

# The SERDP Ecosystem Management Project CS-1114/7

**William D. Goran**

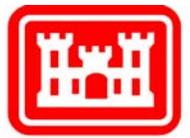
**U.S. Army Engineering Research  
and Development Center (ERDC)**

**U.S. Army Construction Engineering Research  
Laboratory (USACERL)**

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

**16 March 1999**

# The Problem



US Army Corps  
of Engineers.

## Understanding of Ecosystem Management

- 👍 How does the ecosystem function?
- 👍 How do mission and protected resources interact?
- 👍 What are the thresholds of degradation?
- 👍 How might beyond-the-fenceline dynamics impact the mission?

**Knowledge Gaps**

## Guidance for Ecosystem Management

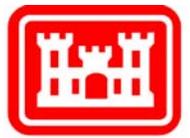
- 👎 DoD Guidance
- 👎 Services Guidance
- 👎 SIKES Act/Regs
- 👎 Endangered Species Act/Regs
- 👎 Public Concerns

**Adaptive Management**

## Ecosystem Management Practices

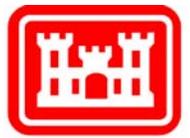
- |                       |                               |
|-----------------------|-------------------------------|
| 👍 Usage Management    | 👍 Invasive Species Controls   |
| 👍 Habitat Protection  | 👍 Species Population Controls |
| 👍 Habitat Restoration | 👍 Erosion Control             |
| 👍 Controlled Burning  | 👍 Sediment Management         |
| 👍 Planting/Harvesting |                               |

# 1997 Ecosystem Research Workshop Identified Research Themes for “Knowledge Gaps”



- Indicators of Ecosystem Status
  - Ecosystem health
  - Signals of change
- Ecological Thresholds
  - Disturbance beyond unaided recovery
  - Minimum population/habitat size
  - Minimum species, ecosystem and landscape diversity
  - Critical zones along biogeochemical gradients

# 1997 Ecosystem Research Workshop Identified Research Themes for “Knowledge Gaps”



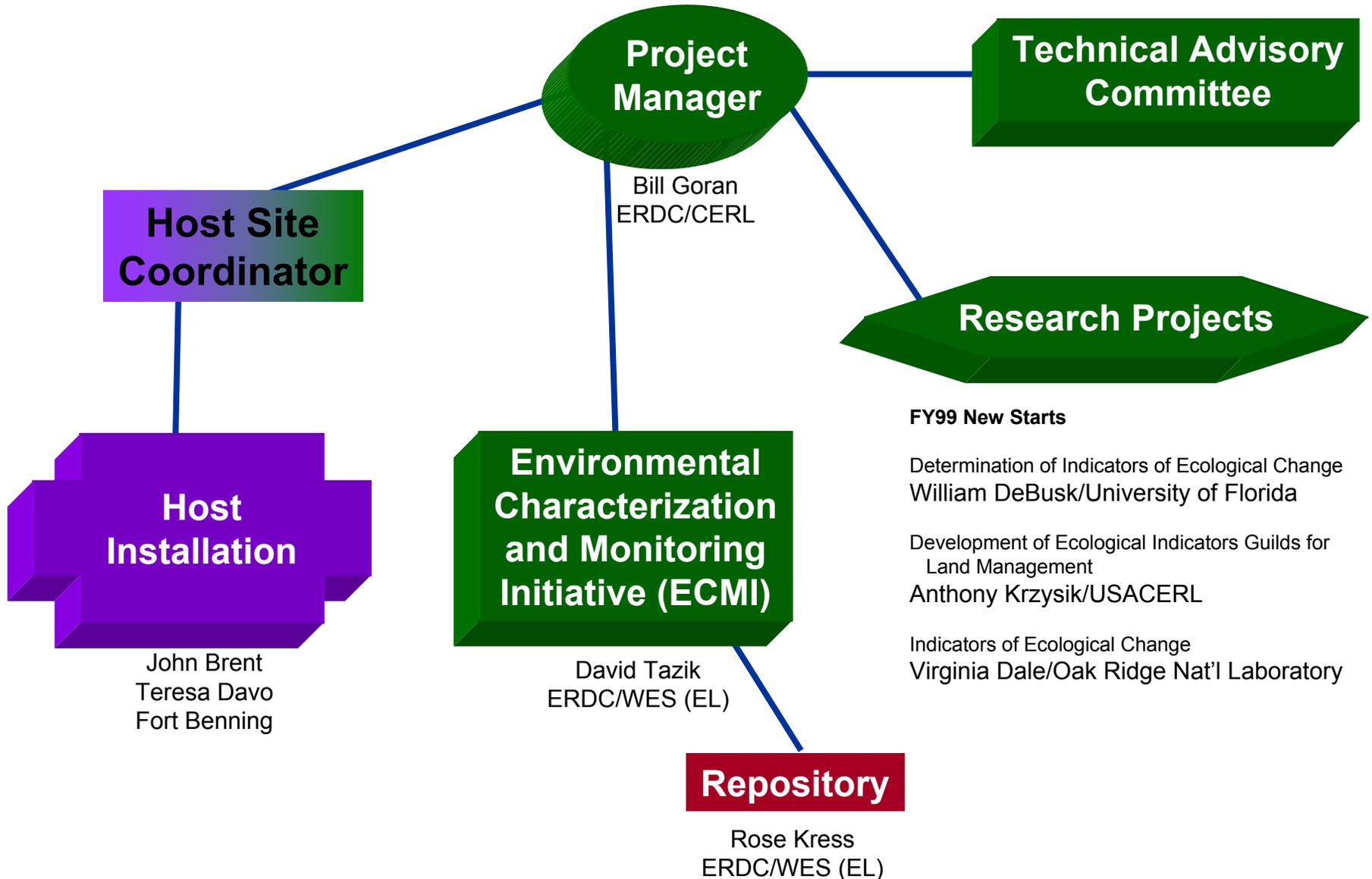
- Role of Manipulating Biogeochemical Cycles
  - To favor one species over another
  - To promote biodiversity
  - To promote recovery
- Important of Spatial/Temporal Scales
  - In the disturbance/recovery cycle
  - In off-post/on-post relationships
  - Relationship between shape, pattern, size and ecosystem dynamics

