SAVANNAH RIVER ECOLOGY LABORATORY

ANNUAL TECHNICAL PROGRESS REPORT
OF ECOLOGICAL RESEARCH

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SAVANNAH RIVER ECOLOGY LABORATORY
FY2008 OVERVIEW

The Savannah River Ecology Laboratory (SREL) is a research unit of The University of Georgia (UGA) that has been conducting ecological research on the Savannah River Site (SRS) near Aiken, South Carolina for over 50 years. The overall mission of the Laboratory is to acquire and communicate knowledge of ecological processes and principles. SREL conducts fundamental and applied ecological research, as well as education and outreach programs, under a Cooperative Agreement with the U.S. Department of Energy (DOE).

The Laboratory's research mission during the 2008 fiscal year was fulfilled with the publication of 41 journal articles and book chapters by faculty, technical staff, students, and visiting scientists. Three books were also authored by SREL faculty members. Additional journal articles have been submitted or are in press. Significantly, SREL outreach activities reached almost 20,000 people of all ages. Other noteworthy events took place as faculty members, staff, and graduate students received awards. These are described in the section titled Special Accomplishments of SREL Personnel.

During the past year, one of our faculty members achieved a prestigious commendation worthy of note:

> **Dr. Rebecca R. Sharitz was elected as a Fellow of the Society of Wetland Scientists** in June 2008. **Fellows** are active members of the Society who have been nominated by other active members, upon recommendation by the Fellows Committee, and elected by the SWS Board of Directors. **Fellow** is the highest recognition of membership bestowed by the Society. The nominee must have made outstanding contributions in an area of specialization whether in research, teaching, management, service, or administration and in public, commercial, or private service activities.

FY08 was also a year of significant change in the vision, structure, and operations of SREL, Direct funding from DOE-EM ceased in FY08. Current funding from EM is based on individual projects and the specific needs of EM. These changes necessitated a conversion to programs that are entrepreneurial and interdisciplinary, and to funding strategies that are competitive, responsive to sponsors' requirements, and based on a diverse and sustainable foundation. This recognition required restructuring of research and supporting infrastructure, including downsizing of personnel and implementation of operational efficiencies.

Although these changes were very challenging, a reduced, but robust SREL presence continued to operate on the SRS in FY08. Currently, SREL's total employment is approximately 45 faculty, technicians, students, and support staff. This level of employees and funding is lean but ensures continued progress toward stated objectives and does not compromise safety and security. Some faculty members and laboratory work that is not site-specific to the SRS transitioned to the UGA Athens main campus, while new partnerships and collaborations with the Athens campus departments and other agencies are being explored in order to fully use SREL assets. Graduate student programs have continued, with all costs paid by external grants, UGA, or the student's host university.

SREL faculty have responded to the revised structure and have sought financial support from external funding agencies, DOE-EM, DOE-NNSA, and WSRC-ACP, while UGA has provided temporary infrastructure support to SREL through this transitional period. A Cooperative Agreement with DOE allows SREL/UGA access to the SRS through 30 September 2011. Continued funding for SREL has been strongly supported by the local community for its role in research, environmental monitoring, and education/outreach programs for local schools and the general public.

Many challenges remain for SREL, including reorganizing research programs to address DOE and SRS-specific concerns, maintaining current research staff, and attracting new personnel. SREL researchers

are also very vigorously pursuing additional funding sources to leverage existing research funds, while continuing to focus the laboratory's research efforts on projects of interest to the SRS.

Researchers at SREL had funding from 24 external grants during FY08. Sources of grant awards range from private foundations such as the National Fish and Wildlife Foundation to federal agencies such as the U.S. Department of Interior, the National Science Foundation, and the Department of Defense.

In addition to holding faculty positions in numerous departments at the University of Georgia, many SREL faculty members have adjunct status at other colleges and universities. Faculty, staff, and students also are active in providing outreach and service to the scientific community. Representatives from the laboratory hold editorial or committee positions in national groups and organizations and also serve on several UGA academic and administrative committees. Many scientific presentations and posters were presented during the past year at scientific meetings, colleges, and universities, including minority institutions.

Participants in the SREL Education Program during FY08 included 4 undergraduate students and 22 graduate students from schools located throughout the United States. The graduate students came from three different universities in the United States. In the past year, six graduate students earned Doctor of Philosophy Degrees, while five students earned their Masters Degrees for their research at SREL. A National Science Foundation grant from the Research Experiences for Undergraduates Program for a proposal titled "The Impact of Energy Technologies on Natural Environmental Systems" provided funding for the undergraduate program at SREL.

The SREL Outreach Program communicates scientific awareness to the general public, an audience different from science professionals. During the past year, SREL presented 179 talks, 41 tours, 9 exhibits, and 14 workshops, reaching a total of 19,502 people. Topics for these presentations included reptiles, amphibians, southeastern plants and habitats, long-term research, safety, biodiversity, local wetlands and watersheds, conservation, and careers in ecology and research.

The SREL Conference Center has continued to see wide use. SREL used the facility to host numerous meetings and environmental education programs for students, teachers, and other groups this past year. The facility is also used by other groups on site including DOE and the US Forest Service when it is available.

During FY08, the SREL faculty and staff were in transition due to our reduced funding and faculty and staff realignment. Many research programs were impacted and therefore may have little or no progress to report. This may be reflected in minimal text or omission of the section if the Principal Investigator is no longer employed by SREL.

SPECIAL ACCOMPLISHMENTS OF SREL PERSONNEL

Dr. Rebecca R. Sharitz was elected as a Fellow of the Society of Wetland Scientists in June of 2008. Fellows are active members of the Society who have been nominated by other active members, recommended by the Fellows Committee, and elected by the SWS Board of Directors. Fellow is the highest recognition of membership bestowed by the Society. The nominee must have made outstanding contributions in an area of specialization whether in research, teaching, management, service, or administration and whether in public, commercial, or private service activities. Dr. Sharitz is one of only nine Fellows of the society.

Dr. Sharitz was also invited to deliver several important presentations including: the keynote address entitled "Factors maintaining species richness in old-growth floodplain forests of the Congaree National Park", at the Congaree National Park Research Symposium, and a synthesis talk entitled "Integrating Science into the Restoration and Management of Floodplain Ecosystems of the Southeast" at the Southeast Floodplain Ecosystem Symposium, held in Little Rock, AR.

SREL faculty and students won numerous awards at the annual meeting of the Association of Southeastern Biologists held in Greenville, SC in May of 2008. **Dr. Kurt A. Buhlmann** won the ASB Senior Research Award, for his paper entitled "Global Distribution of Turtles and Tortoise Richness and Identification of Priority Conservation Areas". **Dr. Tracey D. Tuberville won the ASB Student Research Award and the Eugene P. Odum Award sponsored by the Southeastern Chapter of the Ecological Society of America** for her paper entitled "Mating system in a gopher tortoise population established through multiple translocations: apparent advantage of prior residence". **Evan A. Eskew, an undergraduate at Davidson College, received an honorable mention for the ASB Poster Award** for his poster coauthored with **John D. Willson and Christopher T. Winne** (SREL graduate students) entitled "Ambush site selection and ontogenetic shifts in foraging strategy in a semi-aquatic pit viper, the Eastern cottonmouth (*Agkistrodon piscivorous*)" for his research at SREL. He was also awarded a travel grant to attend this meeting from the Society of Wetland Scientists, South Atlantic Chapter.

SREL faculty continued to serve their professional organizations and society through numerous paths. **Dr. John C. Seaman** served on the Technical Planning Committee for the 2009 Georgia Water Resources Conference and Symposium planning committee for 2009 Agronomy Society of America meeting. In addition, he was elected chair of the Soil Chemistry Division (Div. S2) of the Soil Science Society of America and attended the DOE EM-22 Program Review held September 23-25, 2008, in Denver, CO.

Dr. Kurt A. Buhlmann served on the Executive Board Member for the Turtle Conservation Fund, Steering Committee Member of the Turtle Survival Alliance, and as a member of the National Steering Committee of Partners in Amphibian and Reptile Conservation (PARC).

Dr. Tracey D. Tuberville was the South Carolina State Representative to Gopher Tortoise Council and co-chaired with Kurt Buhlmann and J.D. Kloepfer the Reintroduction Working Group of the Southeast Partners in Amphibian and Reptile Conservation.

Dr. Rebecca R. Sharitz served on the National Research Council (National Academy of Sciences), Committee on Water Resources Activities at the U.S. Geological Survey, the Executive Boards of the International Association for Ecology (INTECOL) and Audubon South Carolina, and on the Review Panel for the National Parks Ecological Research Fellowship Program funded by the Mellon Foundation.

Faculty members also serve their respective departments at the University of Georgia. For instance, **Dr. Sharitz** also was on the Executive Committee of the Plant Biology Department and on the Review Committee for Promotion and Tenure for the Life Sciences.

SREL faculty also organized several professional workshops: **Dr. Kurt A. Buhlmann** and Gabrielle Graeter (a former SREL graduate student) organized the Partners in Amphibian and Reptile Conservation (PARC): Inventory and Monitoring Workshop held in Athens, GA in February of 2008. **Dr. Tracey D. Tuberville** organized the Envirovet training program, held on St. Catherines Island/White Oak Plantation, emphasizing reptile and amphibian capture techniques and gopher tortoise health assessments in June.

Several faculty members serve as editor or associate editors for various journals (**Dr. John C. Seaman** - Journal of Environmental Quality; **Dr. Kurt A. Buhlmann** - Chelonian Conservation and Biology; and **Dr. Ken McLeod** – Castanea).

While members of the SREL faculty were continuing to publish in the open, refereed literature, they were also contributing to more specialized pursuits**. Dr. J. Whitfield Gibbons** had three books published through the University of Georgia Press in Athens with his collaborators (present SREL faculty and past post-doctoral associates).

