

# The SERDP Ecosystem Management Project CS-1114/7

**William D. Goran**

**U.S. Army Engineering Research  
and Development Center (ERDC)**

**Brief to the Scientific Advisory Board (SAB)**

**20 October 1999**

# Outline

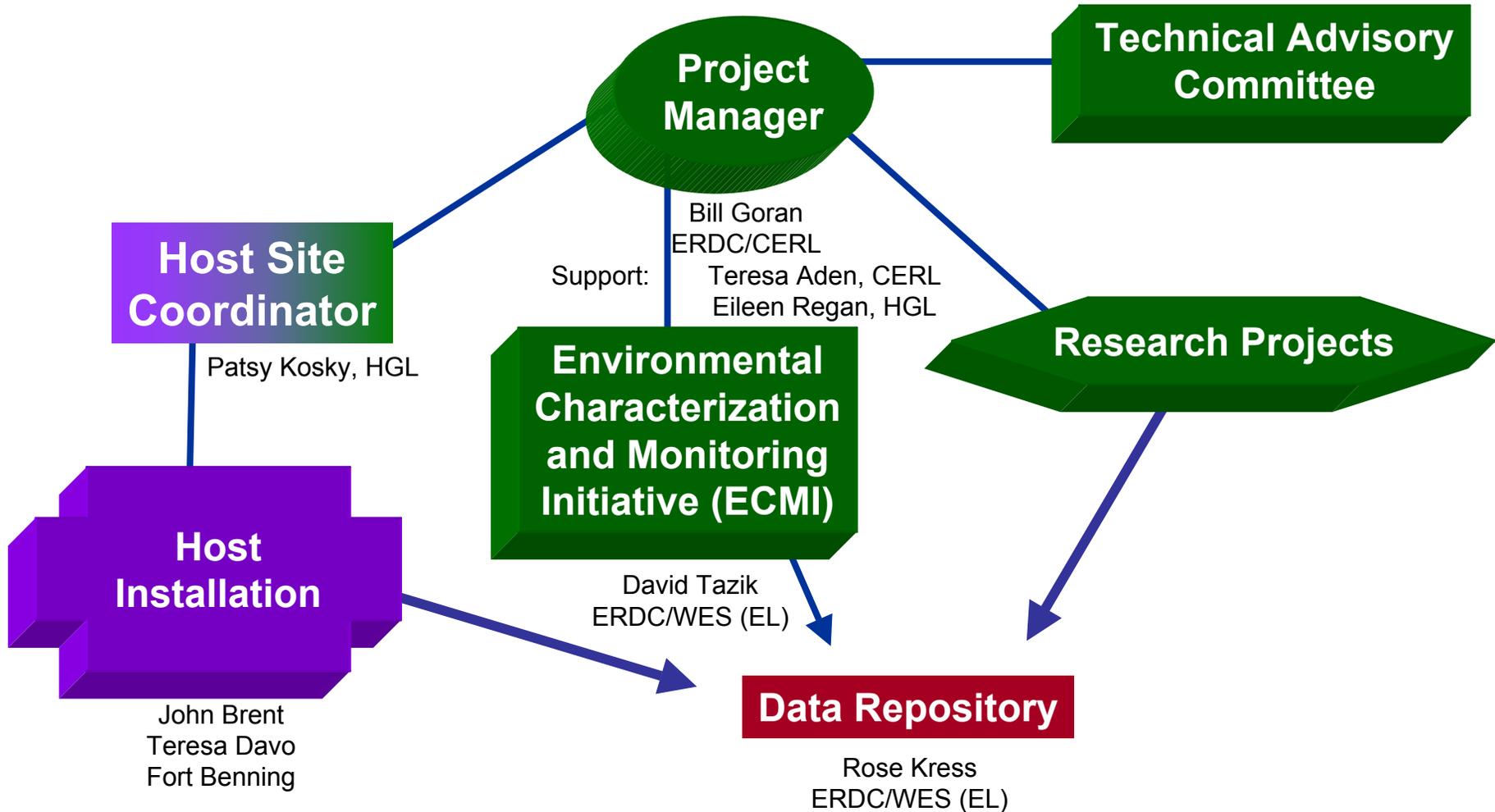
- Introduction -- W. Goran
- Ecosystem Characterization and Monitoring Initiative -- R. Kress
- Introduction to FY99 Research Projects -- W. Goran
- Indicators of Ecological Change (CS-1114C-99) -- V. Dale
- Other FY99 Projects -- W. Goran
- FY00 New Research Projects and Program Plan -- W. Goran

# Technical Objectives



- To Address DoD Requirements and Opportunities in Ecosystem Management Research (as identified by the 1997 SERDP Ecosystem Science Workshop)
  - Indicators of ecosystem status
  - Ecological thresholds
  - Role of manipulating biogeochemical cycles
  - Importance of spatial/temporal scales
- To Establish a Long-term Research Site (or sites) on DoD Lands for DoD Relevant Ecosystems Research
- To Conduct Ecosystem Research and Monitoring Activities Relevant to DoD Requirements and Opportunities
- To Facilitate the Integration of Results and Findings of Research into DoD Ecosystem Management Practices