# Technical Objectives

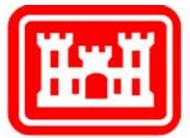


- To Address DoD Requirements and Opportunities in Ecosystem Management Research (as identified by the 1997 SERDP Ecosystem Science Workshop)
- To Establish a Long-term Research Site (or sites) on DoD Lands for DoD Relevant Ecosystems Research
- To Conduct Ecosystem Research and Monitoring Activities 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. Penny Firth, National Science Foundation
-  Mr. Richard McWhite, Natural Resources Chief, Eglin Air Force Base
-  Ms. Kim Michaels, Army Environmental Center, Conservation
-  Dr. Sam Pearsall, Science Advisor, North Carolina Nature Conservancy
-  Dr. Doug Ripley, Headquarters, Air Force
-  Dr. James Spotila, Chief Environmental Scientist, Assistant Sec. of the Army (IL&E)
-  Dr. J. Whitfield Gibbons, Savannah River Ecology Lab and University of Georgia
-  Ex Officio Members from SERDP, ERDC and Fort Benning



# Why Fort Benning?



US Army Corps  
of Engineers.

- Large: 182,000 acres
- Enduring: Category 1 ITAM
- Home to: Multiple TES Species
- Extensive Data Sets: LCTA +
- Proactive Response to SEMP
- Numerous Military Use Stresses