TURTLES OF THE SOUTHEAST. 2008. K. A. Buhlmann, T. D. Tuberville, and J. W. Gibbons

FROGS AND TOADS OF THE SOUTHEAST. 2008. M. E. Dorcas and J. W. Gibbons,

AMPHIBIANS AND REPTILES OF GEORGIA. 2008. J. Jensen, C. Camp, M, Elliott, and J. W. Gibbons.

AN OVERVIEW OF RESEARCH THEMES

Through a Cooperative Agreement between the Department of Energy and the University of Georgia Research Foundation, SREL provides an independent evaluation of the ecological effects of SRS operations through a program of ecological research, education, and public outreach. This program involves basic and applied environmental research, with emphasis upon expanding the understanding of ecological processes and principles, and upon evaluating the impacts of industrial and land use activities on the environment.

This is accomplished through a broad-based program of field and laboratory research conducted on the SRS and published in the peer-reviewed scientific literature; by providing education and research training for undergraduate and graduate students from colleges and universities throughout the United States and abroad; and by engaging in community outreach activities and service to professional organizations. The FY08 SREL research plan responded to guidance from the DOE Site Manager to the SREL Director identifying DOE support for research in three critical areas:

(1) *environmental characterization*,
(2) *ecological risks and effects, and*
(3) *remediation and restoration*.

Research at SREL addresses knowledge gaps in these areas by taking advantage of unique expertise in the environmental sciences and ecology, the unparalleled field research opportunities at the SRS, and the long-term data sets, research tools, and capabilities that SREL has developed over the last half-century.

ENVIRONMENTAL CHARACTERIZATION

Characterization is a necessary first step in determining environmental and health risks and in devising appropriate remediation and restoration strategies. Environmental information is also needed to make informed decisions about long-term stewardship and land management, and it is also a critical component of NEPA reports, Records of Decision (ROD), and other regulatory documents. Environmental characterization is more than simply measuring contaminant concentrations in biota or other media, or reporting the presence of organisms at various locations. It includes developing an understanding of the processes that control distributions of contaminants, chemical forms, and their bioavailability. Characterization is also necessary to construct models of how natural and engineered systems function, both in the presence and absence of environmental contamination.

Assessing the Ecological Health of Stream Systems and Watersheds of SRS Ecosystems: Modeling the Herptofaunal-Biodiversity Relationship

David Scott, Tracey Tuberville, William Hopkins, and Whit Gibbons

In recent years the Ash Plume Wetland (APW) and surrounding area in D-Area on the Savannah River Site (SRS) has been targeted for ecological studies due to the release of coal combustion wastes to the ecosystem several decades ago. High concentrations of trace metals (e.g., arsenic, selenium, and cadmium) in the waste may threaten the environmental health of the APW, especially for organisms such as amphibians that use both aquatic and terrestrial habitats during their life cycle. Our study builds on previous work by SREL scientists that examined the distribution of coal ash wastes in APW and adjacent floodplain, as well as concentrations of metals in soil, plants, invertebrates, and amphibians.

Although trace element uptake and accumulation has been well documented in different species and life stages of amphibians at the APW, potential biological effects are not known. Earlier sampling of the amphibian and reptile community revealed that the assemblage of species at the site is similar to a nearby reference site (Ellenton Bay); i.e., the number of species found at the APW is comparable to the "expected" number. However, with the exception of the leopard frog (*Rana sphenocephala*), newly metamorphosed individuals of amphibians were not found in earlier studies, possibly indicating that the APW is not suitable for successful egg and larval development of some pond-breeding amphibians. If the APW is an ecological trap, rather than a source pond for many species, the lack of recruitment of juveniles into the population may be connected to the elevated trace metal concentrations.

We combined aquatic and drift fence sampling with artificial mesocosm pilot studies to 1) determine the species utilizing the APW and 2) begin assessment of the biological effects of the APW environment on pond-breeding amphibians. Due to funding delays, the study began in mid-March 2008, which was after most species had bred, laid eggs, and completed significant larval development. Nonetheless, we observed newly metamorphosed juveniles of two species (*R. sphenocephala*, and the southern toad, *Bufo terrestris*). In contrast, five species produced juvenile at the reference site during the same time frame (additional species were the ornate chorus frog, *Pseudacris ornata*; the spring peeper, *P. crucifer*; and the tiger salamander, *Ambystoma tigrinum*).

In preparation for biological effects studies in FY-09, we conducted pilot studies in artificial mesocosms in spring 2008. We used sediments from the APW and the reference site to establish APW and reference site aquatic treatments, in which we reared eggs and larvae of four species (*R. sphenocephala*; *B. terrestris*; the southern chorus frog, *P. nigrita*; and the spadefoot toad, *Scaphiopus holbrookii*). In these pilot studies we did not observe any difference between the APW and reference site treatments on our response variables, egg and larval survival. In FY-09 we plan similar, full-scale studies to assess effects of the APW environment on a wider array of species and a greater variety of response variables, such as embryonic and larval malformations, larval performance, and overall viability.

Update of the Wildlife Literature Survey (WLS) GIS Database

Charlie Davis

For FY08, WSRC-SGCP (now SRNS-ACP) continued to fund SREL to update, enhance, and maintain a literature and GIS database on SRS vertebrates (and 1 mollusk) of which are 77 receptor species that are recognized for use in SRS risk assessments and for incorporation into the IOU GIS project. As part of these updates, SREL collects and reviews publications, reports, theses, dissertations and assembles records for all vertebrate species found in these documents and generates specific site locations for the receptor species for inclusion into a WLS Excel and DBF database and ArcView GIS coverage.

Due to the administrative changes and delays in funds being transferred for project renewal startup, SREL prepared and submitted only one update this FY - Version 18. This update was for the July 07-Sept. 08 time period and contains 31 new publications. Twenty publications were from SREL reprints and the remaining eleven were from USFS-SR reports, theses, or dissertations. All publications were provided in PDF format and all publication abstracts were generated in html formats. Three new shapefiles were generated for inclusion into the standing Wildlife shapefile, one of which was a separate point shapefile for later integration. The Wildlife shapefile's metadata was updated to reflect these changes. Due to SREL downsizing, it was decided the Access database would not be maintained for this FY; rather, the original stand alone ArcView project with Excel and DBF spreadsheet files were populated for this version. For this update, 957 records were entered giving the DBF database a total of 13,829 records from 1175 citations. Approximately 400 polygon and 41 point shapefiles have been generated to date.

Deer Forage Habitat Assessment of Upper Steel Creek (USC) Area

Charlie Davis

Historic process water discharges from P Reactor operations produced high volumes of thermal effluents with accidental releases of radioactive contaminants into the Upper Steel Creek (USC) region. These discharges created a highly disturbed environment still evidenced today with deeply incised side slopes and cliffs. Sediment deposits from these slopes eventually formed a modern day floodplain now more transitional than the once natural bottomland hardwood forest that predated the SRS operations. After 46 years of recovery, the stream channel and floodplain has now stabilized with an overstory of pine and light-seeded hardwoods. Where insolation is plentiful, there is abundant understory browse and cover. However, despite the area's stabilization and recovery there are likely significant levels of Cs-137 contamination that remain within the stream and floodplain sediments as well as in the up gradient soils. Because public deer hunts are conducted in the USC area, radiocesium uptake into plants foraged by white-tail deer ranging in this area may pose an ecological contaminant risk as well as a potential human health risk from meat consumed from deer taken on these hunts. As a risk assessment and regulatory commitment, the SRNS-ACP Group tasked SREL in the Spring of 2008 to conduct a habitat survey of the USC corridor using Habitat Evaluation Procedures (HEP) to assess habitat suitability for deer forage to aid in determining if there is a potential contaminant risk associated with USC stream sediments. These are the methods, results, and conclusions of this HEP survey.

In April 2008, SREL divided the 97 acre (39.3 ha) USC survey area into three Reaches and located 27 line transects and 0.2 ha plots for data collection. These 100 m transects were laid perpendicular to the stream dividing the sampling areas into three habitat zones: the impacted stream/riparian bottom and cut banks, and the two adjacent un-impacted upslope areas. Transect center points and slope tops were GPSd as was the majority of the extent of the discharge zone on either side of the creek. Forage habitat was assessed using Model III variables and standard sampling techniques from the USFWS Habitat Suitability Index (HSI) Model for the white-tailed deer. Model III was selected because it is applicable when only general information about forage abundance is available from a survey area and therefore only general statements of habitat quality are possible. From May-July, transect and plot data were collected for seasonal use variables which focused on forage values of spring/summer vegetation (herbaceous cover) and fall/winter vegetation (mast-bearing trees and shrubs). The two variables used to calculate HSI

values were: percent cover of herbaceous plants/1m^2 plot (spring/summer forage surrogate), and number of mast-bearing trees and shrubs per hectare (fall forage surrogate). Values of these variables were averaged for each transect and then summed for each stream Reach. They were then summed together to produce a mean HSI value. HSI values that are 1 or greater suggest habitat conditions are optimal forage suitability. In addition, vegetation of each Reach was classified using SREL's Habitat map (Pinder et.al, 1999) as a comparison to field data and interpretation. Using the HSI model, major forest cover types in the survey area were loblolly pine/hardwoods, upland hardwoods, bottomland hardwoods, and herbaceous wetlands. As expected with the degree of impact and recovery, Reach 1 had the more homogenous vegetation with a mixed canopy of pine and light-seeded hardwoods. Reaches 2 and 3 were more heterogeneous with a combination of less impacted upland hardwoods and mixed pine bottomland hardwoods in the more impacted riparian zone. Vegetation in the lower part of Reach 3 was mostly wetland scrub-shrub and herbaceous wetlands due to the backwaters of L Lake. Photo interpretation analyses and field verifications were used to reconstruct pre-SRS and historical operation events within the drainage area to help explain where concentrations of radio-contaminants were deposited as well as mitigative efforts to slow erosion and downstream contaminant movement. A comprehensive GIS database was constructed for generating area statistics, vegetation and photo overlays, and figure illustrations. Based on this GIS, approximately 44 % (43 acres; 17.4 ha) of the survey area was characterized as having been historically impacted from reactor discharge operations.