# SEMP Organization Chart



# Technical Advisory Committee for SEMP



- Mr. Peter Boice, Director of Conservation Programs, Deputy Undersecretary for Defense, Environmental Security
- Dr. Roger Dahlman, Program Manager, U.S. Department of Energy
- **Dr. Mark Fenn, U.S. Department of Agriculture, Forest Service**
- Dr. Penny Firth, National Science Foundation
- Mr. Richard McWhite, Natural Resources Chief, Eglin Air Force Base
- Ms. Kim Michaels, Army Environmental Center, Conservation Branch
- Dr. Doug Ripley, Headquarters, Air Force
- **Dr. James Spotila, Drexel University**
- Dr. J. Whitfield Gibbons, Savannah River Ecology Lab and University of Georgia
- Ex Officio Members from SERDP, ERDC and Fort Benning



# Ecosystem Characterization and Monitoring Initiative

**Rose Kress**

**US Army Engineer Research & Development Center**

# Monitoring Design Team

- **ECMI Design Team**

- Dr. Rose Kress, Physical Scientist, ERDC
- Dr. Jean O'Neil, Ecologist, ERDC
- Dr. Dave Price, Ecologist, ERDC
- Dr. Dave Tazik, Ecologist, ERDC
- Dr. George Gertner, Biometrician, Univ. of Illinois

- **Coordination & Review**

- Peer Review Group
- SEMP TAC
- SEMP Researchers
- Fort Benning Staff

- **Consultants**

- Dr. Jim Gosz, LTER Program Coordinator, University of New Mexico
- Dr. Dave Coleman, LTER Site Coordinator, Coweeta Hydrologic Laboratory
- Dr. Dale Magoun, Statistician, University of Louisiana
- Dr. Tony Krzysik, Ecologist, ERDC, CERL

# Monitoring Objective

- Characterize the long-term spatial and temporal dynamics of key ecosystem properties and processes
  - Baseline ecosystem monitoring in support of SEMP research
  - Long-term ecological data set

# ECMI Phases

<p>PHASE I 1999 - 2001 <b><u>DESIGN</u></b></p>	<p>PHASE II 2002 - 2005 <b><u>ADAPT</u></b></p>	<p>PHASE III 2006 - <b><u>MAINTAIN</u></b></p>
<p>Extended design, implementation and documentation</p>	<p>Adaptation based on: a) initial monitoring results b) SEMP research results c) land management experience</p>	<p>Long-term maintenance and technology upgrades</p>

# Key Properties and Processes

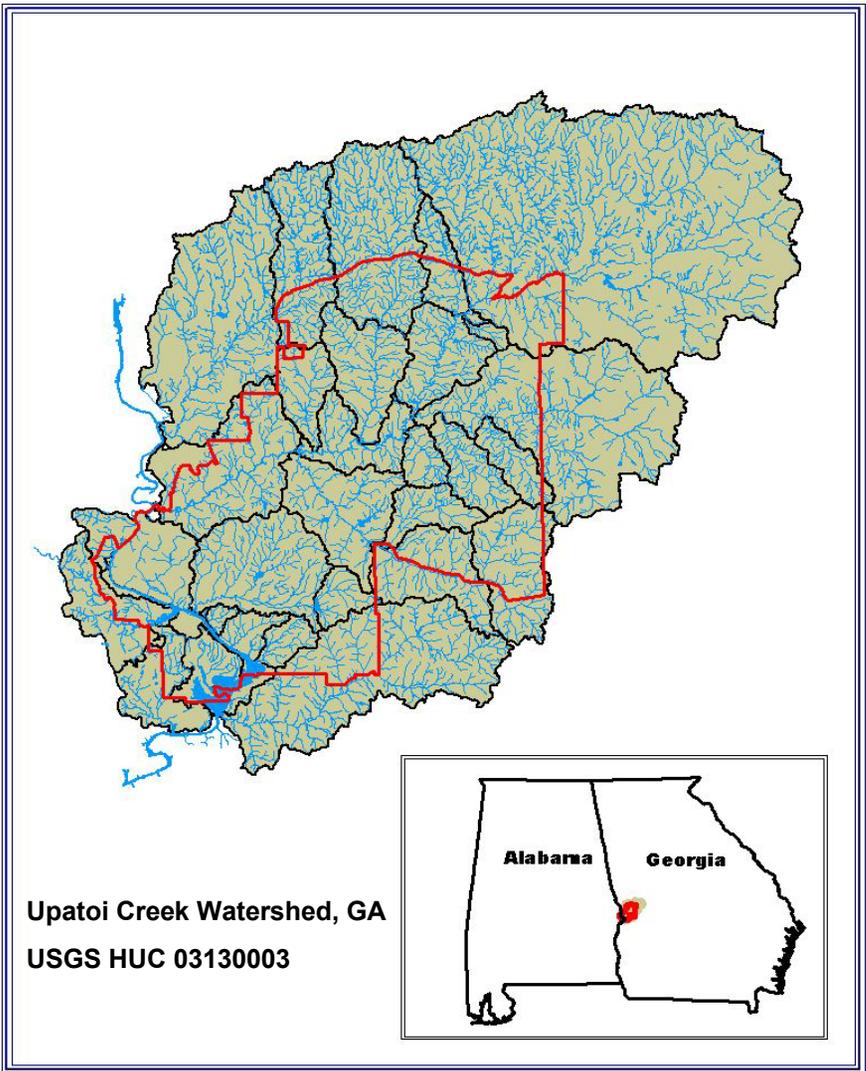
- Those for which fundamental understanding is required to ensure goals of sustainability can be met
  - Hydrologic flux and storage
  - Biological productivity
  - Biogeochemical cycling and storage
  - Decomposition
  - Maintenance of biological diversity