Region of Interest: Southeast



- ➔ Many DoD Installations
- ➔ Ecosystem Constraints to Mission

## Land Resource Areas

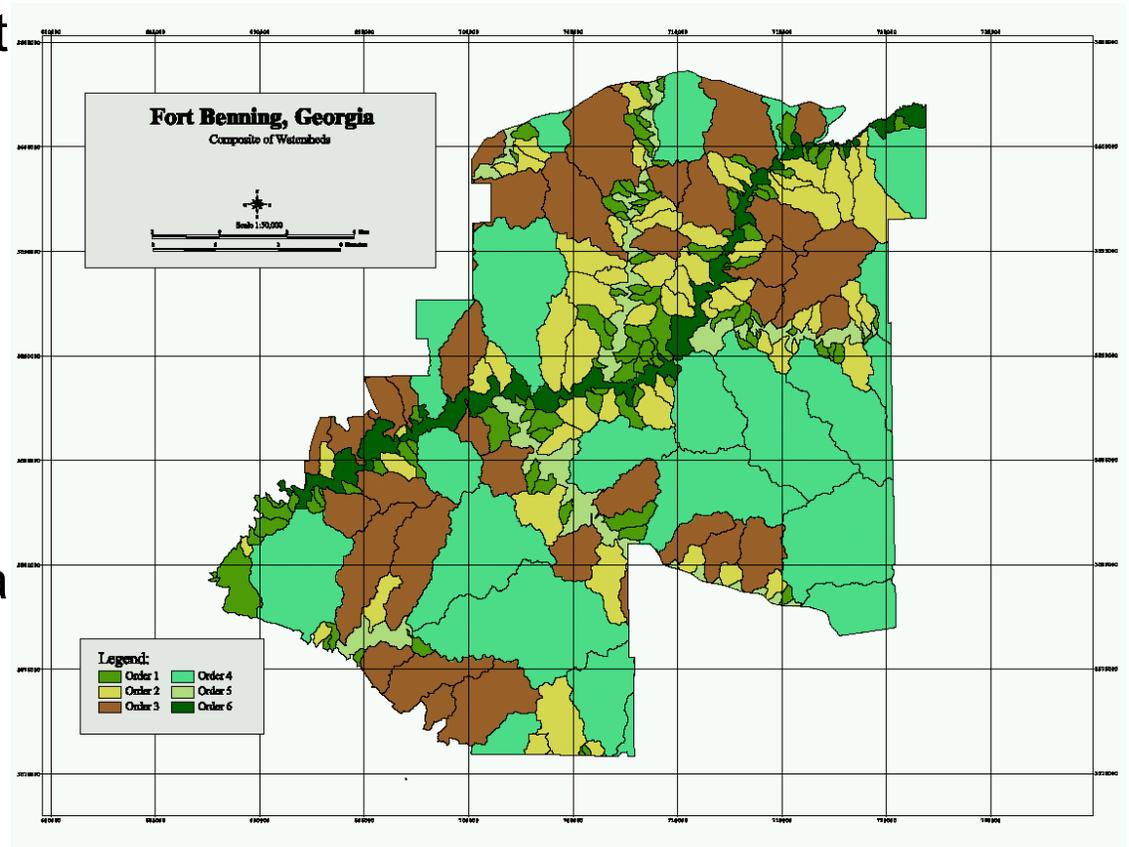


## Home of Infantry

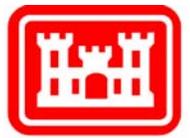


# ECMI Approach

- Inventory and Document Existing Data and On-going Monitoring Programs
- Design the Baseline Monitoring Program
- Implement the Baseline Monitoring Program
- Establish and Maintain a Data Repository
- Adapt the Monitoring Program



# Change Indicators SON 99 Solicitation

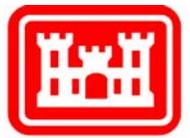


- Identify and Test Potential Indicators of Change
- Define Historic Range of Variation in Indicators
- Develop Methods for Determining Change
- Identify Factors Leading to Change



# Determinations of Indicators of Ecological Change

William DeBusk, University of Florida

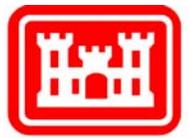


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of Engineers.

- 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

# Determinations of Indicators of Ecological Change

William DeBusk, University of Florida



US Army Corps  
of Engineers.

## Technical Approach

- Within a Watershed, Measure and Model Dynamics Between Vegetation, Soils and Soil Micro-organisms, Water Quality and Sediment Loads Relative to Natural and Anthropogenic Factors
- 5-year Effort

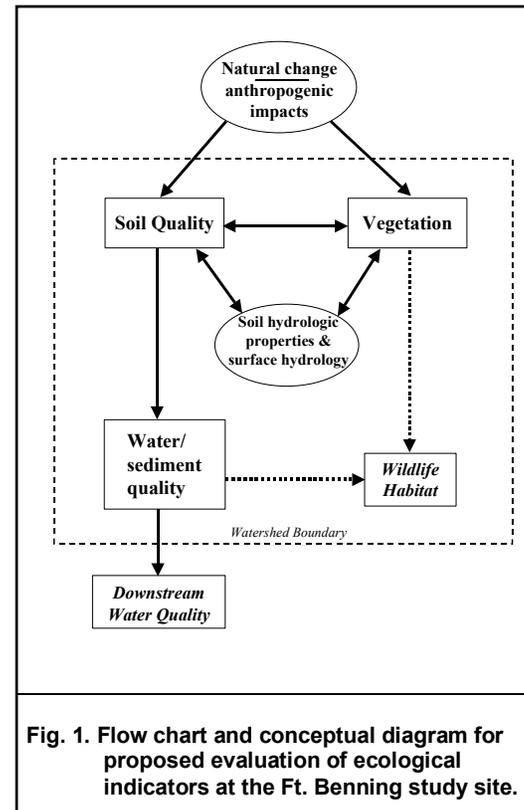
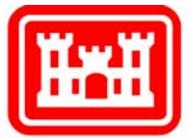