The results and findings of this field survey determined that the suitability of the forage habitat for deer is optimal in the USC survey area. These conclusions are based on averaged transect data and surrogate measures of seasonal food abundance and suitability of habitat use. In addition to the vegetation survey data, evidence of deer browse was commonly observed in all zones throughout the entire survey area during the sampling period. Location of bedding areas, runs, and evidence of reproductive behavior was also commonly observed across the survey area. For all three Zones of disturbance and vegetation cover types and across all Reaches, HSI values exceeded 1. Mean HSI for all reaches ranged from 1.09 to 1.44 across the three zones with the highly impacted riparian zone being the lowest of the three zones. However, if values for each seasonal variable are independently examined, with the exception of HSI values in two zones, forage suitability was less than optimal across the site. This may suggest that while the habitat is utilized year round, seasonal use of the drainage may be limited. However, when combining mean HSI values and availability of water and cover that the habitat provides, it could be concluded that the USC survey area offers optimal forage habitat year round.

In summary, current forest vegetation found in the USC survey area provides a relatively high carrying capacity for white-tailed deer, both in terms of seasonal food abundance and cover. As the modern day, sediment-filled floodplain continues to recover, and if prescribed fire is excluded from the drainage, the fall/winter forage habitat within the disturbed riparian stream zone will likely continue to improve over time as the area should see a successional shift from light-seeded species dominated by pine to a more dominant canopy of mast-bearing hardwoods. Herbaceous forage component should remain constant due to the available moisture within the riparian zone and also due to sunlight where gaps occur in the canopy.

Based on the findings of this project, future vegetation sampling and animal gut analyses would aid in determining seasonal shifts, availability, and preference of foods consumed by deer in the USC survey area. Determining preferences as well as proportions of foods consumed by deer could aid SRS risk assessors in validating models for future deer Cs-137 tissue assessments, as well as other contaminant uptake study needs such as in the Lower Three Runs Creek drainage area.

Survey of Environmental Monitoring Techniques for Application to Defense Program Analysis and Monitoring Needs

Chris Romanek and John Seaman

The goal of this project is to evaluate existing technologies that are presently being used in environmental and ecological initiatives at the Savannah River Ecology Laboratory (SREL) for potential application in

Tritium Facilities. The end product of the project is a literature review of the advantages and limitations of the most promising technologies. Also, the co-investigators will perform experiments that use equipment at SREL to demonstrate the utility of these technologies, when applicable.

Tritium Facility personnel met with the co-investigators several times to explain the functions performed at Tritium Facilities, and various needs were indentified that SREL could potentially fill. Subsequently, the co-investigators reviewed and indentified several pieces of equipment and procedures that may be of value to Tritium Facilities. A series of laboratory investigations is presently underway to determine the protium, deuterium and tritium content of the organic fraction of environmental media from the Savannah River Site.

Also, the literature review is underway; the initial literature search concerning the extraction and analysis of tritium associated with biological tissues is complete. Foremost among the technologies that will be discussed in the review are sensors that monitor the chemistry and isotope composition of various process gases. Specifically, techniques are being evaluated for the analysis of water vapor, ammonia, and methane. Also, $^{3}H_2O$ vapor extraction methods are being modified, and environmental samples are being collected and archived for evaluating alternative tritium analytical methodologies at SREL. Core samples were collected at the MWMF tritium irrigation facility to characterize tritium distribution as a function of soil depth. Each core was subdivided and tritiated pore water was extracted by sublimation (i.e., freeze drying) prior to analysis by liquid scintillation. Gravimetric water content was determined for each sample to estimate total tritium concentration in the residual pore water. Select samples were archived for analysis using a tritium extractor/oxidizer system that will be purchased from a commercial supplier.

Cavity Ring Down Spectroscopy: Proof of Concept for Environmental Analysis and Monitoring of Process Systems of Defense Programs at DOE's Savannah River Site

Chris Romanek and John Seaman

The goal of this project is to evaluate novel instrumentation that is currently available to detect and quantify the chemical and stable isotope composition of water vapor, methane and ammonia in a carrier gas of variable composition (100% N_2 to H_2) as an analogue to Tritium Facilities process gases. The co-investigators have identified one particular technology called Cavity Ring Down Spectroscopy (CRDS) as a viable tool that may meet the gas analysis needs of Tritium Facilities. The co-investigators have been discussing with two groups (Picarro and Los Gatos) the various spectroscopic analyses that can be made using the CRDS technique, and they will purchase off-the-shelf instrumentation for evaluation. In addition, the co-investigators have engaged NASA's Jet Propulsion Laboratory in how to incorporate tritiated isotopologues in the CRDS analysis. The instrumentation will be rigorously tested for the chemical and stable isotope composition of the analytes over a range of concentrations and carrier gas compositions. The results will be compared to conventional analyses performed by high precision gas source isotope ratio mass spectrometry and a report will be provided to Tritium Facilities.

Improved Modeling of Inorganic Contaminant Transport in the Vadose Zone: A Defensible Basis for Monitored Natural Attenuation (MNA) and Enhanced Attenuation (EA)

John Seaman

Consistent with the DOE-EM mandate, the current projects seeks to improve our understanding of contaminant fate and transport in the SRS vadose zone and provide DOE a defensible basis for responsible environmental remediation and long-term stewardship decisions, including the use of Monitored Natural Attenuation (MNA) and Enhanced Attenuation (EA) to address inorganic contaminants when appropriate. Although contaminant modeling efforts have generally restricted sensitivity analysis to

physical transport parameters, recent studies have clearly demonstrated the importance of addressing variation in sorption parameters when predicting contaminant behavior at the field scale. In contrast to empirical partitioning methods (i.e., K_d), Surface Complexation Modeling (SCM) provides a mechanistic basis for predicting changes in contaminant partitioning resulting from natural or induced changes in groundwater chemistry. Despite considerable research demonstrating the utility of SCM in describing contaminant migration in groundwater, there has been very limited research concerning the application of the SCM approach to predicting contaminant movement through the vadose zone.

Objective: The current scope of work seeks to improve our predictive capabilities in describing the coupled chemical and physical processes controlling the vadose zone fate and transport of several DOE contaminants of concern (COC), including uranium (U) and chromium (Cr), contaminants that display a range of disparate transport characteristics. In addition, the experimental approach is generally relevant to vadose zone modeling efforts for numerous other DOE COCs (^{99}Tc, ^{129}I, ^{90}Sr, ^{137}Cs, etc.).

Project Tasks: Initial progress is consistent with the project timeline and start-up funding from DOE-EM. SRNL (Dr. M. Denham) provided 19 vadose zone and 6 water-table aquifer sediment samples from the SRS F-Area for extensive characterization as an indication of 'reactive surfaces' available for contaminant sorption. Similar fractions of each sample were transferred to LBNL as part of a companion study focusing on U partitioning in the saturated zone. SREL is conducting an extensive mineralogical and physicochemical characterization of each sample before choosing a limited set of representative bulk materials and ideal mineral analogs for use in subsequent batch and column partitioning experiments. All resulting characterization data will be exchanged with SRNL and LBNL (Dr. J. Wan) collaborators to benefit related research projects at both institutions. Initial efforts to extract native pore solutions from each sample by centrifugation for chemical analysis as an indication of pore-water chemistry proved unsuccessful. Textural analysis of the samples has been completed, and citrate-dithionite-bicarbonate (CDB) extraction is underway. CDB extractable Fe provides an operational procedure for quantifying the amount of crystalline Fe oxides present in the materials, an important property controlling solid-phase contaminant partitioning. Portable XRF analysis was used to determine the gross composition of the 25 samples, and designate a subset of 12 samples for more extensive mineralogical characterization, i.e., x-ray diffraction of the clay-sized fraction. Extraction of the clay fraction from the 12 samples and XRD analysis is ongoing.

Conservation of Sandhills Threatened, Endangered and Sensitive (TES) Species

Rebecca R. Sharitz

Along the southeastern Fall Line region, there are extensive areas of sandhills and related xeric forests that support a unique flora and fauna, including a suite of threatened, endangered and sensitive (TES) plant and animal species. The responses of the TES plants to habitat disturbances are not known, and forest management practices in this region have the potential to destroy populations, causing them to become even rarer. Nine species, listed as Species of Conservation Concern for Georgia and South Carolina, were chosen for study on several Federal lands along the Fall Line, including the SRS and two military installations, Fort Benning and Fort Gordon. The goals of this research, which is leveraged by funds from the Strategic Environmental Research and Development Program (SERDP), are to characterize the habitats of sandhills TES plants, to evaluate the effects of land management activities (including forest management practices and military training) on their survival and reproduction, and to make recommendations for multiple-species management.

Sixty-three populations of nine TES plant species were sampled and habitat characteristics, including soil properties, canopy openness, and vegetative composition of the surrounding community, were measured. GIS maps of potential habitat locations for each species were generated based upon Landsat-7 enhanced thematic mapper plus (ETM+) satellite imagery acquired during periods of leaf-on and leaf-off and maps of soils associated with known population locations. Composite maps of potential habitat for multiple TES plants were generated by overlaying individual habitat maps and were validated with

additional surveys. These maps are useful in prioritizing sites for TES species protection.