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

# Monitoring Variables Selected

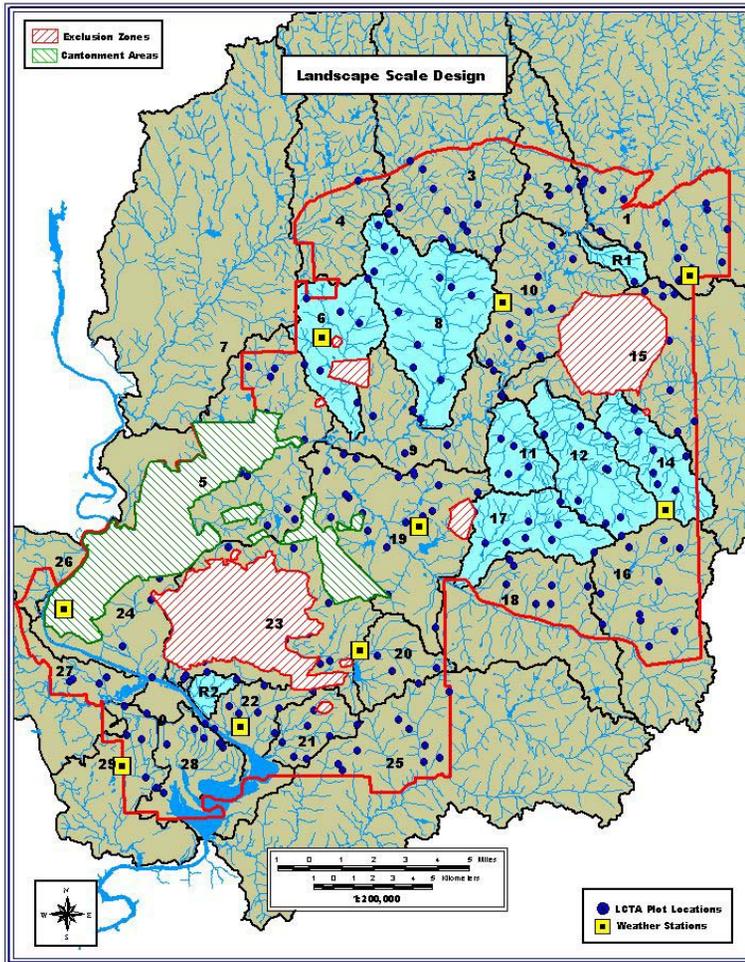
Technique	SPATIAL SCALE		
	Regional	Installation	Watershed
Remote Sensing Image processing GIS	Net primary productivity (NPP) <i>EOS/ MODIS Sensor</i>	Land cover type Land cover pattern Vegetation density <i>Multispectral imagery</i>	Land cover type Land cover pattern Vegetation density <i>Multispectral imagery</i>
Automated Recorders / Remote data download		Weather  <i>Nine stations operational</i>	Surface hydrology - flow and quality  <i>Two stations operational</i>
Field Measurements		Terrestrial productivity Erosion / deposition  <i>Co-locate with LCTA</i>	Terrestrial productivity Erosion / deposition  Aquatic productivity Aquatic decomposition

