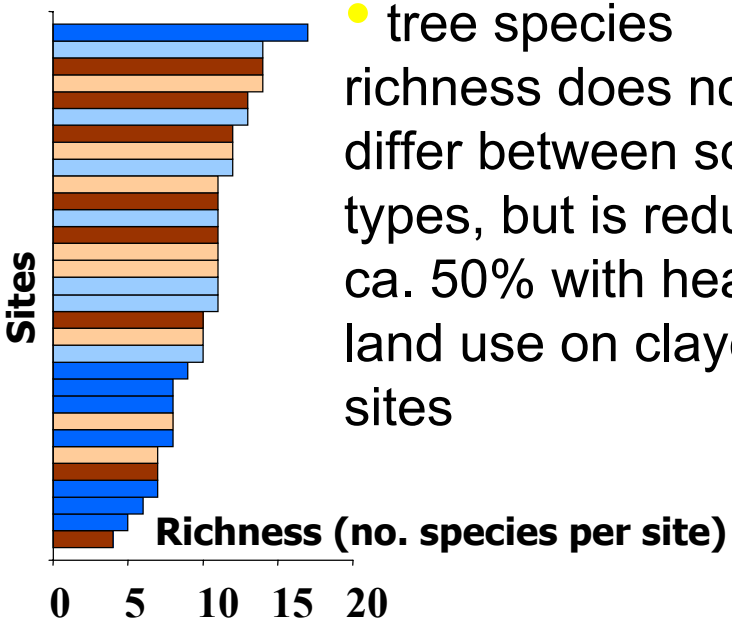
STATUS

- Sites selected (3-5/00)
- Baseline vegetation survey (6-8/00)
- Disturbance features survey (9-10/00)
- Baseline soil texture analyses (9/00 - 2/01)
- Oak/pine seedlings introduced (1-3/01)
- Monitoring equipment/sensors deployed (1-4/01)
- Stable isotope (^{15}N) litter deployed (pilot project) (3-4/01)

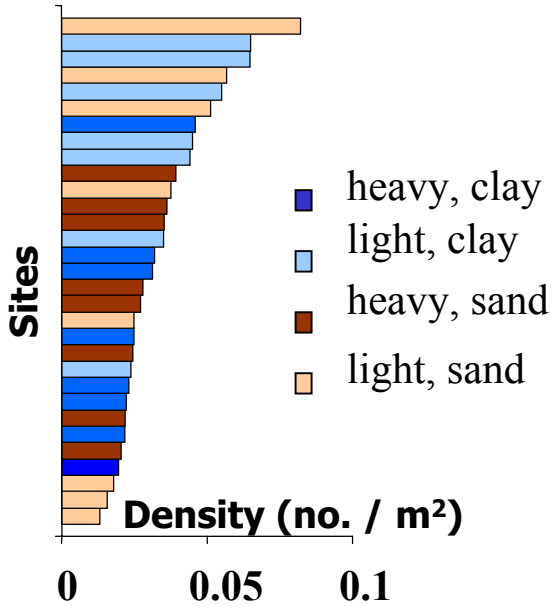
ACCOMPLISHMENTS

UNDERSTANDING - vegetation

- 29/32 selected sites dominated by pines
- initial analyses suggest canopy and ground layer composition reflect site differences and intensity of land use



- tree species richness does not differ between soil types, but is reduced ca. 50% with heavy land use on clayey sites