To evaluate effects of land management activities on TES plants, experimental gardens were established that mimicked forest management practices and military training activities. Four perennial sandhills TES –*Baptisia lanceolata* (lance-leaf wild indigo), *Carphephorus bellidifolius* (sandywoods chaffhead)*, Nolina georgiana* (Georgia beargrass)*, Stylisma pickeringii* (Pickering's dawnflower) – were planted into sites of high disturbance, low disturbance and no disturbance (control sites). All four species had greater survival and growth during the first several years of the experiment in the more highly disturbed sites; however, survival declined by the end of the fourth growing season due to competition with other robust weedy species. In particular, *Carphephorus* and *Stylisma*, which are low-growing plants, were more sensitive to shading than were the more robust *Baptisia* and *Nolina*. All four species also flowered by the fourth growing season. Thus, transplantation of these TES species is an option if their natural habitat is threatened by other land use needs.

The greatest conservation focus in the sandhills, however, is on the federally-endangered red-cockaded woodpecker and on the gopher tortoise which is proposed for federal listing, rather than on TES plants. The plant habitat maps were combined with information on known locations of tortoise burrows, and there was substantial overlap among habitats of these sandhills species. Of 8395 mapped gopher tortoise burrows at Fort Benning, 4854 (or 58%) were within areas mapped as probable habitat for one to five TES plant species. Thus, management for multiple TES species may be a feasible option for protecting rare sandhills plants.

CRAWDAD Maritime Radiation Sensor Test Campaign

A multi-organizational team lead by SRNL successfully completed field execution of the CRAWDAD Maritime Radiation Sensor Test Campaign. The Department of Homeland Security (DHS) Domestic Nuclear Detection Office (DNDO) sponsored operationally-relevant testing of Commercial-Off-the-Shelf (COTS) and Government Off-the-Shelf (GOTS) radiation detection systems at the Savannah River Site's L-Lake.

The objectives of the Crawdad Maritime Radiation Sensor Test Campaign are:

- Characterize radiation detection performance in field-like conditions using realistic sources and operationally relevant scenarios
- Provide technical data needed to support future research and development decisions to enhance mobile radiation detection systems in the maritime environment
- Provide initial characterization of the ease of use of the mobile detection systems from the end user perspective, assuming the end user would be a typical law enforcement officer
- Document the systems' physical characteristics and the external support requirements.

To accomplish the CRAWDAD scope, SRNL assembled a multi-organizational team drawing resources from SRNL, the Health Physics Instrument Calibration Facility (HPICF), Infrastructure and Services (I&S), and the Savannah River Ecology Laboratory (SREL). SREL's role included providing personnel and equipment necessary for the activities on the lake.

Full scale test execution (involving approximately 40 people in the field) was conducted during July and August 2008. COTS boat mounted radiation detection systems, included in the Crawdad Test campaign, were solicited via the Federal Business Opportunities (FedBizOpps) announcement process. GOTS systems were provided by several government entities in response to requests from DNDO. All systems were subjected to detailed Characterization Tests in the Health Physics Instrument Calibration Facility (HPICF) prior to on-the-water testing.

The primary focus of CRAWDAD was on-the-water testing, since the operating environment on water is significantly different than on land. Numerous terrestrial tests have been conducted but there is very

limited performance data in the Maritime environment. The on-the-water portion of CRAWAD was conducted over a four week period on L-Lake.

Radioactive sources were placed in various configurations on the lake to simulate operational scenarios. Each source was contained in an enclosure that was mounted in a Carolina Skiff to provide floatation and anchored to provide consistent skiff position. The floating dock was instrumented to provide real time transmission of GPS data representing the source position.

Detection systems were mounted on pontoon boats that were driven in operationally relevant scenarios to determine the system's ability to detect and/or identify radionuclides of interest. A typical run included three pontoon boats operating simultaneously with multiple detection systems on each boat. Boats and sources were instrumented with GPS devices such that the relative position between each source and the detector could be determined at the point of detection and/or identification. Detector operators entered test events (alarms, identifications, observations, etc.) into data collection tablets on the boats. Test data were transmitted wirelessly back to a centralized data collection system housed on the lake shore to allow real time monitoring of test progression. Test operations were directed from a shore based Command Center using feedback from the real time data collection systems.

The infrastructure to support CRAWDAD had to be developed from scratch since this was SRNL's first DNDO test campaign. In addition to the extensive logistical support required to accommodate the large number of personnel working in a remote area of the site, the integrated Data Collection System, Wireless Communications System, and GPS positioning systems presented significant technical challenges. CRAWDAD introduced many complexities beyond previous DNDO test campaigns. The CRAWDAD team developed all the necessary solutions to execute the test. This significant technical achievement provides a valuable capability at SRS to support planned future DNDO test campaigns. Execution of the CRAWDAD Test was deemed a huge success by the customer. All test objectives were met and testing was completed on-time and under budget.

ECOLOGICAL RISKS AND EFFECTS

Estimated risks and effects determine the need for remediation and restoration efforts, while perceived risks and effects determine the public's acceptance and support of DOE policies and actions. Estimating ecological risks and effects on the basis of sound science helps to ensure that good decisions are made by reducing uncertainties associated with complex environmental processes. A 1999 report from the National Academy of Sciences stated that *"Ecological risks are better characterized at the Savannah River Site than at any other DOE installation, due in part to the designation of the site as a National Environmental Research Park and the presence of the Savannah River Ecology Laboratory."*

Impact of Proposed MOX Facility Effluent Discharge to Upper Three Runs Creek Watershed

Gary Mills, Michele Harmon, and Ken McLeod

The Upper Three Runs Creek Stream Management Policy divides the stream into three regions: Region I is above the confluence of UTR and Tinker Creek, Region II is between this confluence and the confluence of Tim's Branch and UTR, and Region III is downstream of Tim's Branch to the Savannah River. Regulatory compliance with the management plan requires a sound scientific evaluation of the impact of the chemicals, on the aquatic ecosystems within the UTR watershed. The goals of this study are to (1) determine the current water quality characteristics and copper concentrations of UTR and compare these values to a historical comprehensive database; (2) model the chemical speciation of Cu within the expected range of Cu concentrations and measured water quality parameters to predict Cu bioavailability; (3) directly test aquatic toxicity using a standardized bioassay; and (4) develop a site-specific biotic ligand model (BLM) and water effects ratio's (WER)s for UTR by linking dose-response data for Cu toxicity and geochemical Cu speciation data. Three sites, representing the three management regions have been sampled on a weekly basis for the past year. The site locations include: CCW30, northern sampling point located at bridge on Road 8-1; AEL, midpoint located at Aquatic Ecology Lab station off Road C; and UTR 3, a southern sampling point located at the bridge on Highway 125.

Temperature, pH, dissolved oxygen, and redox potential were measured in the field using potable probes. Samples for general water quality parameters were collected, and after returning to the lab, were analyzed for fluoride, chloride, bromide, nitrite, nitrate, phosphate, sulfate, and alkalinity. Samples for metal analysis were collected in separate ultraclean bottles and samples for dissolved organic carbon were collected in precleaned glass bottles. Dissolved copper values for 44 sampling weeks in the study region within Upper Three Runs ranged from 0.39 to 4.35 ppb. There was a slight increasing trend in concentrations from the upper to lower sites with means of 2.71, 2.94, and 3.72 ppb Cu for CCW30, AEL, and UTR3, respectively. Acute copper toxicity determined using a 48 hour bioassay with *Ceriodaphnia dubia* indicated a LC_{50} (lethal concentration for 50% of test organisms) of 5.6 ppb for the AEL site compared with 6.o3 for laboratory control water. Calculations of bioavailability using the EPA Biotic Ligand Model (BLM) are under way and the model predictions based on the measured water parameters will be compared with the daphnia toxicity data.

REMEDIATION AND RESTORATION

The knowledge and expertise based at SREL are ideally suited to address the remediation and restoration of large land areas contaminated with relatively low levels of metals, organics, and radionuclides. SREL conducts multidisciplinary research designed to assist in the development, evaluation and stakeholder acceptance of remediation and restoration efforts that protect human and ecosystem health. Fundamental to the success of various bioremediation, natural attenuation, and *in situ* remediation applications is an understanding of the underlying scientific principles on which they are based.

Continued Research at the Mixed Waste Management Facility

Julian Singer and John Seaman

In support of 2008 remediation efforts at the Mixed Waste Management Facility (MWMF), SREL continued working in collaboration with the DOE, US Forest Service (D. Strawbridge), and SGCP (M. Kasraii) to assist with facility management and provide the evapotranspiration efficiency estimates required for the Corrective Action Report (CAR). SREL representatives met with the MWMF management team on a weekly basis to coordinate all activities, and maintain, update and report the results from the 1D tritium efficiency model originally developed by researchers from Cornell (Drs. K. Rebel and S. Riha). Efforts in FY 2008 focused on collecting and analyzing two sets of bi-annual soil cores. Twelve 3-meter cores (6 soil cores/report) were analyzed for soil physical properties and tritium concentrations in preparation for the 2007 end-of-year and the 2008 mid-year corrective action report.

Also included in the two reports were the Cornell Model estimates of tritium use efficiencies and mass balance tritium use efficiencies based on data collected through 2008. Remediation efficiencies for the MWMF were calculated based on irrigation schedules, climate data, and soil core analysis from select plots within the facility since operation began in 2001. The semiannual report documenting the soil tritium data, evapotranspiration efficiency estimates, and updated results from the Cornell model was provided to ACP in March 2008. Additional soil cores were taken in plots not regularly monitored for comparison with plots routinely included in the CAR. These cores were analyzed in a similar fashion to those from the regularly monitored plots. Similar efforts were conducted in June-August 2008 for the 2008 mid-year CAR, the results of which were submitted to SGCP in September 2008.