# Regional Scale



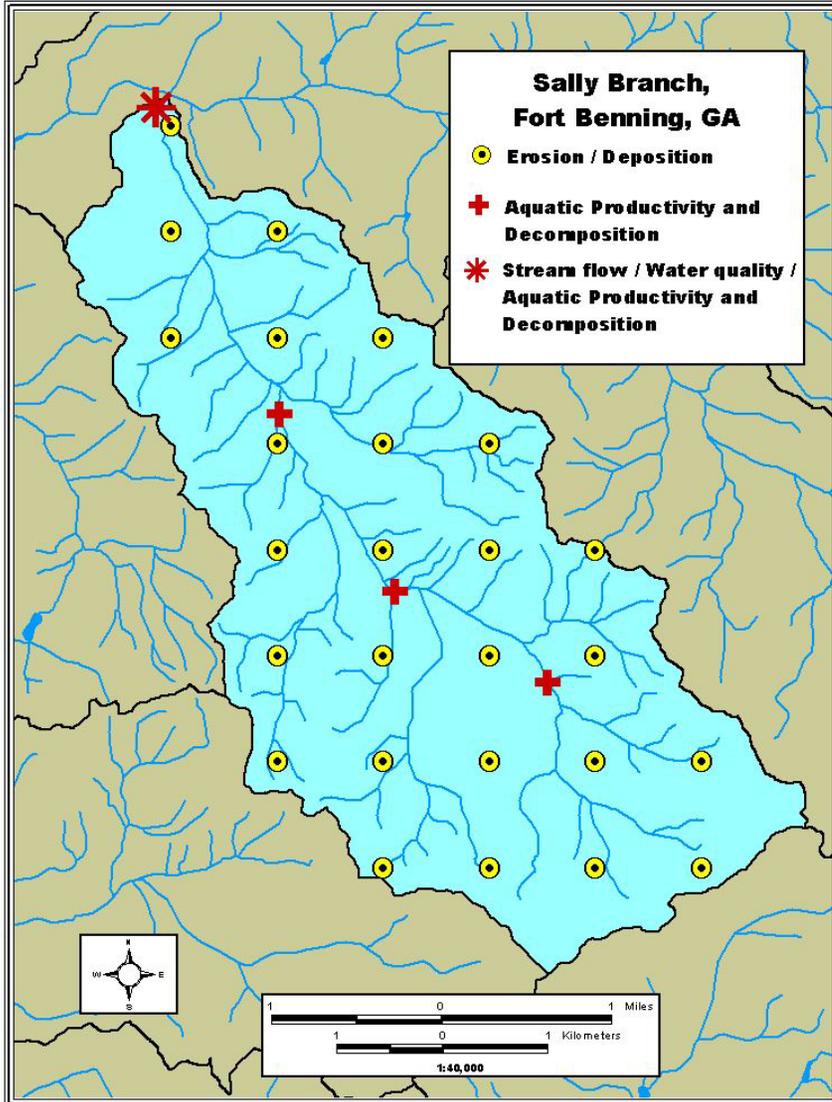
- Net primary productivity
  - Status:** EOS/MODIS delay
- Land cover type/pattern
  - Status:** Landsat 7 ETM +15;  
IKONOS 1M  
Both up
- Physical terrain
  - Status:** completed
    - Digital elevation model
    - Surface hydrology
    - Watershed delineation
    - More

# Installation Scale



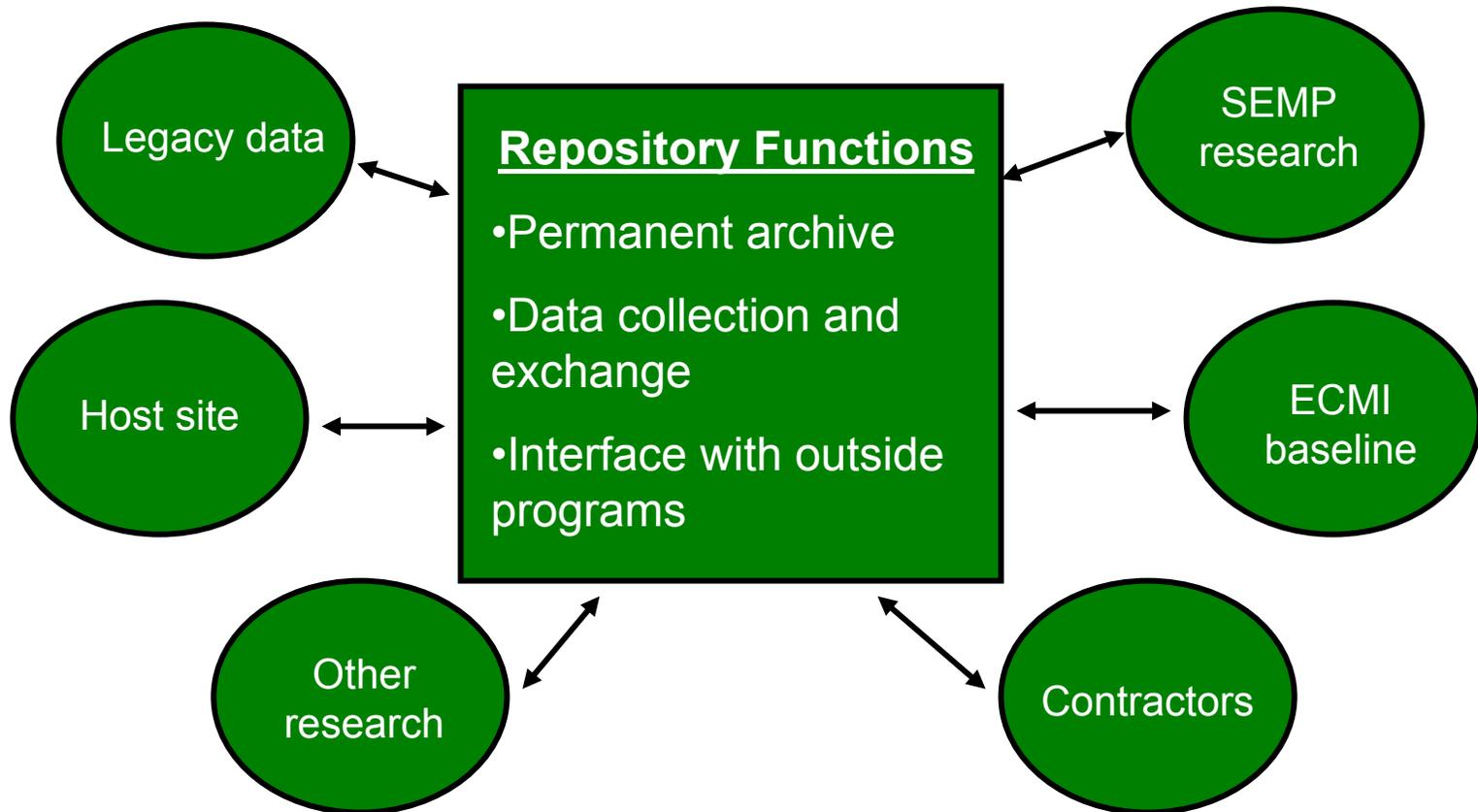
- Weather
  - **Status:** 9 stations operational
- Terrestrial productivity and Erosion/deposition
  - **Status:** Co-locate with LCTA; 200 existing stratified random sites
- Land cover type/pattern
  - **Status:** Landsat 7 ETM +15; IKONOS 1M

