

## SEMP Annual Report 1 Oct 2001 – 30 Sep 2002

**Project Title:** Ecosystem Characterization and Monitoring (ECMI)

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### **Introduction:**

#### *Brief Background on Project*

Within the SEMP, the Ecosystem Characterization and Monitoring Initiative (ECMI) was established to design, develop, and demonstrate an ecosystem characterization and monitoring concept appropriate for military installations. The ECMI products must support multiple SEMP objectives and be beneficial to installation land managers. The ECMI baseline monitoring concepts are intended to have broad applicability and may serve as a model for other installations.

### **Project duration and funding:**

FY99 (\$K)	FY00 (\$K)	FY01 (\$K)	FY02 (\$K)	FY03 (\$K)	FY04 (\$K)	FY05 (\$K)
530.0	655.0	300.0	325.0	325.0	321.0	275.0

#### *Objective of Project*

The objective of ECMI is to develop a framework to characterize the long-term spatial and temporal dynamics of key ecosystem properties and processes in a way that is jointly beneficial to ecosystem research activities and military land management operations. The monitoring conducted under the ECMI is expected to produce a multi-purpose, integrated, baseline ecological information base. This ECMI information base will:

- 1) support SEMP ecological research related to sustainable management of DOD lands,
- 2) contribute baseline level data to the integrated monitoring plan of the host site,
- 3) establish a long-term ecological data set at the host site that will, over time, allow the assessment of relationships between land use, management and ecosystem sustainability, and
- 4) be compatible with monitoring data sets collected by other agencies in the region.

#### *Approach*

The approach has been to complete the design and implementation phase (Phase I, 1999-2001) as described in "Long-Term Monitoring Program, Fort Benning, GA (see Kress 2001). Some adjustments have been made to the original design, in particular to the surface water component because of the extended drought being experienced in the Fort Benning region. The ECMI product has now entered the modification phase (Phase II, 2002-2005).

## **Summary of Monitoring Activities and Results for FY02 (October 1, 2001 through September 30, 2002):**

### ***Meteorology***

Meteorology parameters have been monitored at 10 sites since FY99. The data and summary statistics from 1999 through August 2002 are on the SEMP data repository. The ECMI team worked with personnel in both the Land Management Branch and the Battle Lab at Fort Benning to provide them with the software and training necessary to enable them to download the meteorology data directly, on a twice daily basis for their in-house needs.

### ***Surface Water***

The surface water component was re-designed and re-implemented during summer 2001 to accommodate the current drought trend and subsequent low stream flows. We are now monitoring water flow, level and temperature only with automated stations. Water quality parameters (dissolved oxygen, nitrate, pH, turbidity, and conductivity) are being monitored at six sites via manual sampling on a bi-weekly basis. When the precipitation pattern trends toward a wetter period and stream flows are more robust we will consider deployment of fully automated systems. A technical report has been published describing the procedure used to delineate the streams and develop the watershed boundaries on Fort Benning (Graves 2001).

### ***Ground Water***

The automated ground water monitoring system was fully implemented at four sites during spring and summer 2001. Ground water data consisting of temperature and water depth are being collected hourly and entered onto the repository on a monthly basis. Data are available on the repository through August 2002.

### ***Aquatic***

The aquatic monitoring procedure is currently being adapted to better meet installation and research needs. Monitoring was accomplished through intensive field surveys conducted on 24 streams on Ft. Benning in June 2002. Dip net samples for invertebrates and sediment samples for macroinvertebrates were collected. In addition, the Rapid Bioassessment Protocol (RPB) was conducted at all 24 sites. Physical, chemical, and biological data will be used to contrast and compare conditions at upland vs. blackwater streams. Information collected is being used to characterize riverine habitats on the base, and to prepare an adaptive management plan for aquatic monitoring. Results of the adapted monitoring plan thus far have been provided to the TAC and installation personnel and they will work with us to complete the adaptation of the aquatic monitoring protocol during the first and second quarter of FY03.

### ***Land Cover***

A land cover map (using 1999 Landsat ETM data) with accuracy assessment was developed during FY01 and placed on the repository. A second land cover map has been developed using Landsat ETM data from 2001 and will be completed during 1QTR FY03. Pattern analysis of 1999 land cover, using fragmentation statistical procedures, was completed during 4QTR FY01. Pattern analysis for the 2001 land cover will be completed and used for comparison during 2QTR FY03. These land cover data sets and comparisons will be placed on the repository during 2QTR FY03.