SREL continued assisting the US Forest Service in updating the irrigation system and automating various monitoring system components, including the installation of electronic flow meters to monitor application rates for each irrigation plot. Also, pond recharge rates were calculated using continuous depth gauge measurements, the results of which were provided to USFS and ACP. Additional work is continuing on correlating pond depths with outflow volumes associated with the sheet pile dam weir. Progress has been made in adapting the automated weather data collected on-site into the water deficit calculations performed by USFS personnel. Work integrating automated data collection into daily management of MWMF procedures is ongoing.

In 2008, SREL researchers began developing an alternate 1-D model for describing tritium movement through the soil profile based on the HYDRUS-1D code developed by researchers at the USDA. HYDRUS-1D is a one-dimensional finite element model that uses Richards equation to describe unsaturated/saturated water flow and Fickian based advection-dispersion equations to simulate the movement of heat and solutes in variably saturated, layered heterogeneous media under various boundary conditions. Assuming the new model can be properly calibrated, the HYDRUS-1D provides a more mechanistic description of water movement through the soil profile when compared to the Cornell model. A Morris one-factor-at-a-time (OAT) sensitivity analysis was performed to evaluate the relative elementary and secondary effects for six of the seven van Genuchten Mualem (VGM) hydraulic model parameters used in predicting water retention and movement through a soil profile under atmospheric boundary conditions relevant to the MWMF. Results from the OAT analysis are currently being used to prioritize data collection throughout the course of model development and calibration

In Situ Chemical Oxidation (ISCO) to Address Residual TCE and PCE Contamination on the Savannah River Site

John Seaman

Groundwater contamination plumes containing volatile organic solvents such as trichloroethylene (TCE) and tetrachloroethylene (PCE) remain a major groundwater remediation challenge at the Savannah River Site (SRS) (Mamatey, 2007; Seaman et al., 2007). To address this challenge, a technology demonstration was proposed to evaluate in-situ chemical oxidation (ISCO) as a potential remedial alternative for the M-Area groundwater plume.

Project Tasks: SREL was contracted by Area Closure Project (ACP) to provide technical assistance in the design and permitting of a field-scale technology demonstration to evaluate the potential for ISCO to address VOC contaminated groundwater. Working in collaboration with ACP, SREL assisted in selection of the test site based on an evaluation of existing site data (i.e., VOC contaminant levels, stratigraphy, etc.), site availability and access, and the potential to impact ongoing site remediation efforts. Hydrological modeling was performed to develop an injection/monitoring well configuration to optimize assessment of oxidant dispersion in the aquifer and effectiveness on reducing VOC contamination. A well design compatible with the proposed sampling/monitoring strategy was developed and oxidant-compatible well equipment and materials were purchased.

A bench-scale treatability study was conducted to evaluate the efficacy of Na-persulfate ($Na_2S_2O_8$) and K-permanganate ($KMnO_4$) in oxidizing TCE and PCE using bulk groundwater samples collected in the vicinity of the proposed injection site. Each chemical was evaluated in the presence of several activating agents (i.e., NaOH, Fe-EDTA, Fe oxides) and under varying simulated aquifer conditions. Batch results indicated that persulfate was effective in degrading TCE and PCE, reducing initial TCE levels from 6 ppm to less than 50 ppb within the first few weeks of equilibration at ambient temperatures. Furthermore, the presence of various solution and solid phase Fe sources (i.e., Fe oxides goethite and ferrihydrite) was observed to facilitate VOC degradation. Column experiments were conducted in conjunction with batch experiments to evaluate injectate compatibility with aquifer materials. These data were used in developing the SOW for the injection subcontractor as well as the regulatory injection permit and treatability study.

Other responsibilities:

SREL provided the following deliverables to ACP for regulatory review:

- Program Plan for installation of injection and monitoring wells
- UIC Permit Application for injection of sodium persulfate
- Treatability Study Test Plan

References:

Mamatey, A.R. 2007. Savannah River Site Environmental Report for 2006. Westinghouse Savannah River Company, Aiken, SC 29808.

Seaman, J.C., B.B. Looney, and M.K. Harris. 2007. Research in support of remediation activities at the Savannah River Site. Vadose Zone J. 6:316-26.

H-02 Constructed Wetland Studies

Gary Mills and Ken McLeod

Constructed wetlands offer many advantages over more highly engineered water treatment systems, especially in the cost arena. But, with these advantages, also come some limitations. The extremes in seasonal patterns of temperature, rainfall, evaporation, and overall hydrologic conditions cannot be easily moderated, but their impact on the efficiency of the treatment system can be anticipated and evaluated relative to natural wetland systems. Anticipated concerns for constructed wetlands for water treatment, such as the H-02 wetlands, can be resolved by examining the existing A-01 system and by putting this constructed wetland in context with regional natural wetlands. A regional context is very important due to

the natural soft water which exists in the SRS area and its influence on contaminant toxicity to the aquatic biota.

High productivity of the *Schoenoplectus californicus* (giant bulrush) community planted in the constructed wetlands strongly contributes to the organic carbon pool of the sediments and associated water column. The emergent aquatic vegetation, algae, and bacteria release significant quantities of dissolved organic matter which has bound most of the dissolved copper and zinc. This, in turn, has lead to increased binding potential of contaminants by the organic compounds and an increased efficiency of the entire system. The developing constructed H-02 wetland has removed an average of 66% of the copper and 65% of the zinc from the facility discharge waters entering the system. Biogeochemical processes in the wetland cells also ameliorates and buffers the high, and wildly fluctuating, pH values observed in the influent waters derived from the retention basin.

A series of toxicity experiments has examined the hypothesis that organic contributions from the wetland will negate the effects of increased metal concentrations by making them less bioavailable and, therefore, less toxic to typical aquatic indicator species. Water-Effect Ratio (WER) determination has been conducted according to methods outlined by US EPA (1994). This toxicity testing has been done collaboratively with Dr. Michelle Harmon at the University of South Carolina at Aiken with analytical support from SREL. Assays using this EPA methodology indicate that the dissolved organic matter present in the wetland significantly reduces bioavailability and, consequently, the acute toxicity to *Ceriodaphnia*.

Addition of gypsum and maintenance of low redox potential in the sediments of the A-01 and H-02 constructed wetlands was designed to take advantage of sulfur chemistry (i.e. to encourage binding of metals as insoluble sulfides). Previous studies have shown that the sediment is the ultimate sink for the majority of the metals in the A-01 wetland system. An increase in copper and zinc in the upper sediment layer of the H-02 wetland demonstrates the first step in the ultimate goal of sequestering the metals in the deeper, sulfide-rich sediment. Characterization of the H-02 sediment microbial community has also indicated a significant increase in total bacterial biomass and diversity including sulfate reducers critical for generating sulfides to sequester metals.

H-02 Constructed Wetland Studies: Amphibians and Plants

David Scott, Rebecca Sharitz, Tracey Tuberville, Paul Stankus, Linda Lee, and Whit Gibbons

Construction of the H-02 treatment wetlands adjacent to H-Area on the Savannah River Site (SRS) began during FY-2007. The Savannah River Ecology Laboratory (SREL) initiated ecological studies related to the operation of the H-02 constructed wetlands in May 2008. Constructed wetlands are one method to treat and improve water quality at regulated outfalls on the SRS. Heavy metals such as copper, lead, and zinc are removed by adsorption to organic matter and clay particles, and sulfate reducing bacteria enable the precipitation of metal ions in the anaerobic soils. Constructed treatment wetlands proved effective at the A-01 outfall on the SRS, with removal efficiencies > 80% for copper, mercury, and lead within four years. Systematic monitoring has revealed that water quality is improved prior to discharge into streams, but the extent to which these constructed treatment wetlands also serve other “natural wetland” functions, such as providing wildlife habitat, has not been documented.

Water chemistry is extremely important to the successful development of amphibian eggs and young. Of particular interest are factors such as pH, dissolved oxygen (DO) concentration, and concentrations of metal ions such as copper (Cu) and zinc (Zn). The H-02 wetlands, now in their early phase of establishment, exhibit large fluctuations in some of these parameters. By assessing the response of amphibians to the water quality of the H-02 wetlands over time and comparing amphibian success in created versus natural wetlands, we will better understand the suitability of the H-02 created wetlands for wildlife habitat, especially amphibians. The H-02 wetlands were designed to comply with regulatory guidelines for process and storm water discharge from H-Area facilities, but they may also provide wildlife benefits.

The SREL began amphibian and vegetation surveys at the site in summer 2008. Ecological research conducted by SREL focuses primarily on four questions related to these treatment wetlands: 1) Within 1½ years of construction, what amphibians, reptiles, and plants have become established in the wetlands? 2) Is there any evidence that elevated metals levels in the wetlands (e.g., copper and zinc) affect amphibian success? 3) How do the amphibian diversity and numbers compare to other, more natural, wetlands? 4) As the constructed wetlands age, how will changes in vegetation composition and structure affect the amphibian community?

We conducted amphibian and vegetation sampling at the H-02 treatment wetlands from May-September 2008. Permanent plots for monitoring vegetation and amphibians were established in each wetland cell, and drift fences were constructed adjacent to the area to determine amphibian use of the ponds as breeding sites. We recorded 617 captures of 17 amphibian and reptile species at the H-02 treatment wetlands in FY-08, including successful production of juveniles by eight species. This level of reproductive success was higher than at the natural wetland reference site, which dried in mid-May. However, to date no salamander species have been recorded at the H-02 site. Our baseline vegetation sampling documented 18 vascular plant species plus algae in our plots.