# Watershed Scale



- Erosion/deposition
- Terrestrial productivity
  - **Status:** systematic sample from random starting point; 1km grid
- Aquatic productivity /decomposition
  - **Status:** stream continuum theory for placement
- Surface hydrology
  - **Status:** two stations operational
- Land cover/pattern
  - **Status:** same

# Data Management



# SEMP Research Projects



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## FY99 Topic -- Change Indicators

<u>Organization</u>	<u>PI</u>	<u>Title</u>
	Dr. V. Dale	Indicators of Ecological Change



Dr. W. DeBusk	Determination of Indicators of Ecological Change
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US Army Corps of Engineers.

Dr. T. Krzysik	Development of Ecological Indicator Guilds for Land Management
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## FY00 Topic -- Disturbance Thresholds

<u>Organization</u>	<u>PI</u>	<u>Title</u>
	Mr. C. Garten, Jr.	Disturbance of Soil Organic Matter and Nitrogen Dynamics: Implications for Soil and Water Quality



The University of Georgia

Savannah River Ecology Laboratory

Dr. B. Collins	Thresholds of Disturbance: Land Mgmt Effects on Vegetation and Nitrogen Dynamics
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# Indicators of Ecological Change (CS-1114C-99)

Virginia Dale  
Environmental Sciences Division  
Oak Ridge National Laboratory  
Oak Ridge, Tennessee

# Participants

- Virginia Dale, Environmental Sciences Division, Oak Ridge National Laboratory — Landscape ecology
- Suzanne Beyeler, Institute for Environmental Studies, Miami University, Ohio — Terrestrial indicators
- Thomas Foster, Anthropology Department, Pennsylvania State University — Historical land cover
- Patrick Mulholland, Environmental Sciences Division, Oak Ridge National Laboratory — Aquatic ecology
- Jack Feminella and Ken Gray, Department of Zoology, Auburn University — Macroinvertebrates
- David White and Sarah McNaughton, Center for Environmental Technology, University of Tennessee — Soil microbiology
- Teresa Davo, Fort Benning — Current monitoring programs, technology transfer
- John Hall, The Nature Conservancy — Liaison between science and management, technology transfer

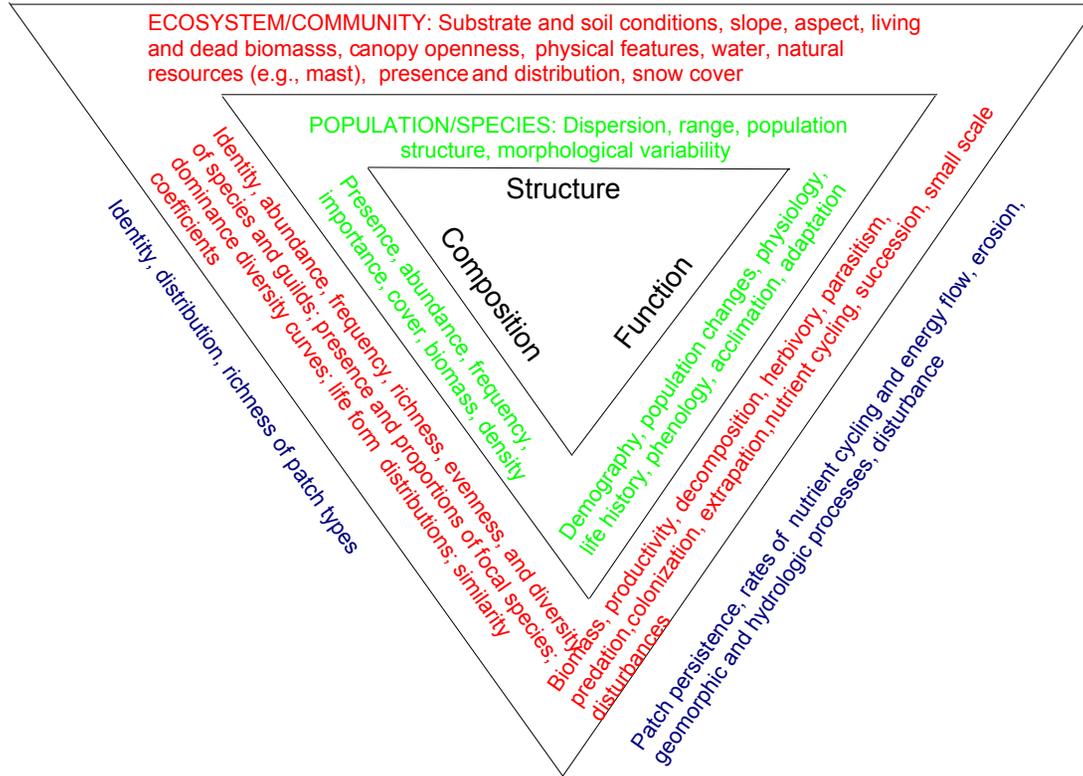
# Technical Objective

- To identify indicators that signal ecological change in intensely versus lightly used ecological systems.
- To ensure that these indicators are feasible for the installation staff to measure and interpret and thus can become a part of the ongoing monitoring system at the installation.