### ***Erosion and Deposition***

The erosion/deposition component was fully implemented during FY01 and the first re-sampling occurred during FY02. The characterization data have been placed on the repository and the re-sampling results were placed on the repository during FY02. A technical note and a technical

report have been published based on the efforts to develop the erosion/deposition component. The technical note describes the development of the high precision horizontal and vertical ground control network set up on Fort Benning. This network is available to anyone needing accurate x, y, and z coordinates on Fort Benning (Hahn 2001). A letter report describing the field test of the S-Tracker System that is used to measure and monitor micro-topography profiles on the ECMI erosion monitoring sites. The technical report describes the initial characterization of the ECMI erosion/deposition monitoring sites using the S-Tracker System (Hahn, Graves and Price 2001).

***Woody Productivity***

The woody productivity component was implemented during FY02 in cooperation with the Fort Benning Land Management Branch (LMB) personnel. Woody productivity is being derived using data from the Forest Inventory procedure used by Fort Benning personnel. This procedure will provide watershed level and an installation-wide estimate of woody productivity and will support both the installation and research group needs. During September 2001 forest inventory data were collected in the Delta 14 and 15 compartments that represent a portion of the area where ECMI monitoring is being conducted. Data from additional compartments will be provided to the ECMI team after they are collected per Fort Benning’s inventory schedule during Summer and Autumn 2002.

**Milestones FY03:**

<b><i>Ecosystem Characterization and Monitoring Initiative (ECMI)</i></b>	
<i>Complete modified Aquatic Monitoring Plan</i>	03/2003
<i>Develop a cost reduction plan for ECMI</i>	06/2003
<i>Technical Report “Phase II ECMI Status and Progress”</i>	09/2003
<i>Evaluate the Erosion/Deposition component of ECMI relative to biotic monitoring needs</i>	09/2003
<i>Evaluate the Biotic and Abiotic monitoring for ECMI</i>	09/2003

**Important Findings and Results for FY02 (October 1, 2001 thru September 30, 2002)**

***Meteorology***

The meteorology stations have performed very well since Summer 1999. Aside from recommended routine maintenance they require very little attention. Two technical reports were published in 2002. The first describes the meteorology stations, the hydrology stations, and the ground water wells, the specifications for each and summarized data (Hahn and Leese 2002). The second report describes an evaluation of the instrumentation and initial tests of newer sensors. Currently we recommend no change in to the existing meteorological instrumentations (Hahn 2002). (All SEMP/ECMI reports can be downloaded from the web site listed below under SEMP/ECMI Publications.) The following is an example data summary for one station for August 2002.

ECMI Meteorological Station Data Monthly Summary Sheet				
Met Station ID: ME08 - Malone Range (Range # 22)				
Time Period Covered: August 2002 - Number of Observations: 1488				
Meteorological Station Height:	Wind Sensors:	Air Temp Sensor:	UTM Easting:	UTM Northing:
approximately 10 feet	3.0 meters	1.5 meters	701525	3593400
Variable Measured (Unit of Measure)	Mean	Std Error	Minimum	Maximum
Air Temperature (Degrees Celsius)	26.2	0.1	16.1	37.4
Relative Humidity (Percent Humidity)	70.0	0.5	23.0	99.0
Barometric Pressure (MilliBars)	1019.8	0.1	1013.0	1028.0
Solar Radiation (Watts / Square Meter)	218.9	7.4	0.0	947.0
Wind Speed (Meters / Second)	0.9	0.0	0.0	3.6
Wind Direction (Degrees from North)	145.0	2.8	0.1	360.0
Precipitation (Millimeters)	0.0	0.0	0.0	11.8

### *Surface Water*

The automated hydrological stations have been maintenance intensive. Aside from problems caused by the drought and low stream flows, sedimentation in and around the sensor packages has caused problems and the dissolved oxygen (DO) sensor did not perform to specifications (Hahn and Leese 2002). We are working with vendors and testing more reliable sensors for the future. Since October 2002 we have been testing new turbidity, DO, pH, and conductivity sensors (Hahn 2002) as shown in the photograph below. These new sensors are collecting accurate data and we are verifying these data by comparing the data to the original sensors used in the automated stations as obtained in manual samples every two weeks and just after significant rainfall events. We are closely monitoring the performance of these new sensors and will complete this evaluation by 3QTR FY03. Currently only temperature, flow and level are monitored with the automated stations and all water quality data are collected manually every two weeks and just after significant events. This current procedure minimizes routine and non-routine maintenance time until more reliable sensors can be evaluated.