Fig. 1. Flow chart and conceptual diagram for proposed evaluation of ecological indicators at the Ft. Benning study site.

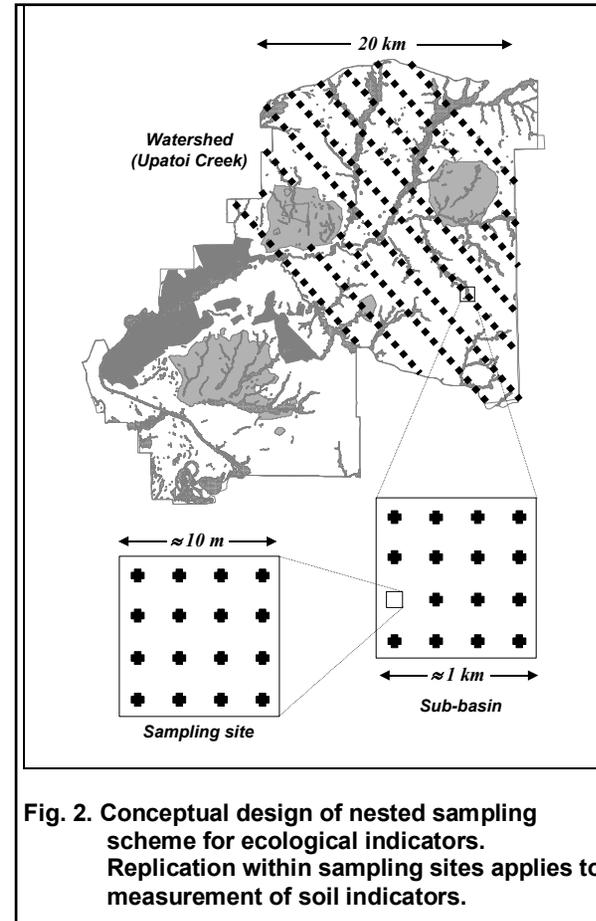
# Determinations of Indicators of Ecological Change

William DeBusk, University of Florida



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of Engineers.

- Parameters to be Sampled
  - Soil/sediment physical & chemical properties
  - Enzyme activity
  - Microbial biomass
  - Microbial respiration rate
  - Vegetation
  - Hydrology
  - Stream water quality

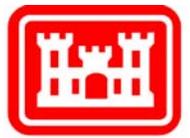


Upatoi Creek Watershed  
Selected Sub-basins

- Technical Concept
  - “biological integrity” or “system wholeness”
- Key Elements
  - Species Diversity
  - Ecosystem Function
  - Landscape Diversity
  - Ecosystem Structure
- Technical Approach
  - Historic Trends Analysis
  - Measure changes in biological integrity of
    - terrestrial ecosystem using a focal species approach
    - aquatic systems (land/water interactions and stream biological communities and processes)
    - soil microorganisms as a measure of the below-ground aspect of integrity
  - Perform “Impact” Experiments (with Ft. Benning)
  - Analyze Results in Terms of “Indicators”
  - Develop Tech Transfer Plan

# Indicators of Ecological Change

## Virginia Dale, ORNL



## Components of Biological Integrity

Hierarchy	Elements	Processes	Suggested Indicators
Taxonomic	Species	Range expansion or contraction	Range size
		Extinction	Number of populations
Ecological	Population	Abundance fluctuation	Age or size structure
		Colonization or extinction	Dispersal behavior
	Assemblage	Competitive exclusion	Number of species
		Predation or parasitism	Species evenness
		Energy flow	Number of trophic levels
		Nutrient cycling	Elements of redundancy
	Landscape	Disturbance	Fragmentation
		Succession	Number of communities
			Persistence



# Indicators of Ecological Change

Virginia Dale, ORNL  
6-Year Effort



US Army Corps  
of Engineers.