# Technical Approach: Background

- The concept of biological integrity frames selection of system-level indicators that are useful for DOD land managers.
- Biological integrity refers to a systems wholeness
  - the presence of appropriate composition: species, populations and communities
  - the occurrence of processes at appropriate scales
  - structural features

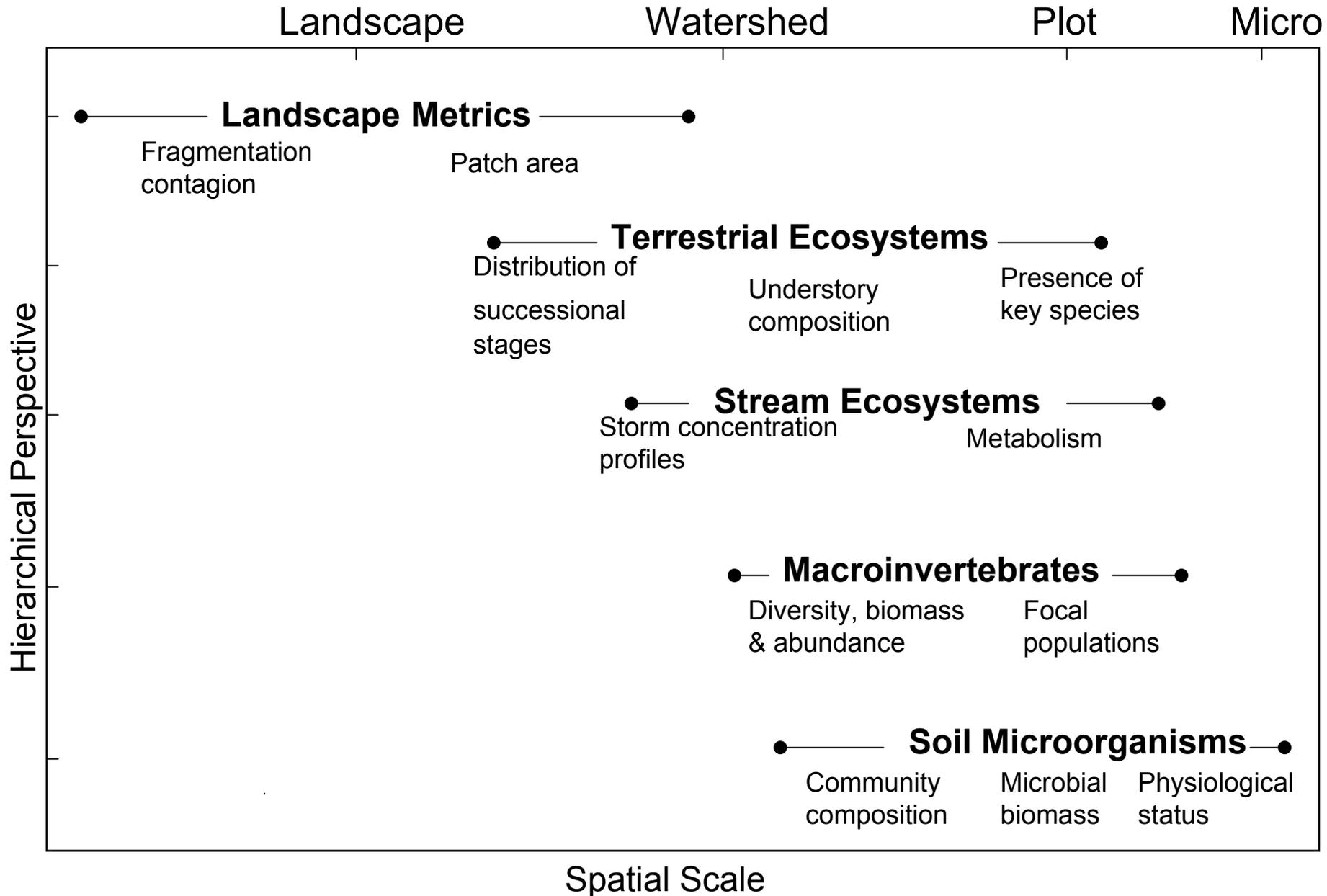
LANDSCAPE /REGION: Spatial heterogeneity; patch size, shape and distribution; fragmentation; connectivity