In FY-09 we plan to continue the drift fence and aquatic trap sampling, and supplement these techniques with night call surveys to estimate numbers of breeding individuals (in FY-08 most amphibians species had either completed breeding or were nearly finished prior to the initiation of this project). Some larvae will also be tested for the presence of the chytrid fungus to compare to levels of this pathogen found in bullfrog (*Rana catesbeiana*) larvae at the A-01 created wetlands. Additional samples will be taken of selected species to assay copper levels in tissues. In conjunction with the study by G. Mills and others, we will use *in situ* toxicity tests to examine the effects of H-02 water chemistry on several amphibian species (e.g., representative frog, toad, and salamander species).

As the H-02 wetlands mature, we will use standard metrics such as plant density and species richness to determine changes in the plant community over time. The giant bulrush (*Schoenoplectus californicus*) is expected to remain the dominant species in the constructed facility; however numerous other species are expected to become established on the shallow and more open boundary around each wetland cell. Vegetation plots will be used to document the increase in bulrush density, and the arrival and establishment of additional species. Vegetation will be sampled at several periods during the growing season and compared from year to year; these data can also be compared with similar created wetland systems (e.g., the A-01 system) and natural wetlands on the SRS.

RESEARCH SUPPORT PROGRAMS

Several SREL programs provide critical support to the research, outreach, and education missions of the Laboratory. These support programs include:

Environmental Health and Safety Program
Quality Assurance Program
Research Data Archive Activities
SREL Undergraduate and Graduate Education Programs
Environmental Outreach Program
DOE Research Set-Aside Areas

Environmental Health and Safety Program

Donald R. Mosser, SREL EH&S Manager

The Savannah River Ecology Laboratory (SREL) continues to operate successfully under the work-smart safety and environmental standards that resulted from SREL's participation in U.S. Department of Energy's (DOE) Necessary and Sufficient process. These standards continue to address the hazards associated with SREL operations by permitting a focused effort on the health and safety issues most pertinent to SREL operations. SREL supports and promotes an integrated approach to SRS environmental health and safety issues as a signatory to the SRS Workplace Safety, Health and Security Policy and the SRS Environmental Management System Policy Statement.

SREL maintains a commitment of one, full-time position (SREL EH&S Manager) dedicated to the support of the SREL EH&S Program. Also several laboratory research technicians provide support to the SREL EH&S Program by serving as laboratory Chemical Coordinators. Chemical Coordinators are responsible for maintaining chemical inventory information and providing support in the identification, accumulation, and storage of hazardous wastes.

In an effort to increase the efficiency and effectiveness of the SREL EH&S Program, an emphasis continues to be placed on safety and environmental training of SREL personnel. All new SREL personnel receive a two-hour SREL-specific orientation on the topic of SREL safety and environmental programs, policies, and procedures in addition to the SRS required General Employee Training (GET). New SREL personnel also receive job specific safety training provided for by their SREL supervisor. Approximately ten new SREL personnel received this required training during FY2008. Additionally, SREL personnel received EH&S related training during FY2008 in the following functional areas as their job tasks required:

Chemical Coordinator Training – chemical inventories and hazardous waste generation and management

Radiological Training – Radiological Worker Training, Radioactive Sealed Source User Training, and Radiation Generating Device training

Remote worker training in accordance with SRS remote worker requirements

Hazardous Waste Management (RCRA) Training for workers responsible for handling or storage of hazardous wastes

Georgia Right-To-Know Law (GRTK-HAZCOM equivalent) chemical specific training for UGA/SREL employees who utilize hazardous chemicals in the work place

The SREL EH&S Manager functions as an interface with other SRS organizations in receiving and distributing applicable Lessons Learned information. By integrating with other SRS organizations to share Lessons Learned information, SREL takes advantage of the collective experience and improvements identified by other organizations for similar work processes and controls at SREL. SREL's internal computer network was used to provide targeted safety information to specific groups in the laboratory. The SREL EH&S Manager electronically distributed **16** (sixteen) lessons learned notices in FY2008 to targeted groups at SREL. Additionally, the SREL EH&S Manager electronically communicated in excess of 100 (one-hundred) SRS operational safety related announcements to SREL personnel.

Waste minimization and chemical disposal issues continue to be emphasized to increase efficiency and cost effectiveness. Waste minimization techniques such as source reduction and bench-top treatment continue to be incorporated into experimental protocols, reducing the burden associated with waste disposal procedures while supporting SREL's pollution prevention efforts. SREL generated very small amounts of hazardous wastes in FY2008 with no hazardous waste shipments occurring during FY2008. As part of SREL waste minimization efforts and to ensure that chemical hazards are addressed prior to purchasing chemicals, the SREL EH&S Manager reviewed and approved **209** (two-hundred and nine) purchase requisitions that included chemicals purchased by SREL personnel.

Following SREL staff and operational reductions from FY2007, the number of SREL employees and personnel stabilized during FY2008 at levels approximately half those of FY2007. The University of Georgia and SREL continued with efforts to responsibly and safely divest of SRS facilities which SREL no longer intends to utilize or occupy (the priority being a laboratory facility and associated office facilities located in B-Area). Due to the many safety and environmental related aspects of such facility closures, the SREL EH&S Manager was assigned primarily responsibility for interfacing with WSRC and SRNS organizations to facilitate closure and transfer of SREL's B-Area facilities to SRNS. Resource and transition issues related to the transfer of the site operating contract from the former WSRC to SRNS during FY2008 may have contributed to delays in the characterization and cleanup of SREL's B-Area facilities. However, SREL continues to work with SRNS on the B-Area closure activities and is confident that the intended B-Area facilities will be safely closed, the associated waste disposed, and the facilities transferred to SRNS control and utilization during FY2009. SREL maintains an ongoing and positive dialogue with DOE-SR management and SRNS's Infrastructure and facilities management regarding support and priorities for SREL's closure of the intended B-Area facilities.

The SREL EH&S Manager provided weekly reports of recordable personnel accidents or injuries to DOE-SR line management. SREL also provided monthly, SREL personnel work hour statistics to DOE-SR. SREL personnel reported a single work related injuries/illnesses during FY2008. Although this is a slight increase from the zero recordable injuries reported during FY2007. This single work related injury was attributable to a field worker who experienced a back-strain related injury with causal factors related to human performance factors. Lessons learned information distributed to SREL personnel regarding this injury highlighted individual considerations for human performance factors when performing physically challenging work associated with work in SRS field locations.

SREL received no Notices of Violation in FY2008 as the result of external or internal reviews, inspections, or assessments. SREL conducted assessments in the areas of chemical and radiological air emissions, community right-to-know, and the Georgia Right-to-Know law in compliance with state and federal requirements. SREL also participated in the SRS's annual, comprehensive review and declaration process for Integrated Safety Management Systems (ISMS). As part of the annual ISMS declaration, SREL revised its Integrated Safety Management System Description Document, reviewed its FY2008 safety performance, and established its FY2009 safety performance goals.

Quality Assurance Program

SREL has continued to maintain a formal, U.S. Department of Energy (DOE)-approved Quality Assurance (QA) program. The program is devoted to assuring the continuing quality of SREL research. These SREL "Good Research Practices" highlight research concepts and context, research logistics, and the conduct of research and are available to all SREL personnel on the Lab's intranet web site. All new Laboratory research personnel are required to familiarize themselves with this material prior to beginning work at SREL.

Research Data Archive Activities

Responsible management of research data holdings plays an important role in preserving the SREL's corporate memory. SREL has actively built a centralized repository of research data files and associated "metadata" necessary to make these data fully accessible. Goals of SREL's Research Data Archive activity are to avoid the inadvertent loss of data and to use advanced electronic computer/communication technology, including the use of computer networks and the Internet, to provide access to important data as efficiently as possible.

A web-based SREL data archive system allows users to upload metadata information and actual data

files directly from their office desktop computers. Anyone at SREL or on the SRS can search for data using this web-based system; however, decisions about releasing original data to third parties are retained by the principal investigators. During FY08, a computer security issue reduced our ability to access this system. While the computer files still exist, they are not as conveniently linked and searchable as before and retrieval of these data would be quite time consuming. SREL hopes to obtain funding to return these data archive files to their previous condition.

SREL Undergraduate and Graduate Education Program

Gary Mills

Objectives of the SREL Education Program are to (1) recruit and develop additional professionals to the environmental sciences, with an emphasis on recruitment from under-represented minority groups, and (2) enhance environmental awareness and research opportunities among undergraduate and graduate students with emphasis on conducting ecological research important to the Savannah River Site mission. Undergraduate and graduate student participants in FY08 are listed in Tables 1 and 2, respectively.

The SREL Education Program has a long history of training undergraduate students. Undergraduate students from more than 275 different colleges and universities have coauthored more than 150 peer reviewed research publications and more than 200 of these students have gone on to pursue careers in science. SREL hosted a smaller group of NSF REU students in FY08, with money carried over from the previous year. Submission of the renewal proposal was postponed for one year.

SREL also has a long history of funding graduate students. Since 1967, an average of six students per year has completed graduate studies at SREL, resulting in a total of more than 325 dissertations and theses. During FY08, six Ph.D. and five M.S. students completed their degree requirements (Table 3). Since 1985, our graduate students have won over 200 awards from regional, national, and international competitions at numerous professional societies and foundations. During the past year, SREL graduate students continued to compete successfully for various national and regional awards. Some of these are listed in the section on Special Accomplishments.

Due to changes in overall SREL funding and reduced faculty and support staff levels, the SREL education program has undergone significant reduction and reorganization in FY08. All graduate students were transitioned to the domain of departments at their home institutions.