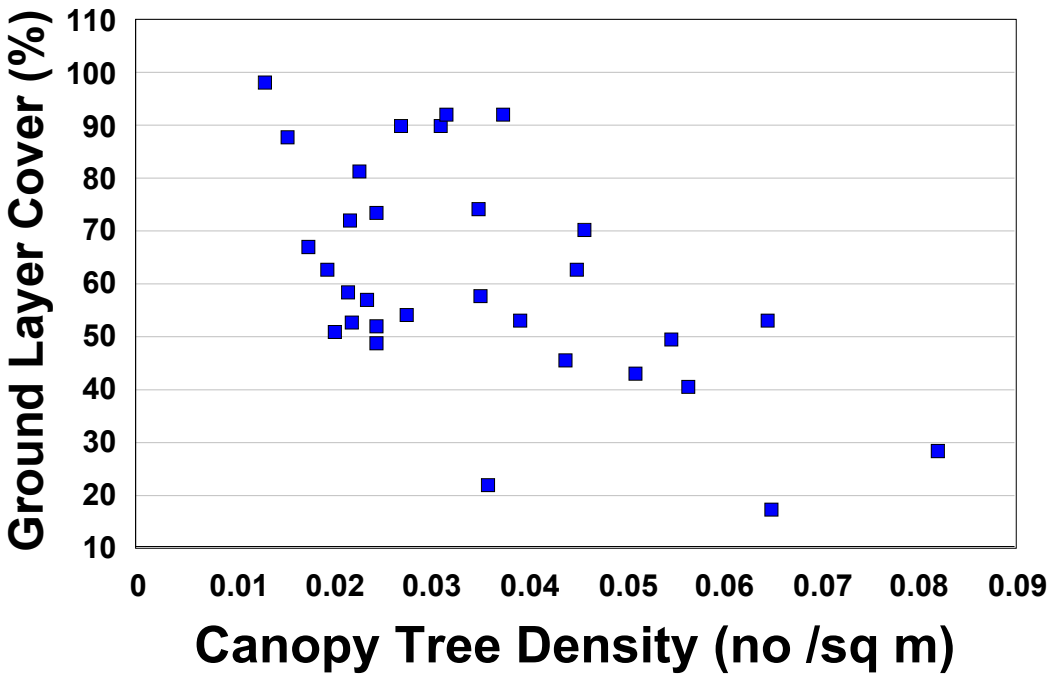


- tree density is greater on sites with lighter vs. heavier military training

ACCOMPLISHMENTS

UNDERSTANDING - vegetation

- initial analyses suggest canopy and ground layer composition reflect site differences and intensity of land use



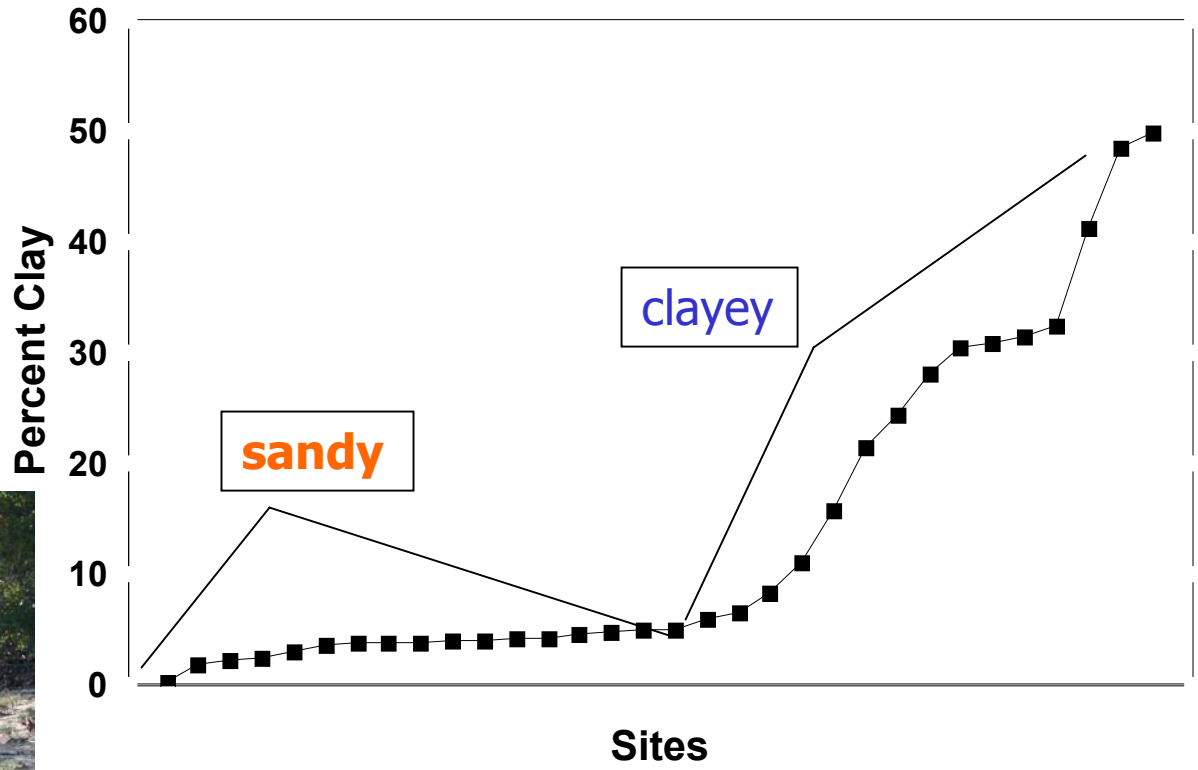
- in clayey sites, ground layer cover is negatively related to tree density (more cover in more open sites), which potentially reflects forest management history