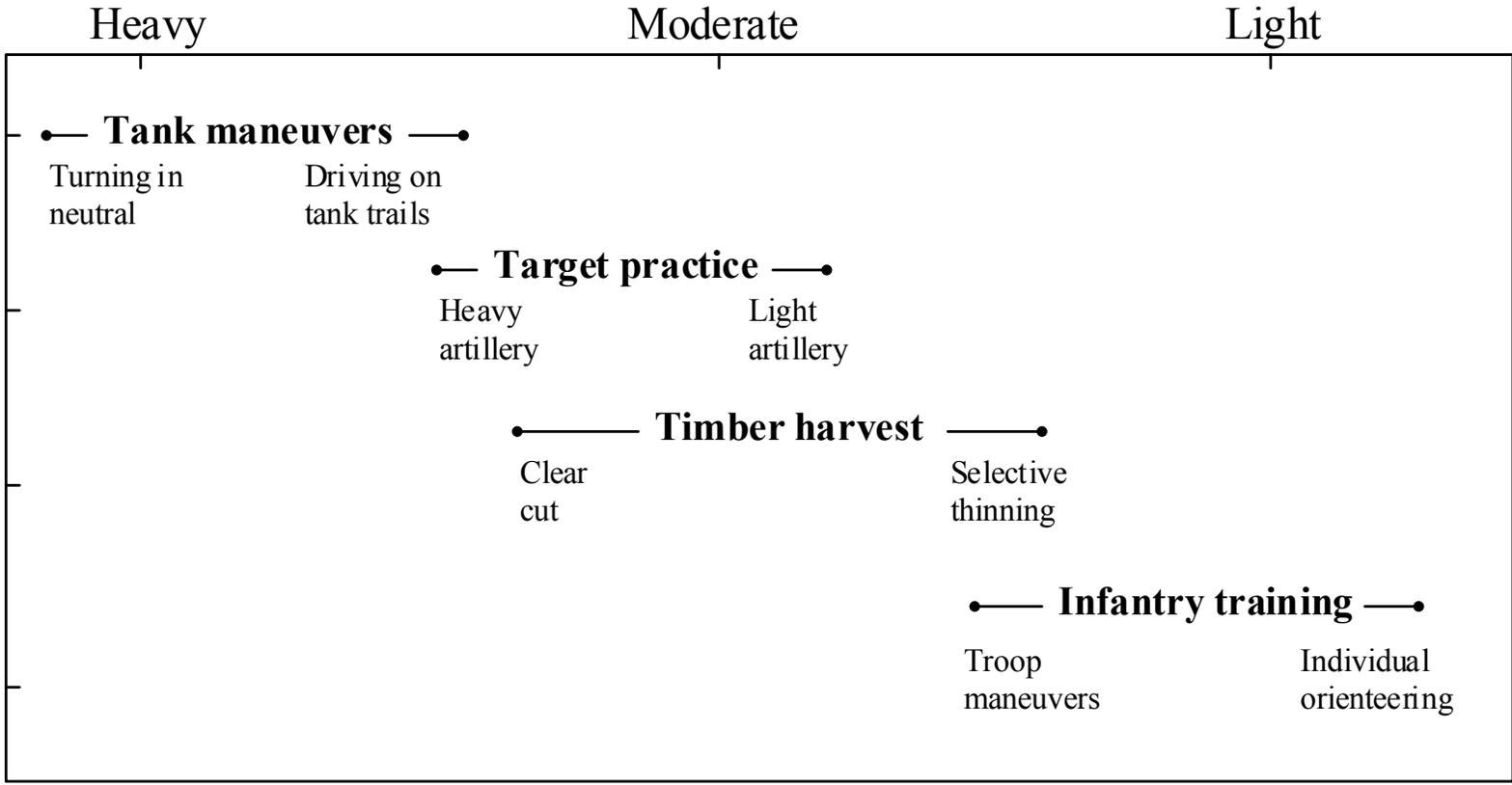
# Criteria for Indicators

- 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

# Hierarchical Overlap of Suite of Ecological Indicators



## Physical Stresses Along an Intensity Gradient



Intensity Scale

## Contributions to Other SEMP Projects

- Criteria for selecting a suite of indicators
- Protocol for selecting indicators
- Data from our studies on indicators: terrestrial, stream, and soil microbes
- Historical vegetation map

## Coordination with Other SEMP Projects

- Baseline information provided by ECMI and LCTA
- Co-location of sampling sites and sharing of data with other SEMP projects
  - Storm hydrological chemistry
  - Stream macroinvertebrates
- A comprehensive picture of changes in microbial community structure

# Determination of Indicators of Ecological Change (CS-1114A-99)

Team Lead Dr. William F. DeBusk  
University of Florida, Gainesville

<u>Team Member Name</u>	<u>Task/Topic</u>	<u>Institution</u>
W. F. DeBusk	Soil/Sediment/Water Quality	Univ. of Florida
K. R. Reddy	Soil/Sediment/Water Quality	Univ. of Florida
A. V. Ogram	Molecular Microbial Ecology	Univ. of Florida
D. L. Miller	Vegetation ecology	Univ. of Florida
G. W. Tanner	Vegetation ecology	Univ. of Florida
J. Jacobs	Surface Water Hydrology	Univ. of Florida
P. S. Rao	Vadose Zone Hydrology	Purdue Univ.
W. Graham	Synthesis/Modeling; Hydrology	Univ. of Florida