Table 1. SREL Undergraduate Student Program Participants, FY 08

Student	Academic Institution	Faculty Advisor
Brian Crawford	University of Maryland	J. W. Gibbons/ T. Luhring
Bess Harris	Agnes Scott College	T. Tuberville/ I. L. Brisbin
Chris Schalk	SUNY- Syracuse	J. W. Gibbons/ T. Luhring
Annie Whitely	University of South Carolina, Aiken	G. Mills

Table 2. SREL Graduate Student Program Participants, FY 08

Student	Degree	Institution	Faculty Advisor
Kimberly Andrews	Ph.D.	University of Georgia, Athens	J. W. Gibbons
Ellen Breazel	Ph.D.	University of Georgia, Athens	T. C. Glenn
Elizabeth Burgess	Ph.D.	University of Georgia, Athens	A. L. Neal
Dana Cook	Ph.D.	University of Georgia, Athens	A. L. Neal
Jaclin DuRant	M.S.	University of Georgia, Athens	R. R. Sharitz
William Duval	Ph.D.	University of Georgia, Athens	R. R. Sharitz
Julie Fiser	M.S.	University of Georgia, Athens	C. S. Romanek
Aaliyah Green	M.S.	University of Georgia, Athens	J. W. Gibbons/C. S. Romanek
Adam Hoffman	M. S.	University of South Carolina, Columbia	L. Newman
Ma Hongbo	Ph.D.	University of Georgia, Athens	T. C. Glenn/P. M. Bertsch
Takeshi Katoh	M. S.	Colorado State University, Ft. Collins	T. G. Hinton
Linda Lee	M.S.	University of Georgia, Athens	R. R. Sharitz
Thomas Luhring	M.S.	University of Georgia, Athens	J. W. Gibbons
Frantisek Majs	Ph.D.	University of Georgia, Athens	J. C. Seaman
Lucas Odum	M.S.	University of South Carolina, Columbia	L. Newman
Julian Singer	Ph.D.	University of Georgia, Athens	J. C. Seaman
Brian Todd	Ph.D.	University of Georgia, Athens	J. W. Gibbons
Tracey Tuberville	Ph.D.	University of Georgia, Athens	J. W. Gibbons
John Willson	Ph.D.	University of Georgia, Athens	J. W. Gibbons
Christopher Winne	Ph.D.	University of Georgia, Athens	J. W. Gibbons
Qi Ye	Ph.D.	University of Georgia, Athens	C. L. Zhang
Weidong Zhao	Ph.D.	University of Georgia, Athens	C. L. Zhang/ C. S. Romanek

Table 3. SREL Graduate Students Completing Degree Requirements in FY08:

Student	Degree	Institution	Faculty Advisor
Ellen Breazel	Ph.D.	University of Georgia, Athens	T. C. Glenn
Julie Fiser	M.S.	University of Georgia, Athens	C. S. Romanek
Aaliyah Green	M.S.	University of Georgia, Athens	J. W. Gibbons/C. S. Romanek
Linda Lee	M.S.	University of Georgia, Athens	R. R. Sharitz
Thomas Luhring	M.S.	University of Georgia, Athens	J. W. Gibbons
Lucas Odum	M.S.	University of South Carolina, Columbia	L. Newman
Brian Todd	Ph.D.	University of Georgia, Athens	J. W. Gibbons
Tracey Tuberville	Ph.D.	University of Georgia, Athens	J. W. Gibbons
Christopher Winne	Ph.D.	University of Georgia, Athens	J. W. Gibbons
Qi Ye	Ph.D.	University of Georgia, Athens	C. L. Zhang
Weidong Zhao	Ph.D.	University of Georgia, Athens	C. L. Zhang/ C. S. Romanek

Environmental Outreach Program

J. Whitfield Gibbons

GOAL: Maintain public outreach and communication programs to enhance the public's understanding of environmental issues affecting the SRS and to increase general ecological awareness.

The Savannah River Ecology Laboratory (SREL) Outreach Program uses information from SREL research efforts to educate the public locally, regionally, and nationally. The Outreach Program is designed to enhance SREL's overall mission of acquiring and communicating environmental knowledge and to highlight NNSA's and the U.S. Department of Energy's (DOE) focus on environmental issues on the SRS. Issues as diverse as amphibian and reptile population declines, potential responses of organisms to contamination, distribution and abundance of sensitive species, and dispersal of organisms from radioactively or chemically contaminated sites all are important beyond SREL. Public education during FY08, especially for K-12 audiences, was accomplished through a variety of programs and materials funded predominately from NNSA MOX.

During the past year SREL scheduled and completed 179 talks, 41 tours, 9 exhibits, 14 workshops, reaching a total of 19,502 people. Topics for these presentations included reptiles, amphibians, southeastern plants and habitats, long-term research, safety, biodiversity, local wetlands and watersheds, conservation, and careers in ecology and research. Student groups from 16 schools enjoyed field trips to the Laboratory's Conference Center to participate in the Ecologist-for-a-Day program.

Outreach programs include: *Ecotalk*, an opportunity for students to have nature brought into their classroom for a face-to-face lesson on a variety of live animals found in local habitats; *Ecologist for a Day* visits allow students to spend the day in the field gaining hands-on knowledge of the plants and animals of the unique Upper Three Runs Creek area; civic group presentations; and ecological tours. All school programs incorporate science standards and curricula for particular school districts. In many of these programs participants get an opportunity to work with SREL staff as they catch, mark, and measure various species of reptiles, amphibians, fish, small mammals, and invertebrates. In addition, the Outreach Program offers tours of SREL facilities, as well as exhibits and workshops for the general public.

The main SREL Outreach site receives numerous hits, as it has links to the popular *Ecologist for a Day* program, Outreach fact sheets and products, and the Ecoviews newspaper column. SREL also continues the website for *Kids Do Science* that provides all the necessary materials for 10 hands-on activities developed as part of the hands-on science program with the AHF. This site is frequented by teachers from throughout the country who use the materials in their own classes.

SREL distributes thousands of copies of educational products and materials nationwide to schools, organizations, and the general public. Educational materials include two six-foot-long full-color posters describing the importance of wetlands to reptiles and amphibians, along with teachers' guides. The full-color brochure *Snakes of Georgia and South Carolina* (currently in its fifth printing) has proved to be an extremely successful educational product that reflects positively on DOE and the SRS. The book has been placed at no charge in every public library in Georgia and South Carolina and is also widely distributed at no cost to hospital emergency rooms, veterinary clinics, ambulance services, classrooms, scout leaders, and to various other organizations such as the Boys and Girls Clubs in Aiken and Augusta. Articles referencing the book have appeared in numerous newspapers and magazines including publications in Florida and Texas. SREL supplies are now depleted. A re-printing will be necessary to continue its distribution for educational purposes.

The Outreach Program also continued to distribute educational materials including fliers on *Carnivorous Plants and Their Habitats*; the national version of the Partners in Amphibian and Reptile Conservation (PARC) poster produced by SREL; the brochure *American Alligator* that discusses all safety, ecological, and conservation aspects of alligators; *An Amphibian's Eye View of Wetlands*; and *Is it a Water Moccasin?*; a children's comic book entitled *Stepping into Ecology: the Ecological Adventures of Mud E.*

Boot; a sticker on *Chemistry – it's all about the nature of things*, and the *Metric System Rap* bookmark, as well as the numerous fact sheets available through the website. All of these products have been extremely popular and thousands of copies have been distributed during the past year. Previously created full-color fact sheets and research "snapshots" on a wide variety of research topics were distributed as well. The SREL copies of *Carnivorous Plants and Their Habitats, American Alligator,* and the PARC poster are now depleted. Reprinting will be necessary to continue their distribution for educational purposes.

The Outreach Program continues to respond to inquiries from the press, directing reporters to the most appropriate researchers for their stories. In addition, SREL sends press releases to media contacts on a regular basis as well as submits research information to appropriate audiences. From 2007-2008 SREL researchers provided information to such diverse outlets as the SC Wildlife Magazine, Natural History Magazine, Riverbanks Zoo Magazine, and Reptiles Magazine as well as local news outlets in the Southeast such as *The Aiken Standard*, *The Atlanta Journal-Constitution*, *The Athens Banner-Herald*, *The Augusta Chronicle, Bluffton Today, The Charlotte Observer,* and *The State*. Topics in the news included: animal behavior, release protocols, preserving data sets, conservation, and SREL researcher profiles.

DOE Research Set-Aside Areas

Charles E. Davis

The SRS's Set-Aside Program began in the 1960s when the AEC (Atomic Energy Commission) established 10 relatively small *SREL Reserve Areas* to represent the various habitats on the SRP and to secure study sites for conducting long term ecological research. The Program was expanded in the 1980s to 30 *DOE Research Set-Aside Areas* to better protect sensitive species habitats, preserve the biological integrity of UTRC, and to buffer SREL's long term research from encroaching forest management activities. These areas are a significant component of the SRS landscape (7% of SRS totaling 14,560 acres/5,892 ha) and are found in 43 of the Site's 89 timber resource compartments. There are approximately 275 miles (443 km) of posted boundary line.

Set-Aside Areas are critical to the DOE's Environmental Stewardship mission: they provide for long term study sites as well as sanctuary and protection to much of the SRS's sensitive flora and fauna, including many archaeological sites. They also serve as benchmarks or baseline controls for conducting ecological risk assessments, contaminant transport studies, and site remediation and restoration work. They exist today in strong support of the SRS being a National Environmental Research Park.

Administration and Management of the Set-Aside Areas

Under the existing Cooperative Agreement with DOE, SREL serves as custodians for the 30 Set-Asides and provides day-to-day administration of the SRS Set-Aside Program, including boundary maintenance, developing and implementing stewardship management plans, Site Use coordination, and maintaining research and GIS databases. SREL chairs the DOE's Set-Aside Task Group which approves management prescriptions and ensures protection from land use activities. In FYs 2007 and 2008, DOE funding support for this program ceased; however, as part of the downsized vision of SREL, UGA determined it was in SREL's best interest to continue the day-to-day administration of the program and to implement management treatments in Set-Asides in order to maintain their ecological integrity and future research value. Management treatments in the form of controlled fire or silvicultural thinning are prescribed for timber stands/vegetation types in various Set-Aside Areas to move overstocked plantation pine into a healthier, more natural plant community that is more suitable to the soil and less likely to attract beetle infestation. It also reduces the potential for a damaging wildfire by reducing the fuel build up.