ACCOMPLISHMENTS

UNDERSTANDING - soil texture

- soil texture (% clay) is more uniform in sandy sites (3 % - 5 % clay) than in clayey sites (6 % to 50 % clay)

- ecosystem responses to soil texture might vary more among clayey sites



ACCOMPLISHMENTS

UNDERSTANDING - disturbance features

- surveyed *all* natural, military use, and forestry disturbances in each site

•depression

•ditch

•gully

•erosion

•firebreak

•mound

•berm

•treefall

•gap

•clearcut

•skidder trail

•unimproved road

•road

•tank trail

•tank area

•bare area

•remnant trail

•remnant road

ACCOMPLISHMENTS

UNDERSTANDING - disturbance features

- surveyed natural, military use, and forestry disturbances in each site

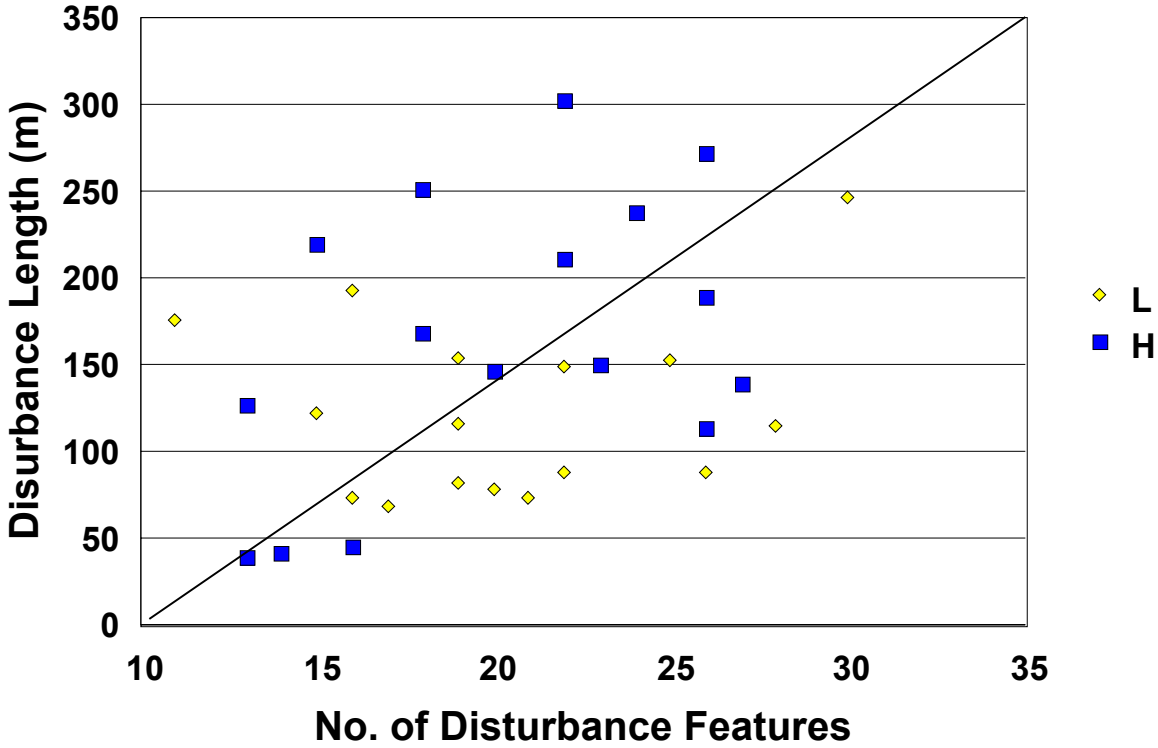
- at least 4 different types of disturbance features are found in each site; 7 % to 50 % of sampled area was disturbed

- disturbance features range from small (treefalls, depressions) through large (canopy gaps, bare areas, clearcuts)

- remnant roads are the most common disturbance feature; they occupied 14 % of the total disturbed area