### ***Ground Water***

Five wells were drilled during June 2001 to monitor the shallow alluvial aquifers. The Bonham Creek site was dry with no indication of subsurface water down to a depth of 55 feet. The well site was within 100 feet of the main streambed. Four successful wells were drilled in Little Pine Knot, Oswichee, Randall, and Sally Branch Creeks. These wells were instrumented with In-Situ Mini-Trolls to measure ground water temperature and level (Hahn and Leese 2002). The Mini-Trolls have been very dependable since deployment and we recommend no changes to the ground water instrumentation at this time (Hahn 2002).

### ***Aquatic***

In June 02 the aquatic monitoring component, macroinvertebrate samples and habitat data were collected at 24 locations from among 18 second to sixth order streams at Fort Benning Military Reservation, Georgia. Environmental data collected at each site included turbidity, pH, specific conductance, temperature, and dissolved oxygen concentration. Sample locations included one or more 100-m reaches in the following creeks: Bonham, Cox, Laundry, Little Pine Knot, Pine Knot, Ochillee, Oswichee, Upatoi, Randall, Sally, Tar, Uchee, and Wolf, as well as several unnamed creeks.

There are two prominent physiographic regions within at Fort Benning: 1) upland sandy hills region and 2) coastal plain region. Streams within the upland area tend to have lower turbidity, higher pH, and less instream habitat diversity than do streams in the coastal plain. Variability in pH and turbidity best explain differences. Streams could be classified into one of three groups: 1) upland stream of normal pH and low turbidity; 2) coastal plain stream with lower than normal pH and high turbidity; and 3) coastal plain stream with low pH and low turbidity.

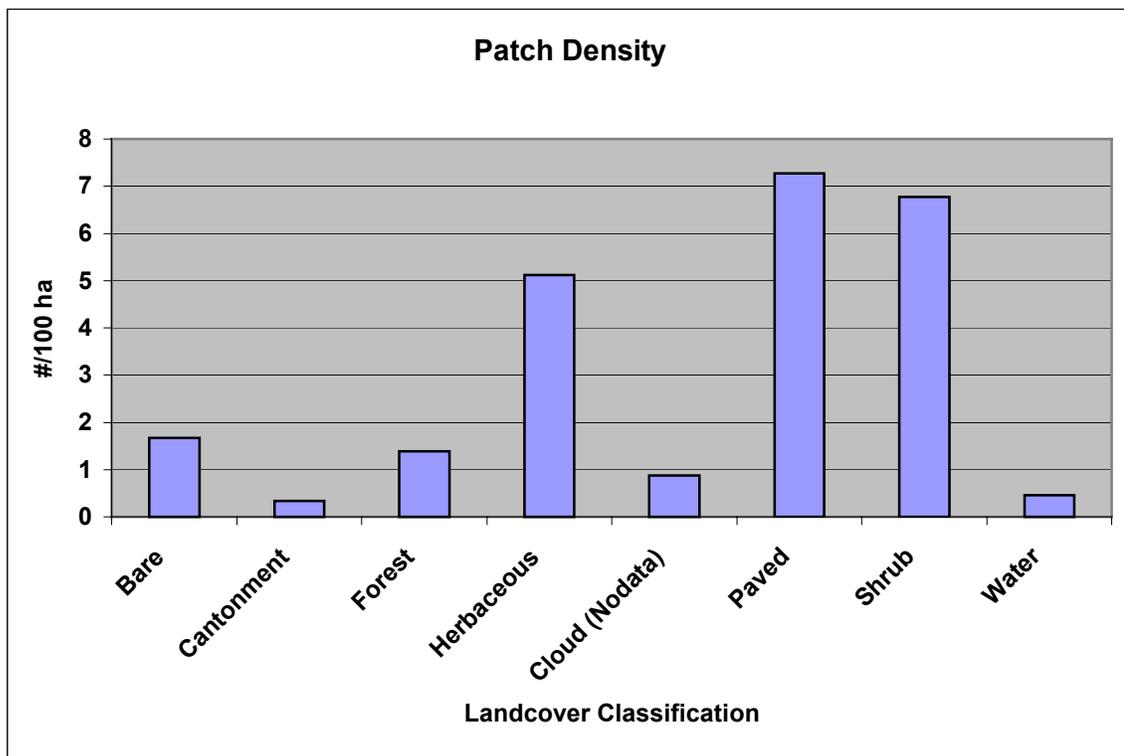
Rapid Bioassessment Protocols were used to calculate index values representing physical habitat quality. Final index values ranged from 99-183; habitat quality increases with score value. Overall, there were no clear differences in physical habitat quality between upland and coastal plain streams. However, coastal plain streams that were more turbid, slow flowing, and deeper (i.e., Oswichee, Ochillee, Uchee and Sally Branch) had much lower scores than the more clear, fast-flowing streams within the same physiographic region (i.e., Little Pine Knot, Pine Knot, and Laundry). Physical habitat quality increased in a downstream direction. Pine Knot creek was the only stream sampled at multiple locations that did not have a higher RBP score at the downstream location, although the scores for the two Pine Knot sites actually were very similar. Although there was some site-to-site variation among all sites, none of these streams provide what could be considered optimum habitat for infaunal and epiphytic macroinvertebrates. The primary limiting factor for upland streams seems to be a lack of high quality physical habitat; substrata in these streams almost exclusively consist of loose, shifting sand with very little hard, stable habitat. Although physical habitat quality is much better in coastal plain streams, low pH is probably the most important limiting factor in these systems.