## Milestone

## Completion Date

Development of candidate indicators	Nov 99
Preparation of digitized land cover and historic disturbancy map for Ft. Benning	Mar 00
Definition of focal elements at Ft. Benning	Mar 00
Report on how historical trends affect candidate indicators	Nov 00
Implementation of experiment	Nov 01
Report on critical attributes of land/water interface	May 03
Report on key soil microorganisms at Ft. Benning	Mar 03

# Development of Ecological Indicator Guilds for Land Management

Anthony Krzysik, U.S. Army CERL



US Army Corps  
of Engineers.

## 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

# Development of Ecological Indicator Guilds for Land Management

Anthony Krzysik, U.S. Army CERL



US Army Corps  
of Engineers.

## Nested Sampling Sequence

### Hierarchy

### Sample Frame

### Variance Contrasts

Ecoregion

Sites

controls, gradient of disturbance

Ecosystem

Plots

uplands, riparian, lotic aquatic

Macrohabitat

Strata

habitat mosaics: patches,  
environmental gradients

Microhabitat

Samples

replicates



# Development of Ecological Indicator Guilds for Land Management

Anthony Krzysik, U.S. Army CERL



US Army Corps of Engineers.

## Milestone

## Completion Date

(after funds distribution)

Selection of study sites and plots	2 months
Selection of ecological indicators	8 months
Pilot study completed	12 months
Data assessment on military impacts on SE ecological systems	30 months
Use of Ecological Indicator Guilds for military land mgmt in southeastern United States	50 months
Applications of Ecological Indicator Guilds to southwestern, northwestern and northeastern ecoregions	60 months

# Disturbance Thresholds SON 00 Solicitation



- ☹ Thresholds for Disturbance Beyond Historic Range
- ☹ Spatial Extent, Intensity and Frequency



# Program Plan

Description	FY99	FY00	FY01	FY02	FY03	FY04
Management	182	200	200	200	200	200
Characterization, Monitoring and Repository	893	700	350	300	300	300
Developing Ecological Indicator Guilds (CERL)	392	382	388	388	368	
Determination of Indicators of Ecological Change (Univ. of FL)	400	404	409	403	398	385
Indicators of Ecological Change (ORNL)	400	400	400	400	400	400
Host Site Coordinator	70	70	72	75	75	75
Disturbance Thresholds (FY00 SON)		400	400	400	400	
FY02 SON				400	400	400
Lessons Learned Report/Analysis/Workshop			150			150
FY04 SON						650
<b>Total Funding</b>	<b>2337</b>	<b>2556</b>	<b>2369</b>	<b>2566</b>	<b>2541</b>	<b>2560</b>

# FY99 Milestones



## HOST INSTALLATION ACTIVITIES

MOU and license for facilitating work at study site 03/15/99

## SON ACTIVITIES

FY99 SON (Change Indicators)

Evaluation of proposals complete 11/30/98 (C)

Solicitation and Review of FY00 SON (Disturbance  
Thresholds) 08/30/99

## TAC ACTIVITIES

Hold session of TAC for review of project plans 12/15/98 (C)

Hold second TAC session for review of FY00 SON topics 08/15/99

## ECOSYSTEM CHARACTERIZATION & MONITORING ACTIVITIES

Complete monitoring status report for Fort Benning, GA 04/15/99

Develop plan for new monitoring activities at study site 06/15/99

Data repository design and access protocol 09/15/99

Acquisition and fielding of new monitoring equipment/stations 09/15/99

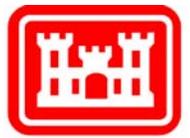
## OTHER ACTIVITIES

Plan and implement SEMP Website 03/31/99

# Deliverables

- Every 3 Years (01, 04, 07)
- Year 2 (with revisions in later years)
- Every Year
- As Planned
- Continuous Updates
- Lessons Learned Reports and Workshops
- Monitoring and Repository Plans
- Annual Monitoring and Repository Summary and Analysis
- Reports and Deliverables from Specific Research Efforts
- Website

# Mapping SEMP Investments to Need to Know Questions



How does the ecosystem function (and  
what do we monitor to track it)?

Change Indicators  
ECMI

How do mission and protected  
resources interact?