# Determinations of Indicators of Ecological Change

William DeBusk, University of Florida  
(CS-1114A-99)



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- Technical Premise
  - Soil serves as central ecosystem component linking terrestrial and aquatic habitats
- Technical Objective
  - Evaluate a suite of parameters related to properties and processes in the understory vegetation, soil and surface hydrology as potentially sensitive indicators of ecosystem integrity and ecological response to natural and anthropogenic factors



# Development of Ecological Indicator Guilds for Land Management (CS-1114B-99)



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Team Lead Dr. Anthony J. Krzysik, U.S. Army CERL

## Team Member Name

## Task/Topic

## Institution

John M. Emlen

Theoretical Ecology

U.S. Geological Survey

D. Carl Freeman

Plant Ecology & Physiology

Wayne State University

John H. Graham

Population Genetics

Berry College

David A. Kovacic

Ecosystem Ecology

University of Illinois

Lawson M. Smith

Geomorphology/Geology

Geotechnical Lab, WES

Ann-Marie Trame

Plant Populations

USACERL

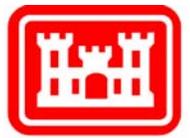
John C. Zak

Soil & Microbial Ecology

Texas Tech University

# Development of Ecological Indicator Guilds for Land Management

Anthony Krzysik, U.S. Army CERL  
(CS-1114B-99)



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## Technical Objective

Develop “Ecological Indicator Guilds” based on ecosystem relevant design criteria and landscape scales, for the purpose of monitoring biological viability, long-term productivity, and ecological sustainability of military training and testing lands.

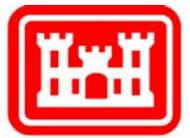
## Technical Approach

- Identify Ecological Indicator Guilds Based Upon Assessment of:
  - Indicator Species
  - Ecofunction Groups
  - Geomorphic Indicators
  - Developmental Instability and Plant Stress
  - Nutrient Flux
  - Microbial Functional Activity

response to stressors

along gradient of military  
use intensity

# Disturbance Thresholds SON 2000 Solicitation



# Thresholds of Disturbance: Land Management Effects on Vegetation and Nitrogen Dynamics (CS-1114E-00)

Team Lead Dr. Beverly S. Collins, Savannah River  
Ecology Laboratory (SREL)

<u>Team Member Name</u>	<u>Task/Topic</u>	<u>Institution</u>
T. Hinton	Radioecology	SREL
R. Sharitz	Plant Ecology	SREL
J. McArthur	Microbial Ecology	SREL
C. Romanek	Geochemistry	SREL
J. Seaman	Soil Chemistry	SREL
M. Cadenasso	Landscape-level Disturbance Consequences	Institute of Ecosystem Studies (IES)
D. Imm	Botany	U.S. Forest Service Sav. River Institute (SRI)
P. White	Disturbance Ecology	University of North Carolina

# Thresholds of Disturbance: Land Management Effects on Vegetation and Nitrogen Dynamics (CS-1114E-00)

- Objective of Research
  - Evaluate the ecological effects of military training and forest management for longleaf pine, to determine if there are thresholds beyond which upland ecosystems cannot sustain the combined effects of thinning, burning and military traffic disturbances.

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

Team Lead Mr. Charles T. Garten, Jr., Oak Ridge  
National Laboratory (ORNL)

<u>Team Member Name</u>	<u>Task/Topic</u>	<u>Institution</u>
T. Ashwood	GIS	ORNL
B. Lu	Lab Technician	ORNL

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

- Objectives of Research
  - Characterize the effect of disturbances and land use on key measures of soil quality
  - Determine whether there are thresholds associated with natural and/or anthropogenic disturbance that establish the potential recovery of soil quality on disturbed lands

# Funding Program

• SEMP Management	153,516
• SEMP Host Coordinator	75,000
• SEMP Framework Integration Report	50,000
• SEMP ECMI	580,000
• SEMP Repository	110,000
• FY99 Research Projects	
– Indicators of Ecological Change (ORNL)	400,000
– Determination of Indicators of Ecological Change (U of F)	426,220
– Development of Ecological Indicator Guilds (ERDC)	403,010
• FY00 Research Projects	
– Disturbance of Soil Organic Matter and Nitrogen Dynamics (ORNL)	200,000
– Threshold of Disturbance (SREL)	258,254
<b>Total FY00 Program</b>	<b>\$2,656,000</b>

# Milestones



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- Technical Management Activities
  - Second site recommendation report 07/15/00
  - Conceptual framework for SEMP 08/15/00
- TAC Activities
  - Session to consider future plans and  
framework schema 12/15/99
- SON Activities
  - Final FY02 Statement of Need 09/01/00
- ECMI Activities
  - Phase I repository on-line 11/30/99
  - QA/QC planning 02/28/00
- Communication and Data Management Activities
  - SEMP public website revision 11/15/99
  - SEMP information package 11/30/99
- Research Team Annual Reports 09/15/00

# SEMP Website



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# http://www.denix.osd.mil/SEMP

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SERP Ecosystem Management Project (SEMP)

**SEMP**

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