Organisms were identified to genus or the lowest taxonomically significant level possible. Georgia Index of Biotic Integrity (GIBI) scores were calculated for each location and used to assign a classification based on other scores within the region. Only one sampled location, from upper Randall Creek, was classified as **Good**; there were 8 **Fair**, 8 **Poor**, and 7 **Very Poor** locations. The GIBI scores were negatively influenced by the abundance of chironomid larvae and relatively low numbers of Ephemeropterans, Plecopterans, and Trichopterans.

We are currently modifying the aquatic monitoring plan as requested by the Technical Advisory Committee (TAC) and installation personnel. The revised plan is to be completed during the second quarter of FY03.

### ***Land Cover***

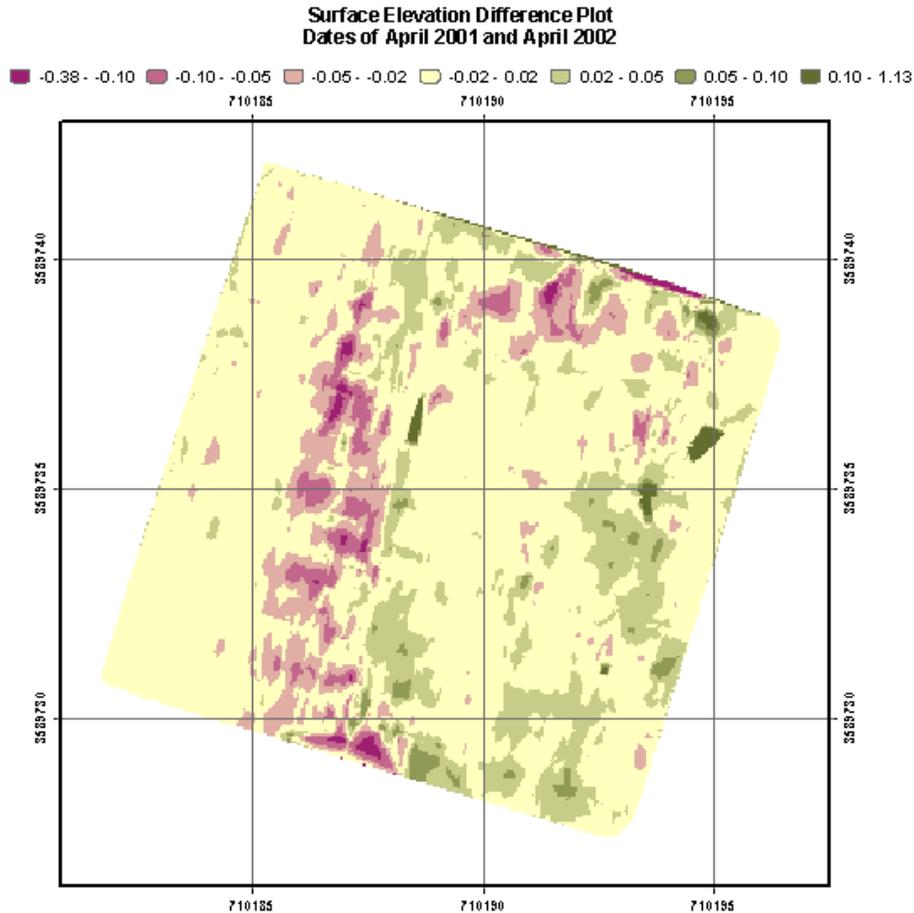
Currently we have generated land cover maps based on imagery from 1999 and 2001. Plans are to use these data sets to define changes to the urban areas adjacent to Fort Benning and for the cantonment area. We will continue to develop land cover metrics using both data sets. Fragmentation statistical techniques and comparisons will be provided between years based on these landscape metrics. The bar graph below is an example of the landscape metrics being used (Graves and Bourne 2002) and shows the number of patches for each land cover category per 100 hectares on Fort Benning. This type of metric can be used to determine the degree that a landscape meets specific habitat requirements for target species.