Change Indicators and  
Disturbance Thresholds

What are the thresholds of  
degradation?

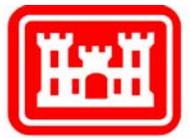
Disturbance Thresholds  
ECMI

How might beyond-the-fenceline  
dynamics impact the mission?

Landscape “Indicators” Project  
Disturbance Thresholds  
TNC Study (Legacy/Southeast)  
ECMI



# Backup Slides



US Army Corps  
of Engineers.

# Environmental Characterization and Monitoring Initiative (ECMI) Team



- Mr. Scott Jackson, EL (WES)
- Dr. Rose Kress, EL (WES)
- Mr. Robert Lozar, USACERL
- Dr. Jean O'Neal, EL (WES)
- Dr. David Price, USACERL
- Mr. Wade West, EL (WES)
- Dr. Adeyami, Clark-Atlanta University

## Repository

- Dr. Rose Kress, EL (WES)
- Ms. Kelly Dilks, USACERL

# Determination of Indicators of Ecological Change

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

## Team Member Name

## Task/Topic

## Institution

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



US Army Corps  
of Engineers.

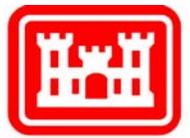
## Milestone

## Completion Date

(after funds distribution)

Project Work Plan	4 months
Installation-Wide Sampling	12 months
Low-Order Watershed Sampling (6 sites)	42 months
Intensive Sampling Along Local Gradients	42 months
Follow-up Installation-Wide Sampling	50 months
Synthesis and Modeling	56 months
Final Report	60 months

# Indicators of Ecological Change



Team Lead Dr. Virginia Dale  
Oak Ridge National Laboratory

## Team Member Name

## Role

## Institution

Virginia Dale	Landscape Ecology	ORNL
Thomas Foster	Historic Land Cover	Penn State Univ.
David White	Microbiology	Univ. of Tennessee
Pat Mulholland	Aquatic Ecology	ORNL
Katherine Eddins	Technology Transfer	The Nature Conservancy
John Hall	Technology Transfer	The Nature Conservancy
Teresa Davo	Impact Experiments and T2	Ft. Benning DOT

# Indicators of Ecological Change



- The technical concept, “biological integrity” or “system wholeness,” incorporates the concepts in the report from the Ecological Society of America Land Use Committee entitled, *Ecological Principals and Guidelines for Managing the Use of Lands*.