ACCOMPLISHMENTS

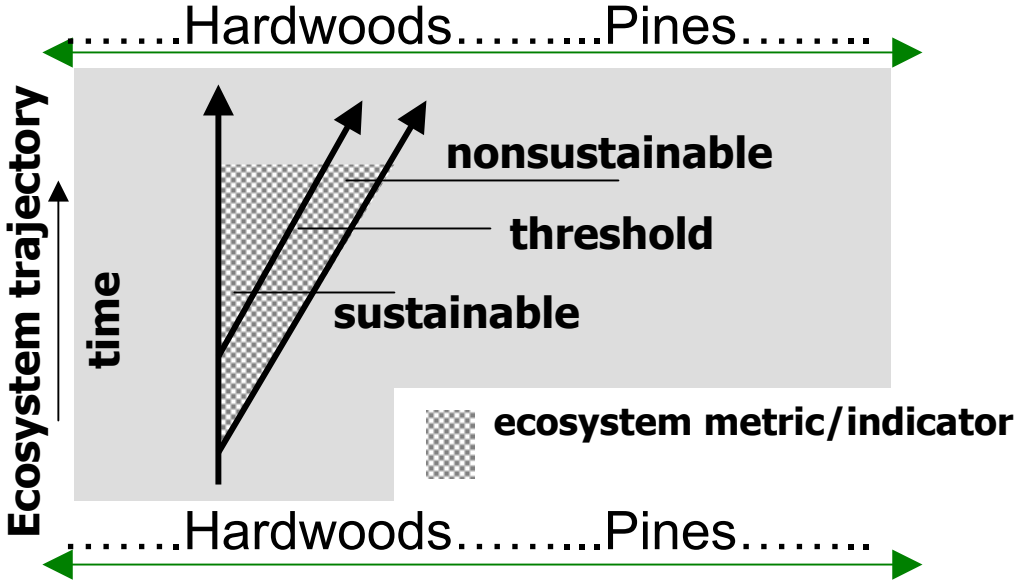
UNDERSTANDING - disturbance features



- sites with heavier military use do not necessarily have more disturbance features than lighter use sites (H sites are not grouped to the right on the x-axis), but tend to have a greater amount of disturbance (H sites tend to fall above the diagonal line)

ACCOMPLISHMENTS

INTEGRATION



- Canopy and ground layer vegetation composition, richness, and density (cover) indicate intensity of past, longer-term land use disturbances.

- Baseline data suggest response to disturbance may be greater on clayey soils as hypothesized
  - lower threshold for sustainability on clayey soils?

PROGRAM PLAN

NEXT STEPS

2001 tasks (year preceding YR2 burn) …..

- Monitor field environment
  - soil, air temperature; canopy; rainfall; soil moisture
- Monitor vegetation
  - ground layer composition, seed influx, potential indicator species (e.g., legumes), phytometer (oak, pine) seedlings
- N transformation studies
  - litter decomposition, NH_4/NO_3 availability

Analyses of metrics of ecosystem response should reveal military training and forest management treatment combinations that are not sustainable

PRODUCTS

- Collins, B. Land use and disturbance on DOE and DoD sites. Westinghouse Environmental Advisory Committee Meeting. SRS, 8 November, 2000.
- Collins, B., J. Dilustro, L. Duncan, R. Sharitz, J V. McArthur, C. Romanek, J. Seaman, D. Imm, M. Cadenasso, and P. White. Thresholds of disturbance: land management effects on vegetation and nitrogen dynamics. SERDP Annual Technical Symposium, Arlington, VA. 28-30 November, 2000.
- Dilustro, J. , B. Collins, L. Duncan, R. Sharitz, J V. McArthur, C. Romanek, and J. Seaman. 2001. Thresholds of disturbance: land management effects on vegetation and nitrogen dynamics. Southeastern Biology 48(2):80.
- Partners Along the Fall-Line: Sandhills Ecology and Ecosystem Management Workshop. SREL Conference Center, March, 2001.
- Dilustro, J. , B. Collins, L. Duncan, R. Sharitz, J V. McArthur, C. Romanek, and J. Seaman. Thresholds of disturbance: land management effects on vegetation and nitrogen dynamics. Ecological Society of America, August, 2001.
- Collins, B., J. Dilustro, L. Duncan, and R. Sharitz. Soil type and disturbance intensity effects on vegetation: an example from Fort Benning, GA. Planned publication for J. Torrey Botanical Society.