### ***Erosion and Deposition***

Data from the erosion deposition monitoring will be analyzed and summarized to determine the benefit and use to the Fort Benning land management personnel. This will be done within the context of the milestones to “evaluate the balance between biotic and abiotic components of ECMI”, and “...justification for the erosion/deposition component of ECM”. The graphic below depicts the change in surface elevation in centimeters (cm) or areas of erosion and deposition between April 2001 and April 2002 on one site in Bonham Creek watershed. Analyses will be performed to estimate volumes of soil

moving onto and off of the erosion sites over yearly timeframes. Other analyses will be performed based on input from installation personnel.



### ***Woody Productivity***

The woody productivity component was implemented during FY02 in cooperation with the Fort Benning Land Management Branch (LMB) personnel. Woody productivity is being derived, in part, using data from the Forest Inventory procedure used by Fort Benning personnel. Additional data are also available from SEMP research projects on Fort Benning. The procedure will provide watershed level and an installation-wide estimate of woody productivity and will support both the installation and research group needs. During September 2001 forest inventory data were collected in the Delta 14 and 15 compartments that represent a portion of the area where ECMI long-term monitoring is being conducted. Data from additional compartments will be provided to the ECMI team as they are collected per Fort Benning's inventory schedule during Summer and Autumn 2002. Based on a feasibility analysis (O'Neil, Lee and Price, 2002) we plan to develop an estimate of woody productivity for the Fort Benning installation during FY03.

**SEMP/ECMI Publications FY02:** <http://www.wes.army.mil/el/t2info.html#publists>

Hahn, Charles D., and David Leese. 2002. Environmental Data Collection at Ft. Benning, GA from May 1999 to July 2001. ERDC TR-02-3, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Hahn, Charles D. 2002. Evaluation of ECMI Instrumentation Deployed at Fort Benning, GA. ERDC/EL TN-ECMI-02-1, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

O'Neil, L. J., Lee, A., and Price, D. (2002). Terrestrial Productivity at Fort Benning, GA; A Feasibility Analysis: Ecosystem Characterization and Monitoring Initiative, ERDC TR 02-XX, U.S. Army Engineer Research and Development Center, Vicksburg, MS. (In Printing)

Graves, Mark R., and Scott G. Bourne. 2002. Landscape Pattern Metrics at Fort Benning, GA. ERDC/EL TN-ECMI-02-2, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

**Challenges:** With the assistance of the Fort Benning land management branch we have developed a draft white paper titled "ECMI Technology Transfer to Proponents" (3 pages), that is currently under review. This document suggests a process to ensure a successful "handoff" of ECMI methodology, including results of research, to the installation and others. The process of transferring the SEMP technology to Fort Benning and other DOD installations as well as cost reductions for long-term monitoring will be further developed during FY03.