# Development of Ecological Indicator Guilds for Land Management



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

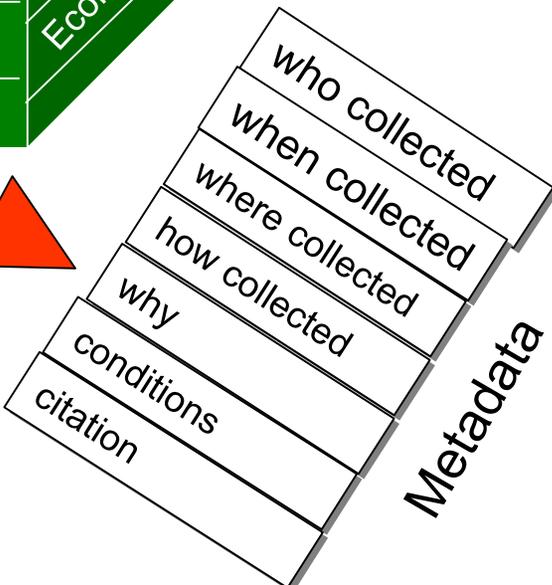
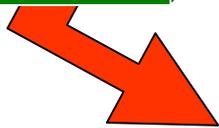
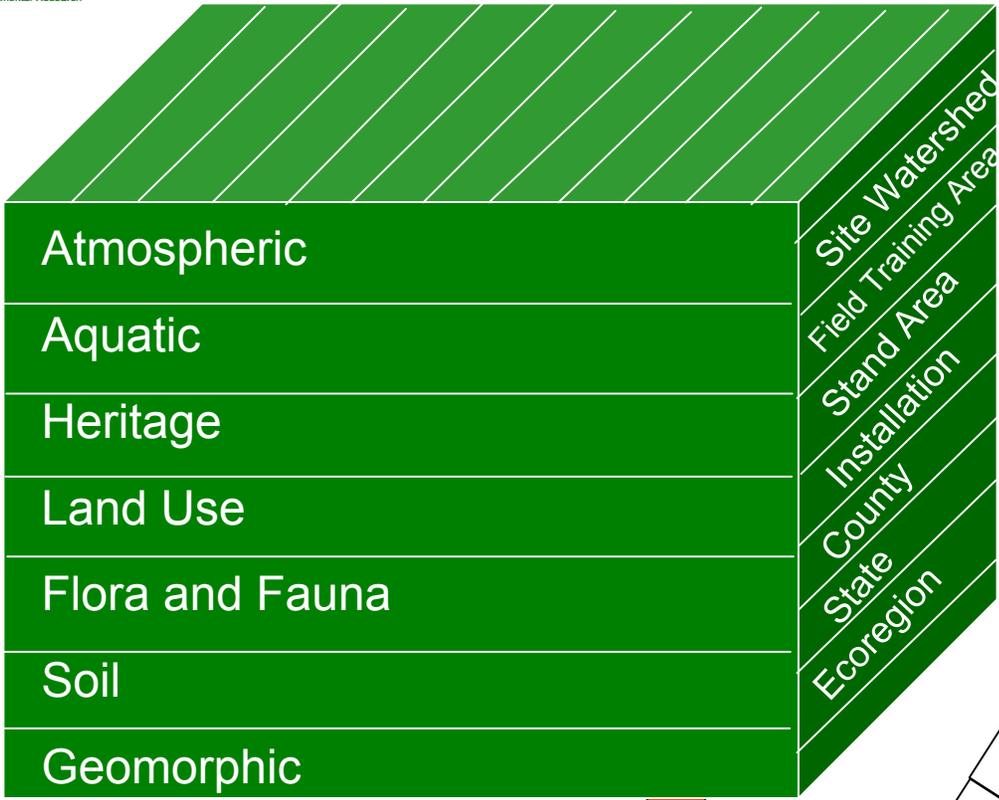
Texas Tech University

Timeframe

Thematic Context

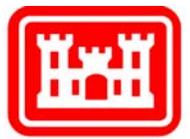
Location

# Site Data Repository



Medium of Exchange for  
Simultaneous and Sequential  
Investigators

# SEMP Website Through DENIX



US Army Corps of Engineers.

The screenshot shows a web browser window with the address bar containing <http://www.denix.osd.mil/denix/DOD/Working/SEMP/sem.html>. The browser interface includes a menu bar (File, Edit, View, Go, Favorites, Help) and a toolbar with navigation buttons (Back, Forward, Stop, Refresh, Home, Search, Favorites, History, Channels, Fullscreen, Mail, Print, Edit).