SERDP
Strategic Environmental Research and Development Program
Improving Mission Readiness Through Environmental Research

US Army Corps of Engineers

SEMP Management

- Budget Projections
- Milestone Accomplishment
- FY 2000 Calendar of Activities
- Where is SEMP (in re other initiatives)
- Resolution of Items from 2000 Review

FY01 Milestones (Management Activities)

Milestone	Scheduled Completion Date	Actual Completion Date
Update SEMP information package	Nov-00	Nov-00
Hold session of TAC to review current progress of SEMP, review the emerging product of SEMP and to provide input for future plans	Dec-00	Nov-00
Final Report entitled, "Plans and Progress of the Strategic Environmental Research and Development Program (SERDP) Ecosystem Management Project (SEMP)	Mar-01	Apr-01*
Host "Along the Fall Line" ecoregional workshop	Mar-01	Mar-01
Final Framework Report	Jun-01	
2nd edition of SEMP newsletter	Jul-01	
Review of monitoring program and repository	Sep-01	
Report on effectiveness of the monitoring and repository projects	Dec-01	
FY01 Annual Technical Report	Dec-01	
Host Site Coordination Reports	Monthly	
Maintain and upgrade SEMP website	Continuous	

Action Item
(April 2000)

- **Correlate run off peak flow from various land uses, both military and agricultural (e.g., plowed; conservation tillage; grassed fields). Your approach to this correlation should augment Chuck Garten's project (i.e, using key soil quality measurements to characterize the effect of disturbances and land use).**

  (To Bill DeBusk, CS 1114A)

Response

- **This suggestion is in line with our current plans for hydrologic study. Among other studies, we intend to characterize peak flow, time to peak, centroid lag, runoff percentages and runoff duration in watersheds representing a variety of military and non-military land uses. Our intent is to select watersheds (typically of order 1 or 2) representing a cross-section of land use/land cover at Ft. Benning and, hopefully representative of other bases along the fall line. I'm not sure how we would obtain direct measurements for agricultural or grassed watersheds at Benning, but we could possibly extract relevant information from the literature.**

- **Our hydrologic measurements will likely augment the work of Chuck Garten, but will be more directly linked to our own determinations of soil quality indicators of disturbance and land use. As a reminder, our soils group is evaluating a comprehensive set of variables related to storage and cycling of C, N and P, including physical, chemical and microbiological properties and processes.**

Bill DeBusk, PI, 27 Jul 00

Action Item

(April 2000)

- Provide a draft transition plan on a product-by-product basis. Identify the end products that will be transitioned (I.e., monitoring protocol, data repository, actual data).
- Address the feasibility of these products being downloadable from a website.
- Explore how Ft. Benning/SEMP can be recognized as a MEL (Master Environmental Library) site node for DMSO (Defense Modeling and Simulation Office) and NIMA (National Imaging and Mapping Agency) clearinghouse.

Conceptual Transition Plan

- **Each component has an element to transition**
  - Basic ecosystem functional data & processes
  - Standardized real-time environmental data streams
  - Functional, maintainable data repository
  - Adaptive management tools using these data
- **Time frames vary for different components**
  - FY 2005 to 2010
- **Subsequent transitions will be to other installations**
  - Mechanical components most easily transitioned
  - Adaptive management tools will depend on local goals

Feasibility of products being website downloadable

- Repository concept not restricted to data
- Development of modular tools for adaptive management relies on web access
- Web access and internet transfer already integral part of long range plans
- Basic management tools will require site adaptation
  - will need paths to local databases
  - will depend on characteristics of installation's GIS implementation

FY2001 Plans for SEMP

NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	
					TTAWG IPR						
SON Deferred		Adaptive Mgmt Study			Installation Land Mgmt Tasks Evaluated			Study Results to TAC	TAC SON Recommend ations		
	TAC Meeting							TAC Meeting			
Research Coord Meeting				Along the Fall Line Ecoregional Workshop		Sharing SEMP Results Workshop	SEMP Newsletter				
American Society of Agronomy Presentation/ Session	SERDP ESTCP Symposium			Military Fish and Wildlife Meetings/ Session					Ecological Society of America Meeting/ Session		
	Research Results Reported			Research Results Reported			Research Results Reported			Research Results Reported	
		Repository Plan and Approach		Guidelines for Baseline Monitoring Programs	FY00 Annual Report						

- SAB and TTAWG Briefings
- SON Activities
- TAC Activities
- Communication Notes and Workshops
- Scientific Meetings and Exchange
- Research Results Reported
- Publications/Reports