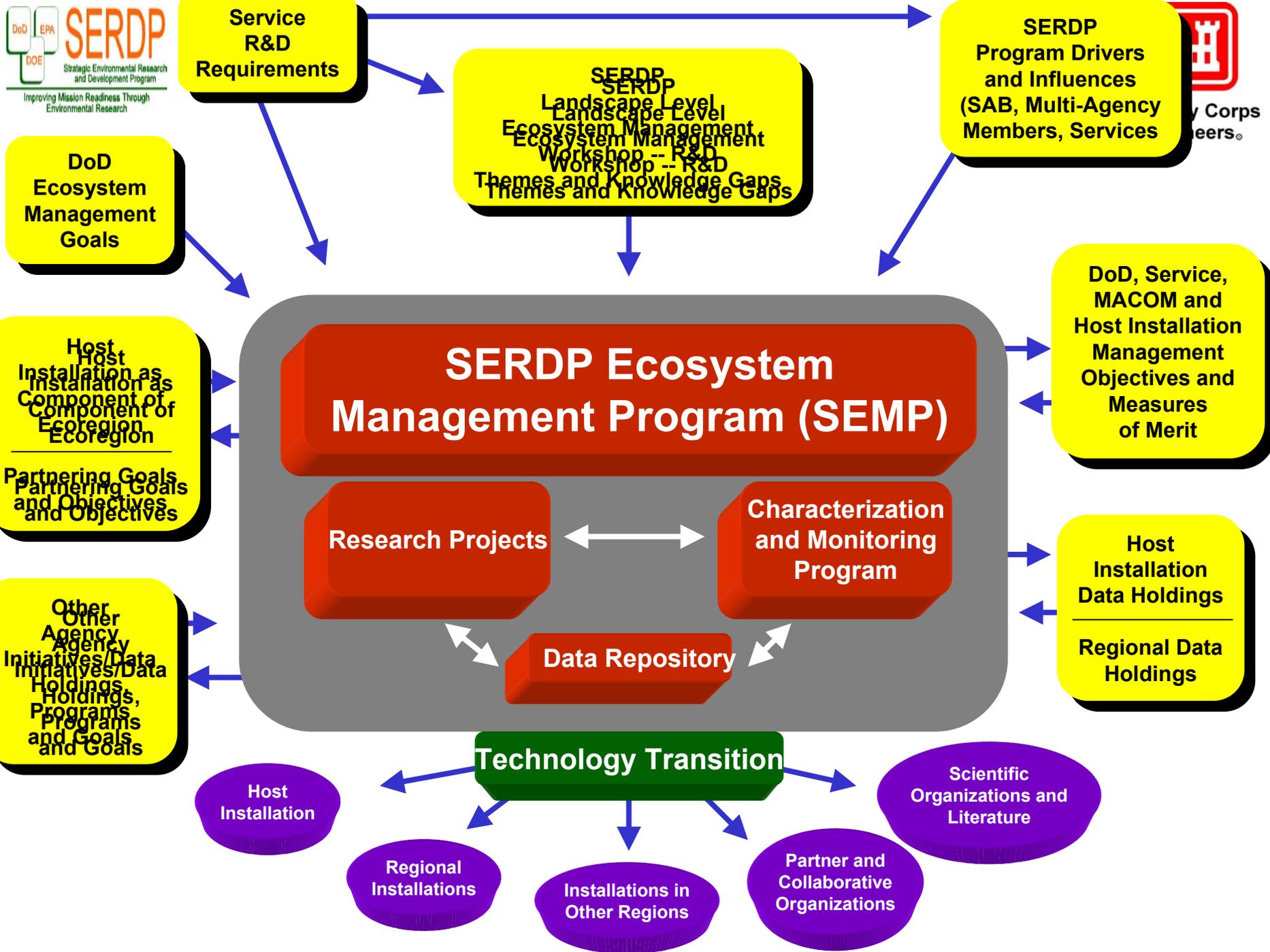
The website content is displayed within the browser window:

- Navigation:** search, sitemap, denix home
- User Interaction:** Working groups banner with a photo of people in a meeting.
- Menu:**
  - dod menu
  - state menu
  - public menu
  - int'l menu
- Left Sidebar:**
  - What's New:** [Current Messages](#), [NewInfo Feature](#), [Calendar](#)
  - User Interaction:** [Discussion Forums](#), [Mail](#), [Reporting](#), [Working Groups](#), [DENIX User Forum](#), [Online Chat](#)
  - Information Areas:** [News & Information](#), [Training Resources](#)
- Main Content:**

## SEMP Working Group

  - [About SEMP](#)
  - [Events Calendar](#)
  - [SERDP Home Page](#)
  - [TAC Member List](#)
  - [ERDC Home Page](#)
  - [Meetings](#)
  - [Research Activities](#)
  - [Document/File Library](#)  
File repository for uploading/downloading binary files (MS Word, WP, Adobe Acrobat, etc.).
  - [Administrators](#) Menu restricted to SEMP administrators.
    - [Upload Files](#)
    - [Download Files](#)
    - [Delete Files](#)

The browser status bar at the bottom indicates "Internet zone".



**Service R&D Requirements**

**SERDP Program Drivers and Influences (SAB, Multi-Agency Members, Services)**

SERDP Landscape Level Ecosystem Management Workshop -- R&D Themes and Knowledge Gaps

**DoD Ecosystem Management Goals**

**Host Installation as Component of Ecoregion**  
**Partnering Goals and Objectives**

**Other Agency Initiatives/Data Holdings, Programs and Goals**

**SERDP Ecosystem Management Program (SEMP)**

**Research Projects**

**Characterization and Monitoring Program**

**Data Repository**

**DoD, Service, MACOM and Host Installation Management Objectives and Measures of Merit**

**Host Installation Data Holdings**  
**Regional Data Holdings**

**Technology Transition**

**Host Installation**

**Regional Installations**

**Installations in Other Regions**

**Partner and Collaborative Organizations**

**Scientific Organizations and Literature**