Accomplishments and maintenance activities for the Set-Aside program for this FY include:

- The Set-Aside Task Group met both formally and informally four times to address issues concerning Set-Asides.

- There is one pending timber sale scheduled for the Dry Bay Set-Aside. SREL and USFS-SR cooperated to implement a thinning treatment.

- An escaped wildfire from an adjoining prescribed control burn burned through approximately one half of the Little Cypress Set-Aside but caused very little tree mortality.

- The Craig Pond Scientific Advisory Group again requested a prescribed growing season burn for Craig Pond (Set-Aside Area No. 17). SREL worked in cooperation with the USFS-SR and Chem-Nuclear to accomplish a late spring/early summer treatment.

-The SCDNR formally requested from DOE-SR to acquire the Craig Pond/Sarracenia Bay Set-Aside so that the entire Craig Pond area could be owned and managed as DNR's Heritage Preserve and Wildlife Management Area for public recreation and hunting.

- SREL released an updated version of the Set-Aside GIS boundary layer to the USFS-SR to reflect administrative boundary changes based on USFS-SR Treatments GIS layer.

- Prescribed winter season burning coordination continued between SREL and the USFS-SR to minimize potential impacts to Set-Asides.

- USFS-SR coordination for the first thinning treatment scheduled for the Dry Bay Set-Aside (Area No. 23) was initiated pending SREL personnel commitments to boundary and stand markings in preparation for marking of the timber sale.

- Members of the Set-Aside Task Group continued to address erosion impact issues to Area No. 30 (Reedy Branch area) that were associated with WSI/DOE authorizing timber removal that was to provide a vegetative buffer to the expansion of the ATTA range.

- SREL cleared interferences for 34 Site Use Permits for potential impacts to the Set-Aside Areas and applied for one new permit this FY. SREL provided comments on three NEPA documents which included potential impacts to Set-Asides from the ATTA Range expansion, US Military training maneuvers, and the siting of a Biomass power plant. SREL attended four meetings and workshops with the US Army to discuss potential impacts from proposed training activities on Set-Aside Areas.

- In collaboration with USFS-SR, SREL submitted a grant proposal to the EPA for conducting wetland restoration research in the Mona/Woodward Bay Set-Aside. Additional research proposals focusing on the effects of DOE-SR operations on the biodiversity of Upper Three Runs as well as long term data sets associated with Set-Asides were submitted for funding.

- SREL initiated a new vegetation research study in collaboration with Syracuse University using Field 3-412 as one of six cross-latitude experimental network sites.

- There was no new acreage added or deleted from the program this FY, nor was there any boundary line marking performed for boundary changes added in FY 07.

Program needs include:

- Completion of management plans for the Craig Pond/Sarracenia Bays (Area No. 17), Old UGA Lab Site (Area No. 2), Risher Pond (Area No. 10) and the Ginger's Bay Set-Aside (Area No. 19) continue to be on hold.

- Pine beetle infestation in an ice damaged stand slated for regeneration and conversion to a longleaf/wiregrass community in the Flamingo Bay Set-Aside (Areas No. 21) was recommended for harvest but has not been accomplished to date.

- The Site Use Permit for the Set-Aside Areas remains in need of amendment updates to reflect changes to the administrative boundaries for the Set-Aside Areas Nos. 3, 11,12, 24, 29, and 30. Following Site Use approval, area additions will require new boundary postings.

Research and Outreach in Set-Aside Areas

Long-term research continued in Set-Aside Areas using traditional study sites and reference sites for collections of uncontaminated plants, animals, soils, or water. SREL produced 11 publications that used Set-Asides with a majority of these were devoted to amphibian research in depressional wetland Set-Asides.

SREL completed its 30th year of daily sampling of the Rainbow Bay Set-Aside, the longest continuous amphibian study in the world, while Ginger's Bay Set-Aside continued its seasonal sampling which has been ongoing for 22 years. These and other long-term data coming from studies in Set-Asides continue to be used to better understand survival patterns and population dynamics of southeastern herpetofauna. Studies continued on the effects of the chytrid fungus which has been reported on the SRS from several locales, which may yield an understanding of the factors that drive populations up and down, especially with drought becoming increasingly important in years to come. Coupled with this, select amphibian species at a number of Carolina bay Set Asides continued to be sampled to help determine how genetically isolated populations differ. Combined with estimates of terrestrial distributions and movements of salamanders from the Ginger's Bay Set Aside, these site-wide genetic data will allow researchers to model connections among wetlands and the likelihood of recovery from local extinctions.

Studies continued to be conducted in the Steel Creek and Dry Bay Set-Asides where aquatic vertebrates and invertebrates were sampled to examine seasonal activity. Tissue samples were collected from greater sirens for use in population genetics and for the development of a sex-linked marker. Also, a mark-recapture population analysis continued on greater sirens and two-toed amphiumas using PIT tags in Dry Bay. This study examined the distribution of species and individuals among microhabitats and depth levels in the bay and focused on the ability of these species to sense and respond to chemical cues from predators.

Also, SREL researchers continue to examine the role of prey availability, prey type, and environmental stochasticity on aquatic snakes at the level of the individual, population and community at Ellenton Bay and other wetland Set-Aside Areas. Long-term monitoring of these aquatic snake populations and their community dynamics will aid in understanding their response to environmental variation (drought) and amphibian prey availability. In addition, Ellenton Bay is sampled monthly as a comparison site for the projects we are conducting at the D-Area Ash Plume Wetland and the H-02 constructed wetland.

A new vegetation study was initiated this FY using the Field 3-412 Set-Aside as part of a cross-latitude experimental network determining climate change affects on old field vegetation succession across the Eastern US. Data gathered from this study will aid researchers in assessing important controls on the rates of woody succession and in the development of predictive climate change models.

The Sandhills and Scrub Oak Natural Area Asides continued to be used as controls to evaluate impacts from military training and forest management on TES species. Archaeologists with the USC-Savannah River Archaeologist Research Program continued their investigations examining the occupational use of the Flamingo Bay sand rim.

SREL's Outreach program continued to use the E. P Odum Wetland (UTRC) when conducting Ecologist-For-a-Day at the UGA Conference Center. This program conducts field studies with local school groups where participating students are able to use ecological research techniques to experience the biodiversity associated with the surrounding habitats of UTRC. The purpose of these outdoor classroom studies are to enhance environmental awareness about the UTRC watershed, promote environmental stewardship, and to encourage students to consider careers in the sciences.

Externally Funded Grants

PI	Carl Bergmann
Project Title	CRAWDAD Maritime Test Campaign
Funding Agency	Savannah River National Laboratory
Period	June 1, 2008—October 31, 2008
Budget	$80,000

PI	I. Lehr Brisbin
Project Title	Ecological Studies of Birds in the Vicinity of the Augusta Regional Airport at Bush Field and the Messerly Wastewater Treatment Plant
Funding Agency	Augusta-Richmond County
Period	October 1, 2007—September 30, 2008
Budget	$99,308

PI	I. Lehr Brisbin
Project Title	UGA Foundation Canine Research
Funding Agency	UGA Foundation
Period	Open
Budget	$28,505

PI	Larry Bryan
Project Title	Determination of Wood Stork Breeding Success in Georgia
Funding Agency	U.S. Department of the Interior-FWS
Period	April 1, 2004—June 30, 2009
Budget	$46,666

PI	Larry Bryan
Project Title	Determination of Wood Stork Colony Breeding Success on Kings Bay Naval Submarine Base
Funding Agency	U.S. Department of the Interior-USFWS
Period	March 1, 2004—September 30, 2009
Budget	$8,414

PI	Larry Bryan
Project Title	Determination of Core Foraging Areas for Wood Stork Nesting Colonies in Northern Florida
Funding Agency	U.S. Department of the Interior-USFWS
Period	March 1, 2004—September 30, 2009
Budget	$30,000

PI	Larry Bryan
Project Title	Wood Stork Foraging Habitat Assessment for Southwest Florida
Funding Agency	National Audubon Society
Period	June 1, 2007—September 30, 2009
Budget	$7,200

PI	Larry Bryan
Project Title	Determination of Wood Stork Colony Breeding Success in Georgia and South Carolina in 2007
Funding Agency	U.S. Department of the Interior-USFWS
Period	April 1, 2004—September 20, 2009
Budget	$8,496

PI	Charles Davis
Project Title	Wildlife Literature Survey and GIS Database Update
Funding Agency	Washington Savannah River Company-SGCP
Period	October 1, 2007—September 30, 2008
Budget	$35,863

PI	Charles Davis
Project Title	Deer Forage Habitat Assessment of Upper Steel Creek (USC) Area
Funding Agency	Washington Savannah River Company-SGCP
Period	October 1, 2007—September 30, 2008
Budget	$43,440

PI	Whit Gibbons
Project Title	Land Use Practices and Persistence of Amphibian Populations
Funding Agency	National Science Foundation
Period	May 15, 2003—April 30, 2009
Budget	$283,452

PI	Whit Gibbons
Project Title	Feasibility of Translocation as a Management Tool for Diamondback Rattlesnakes
Funding Agency	South Carolina Department of Natural Resources
Period	January 1, 2006—September 30, 2008
Budget	$96,000

PI	Whit Gibbons
Project Title	Wildlife Highway Crossing Study: Investigation of the Use of Highway Culverts by Wildlife
Funding Agency	U.S. Department of the Interior-USGS
Period	February 17, 2006—September 30, 2008
Budget	$74,939

PI	Whit Gibbons
Project Title	Website Maintenance and Scientific Oversight of the North American Reporting Center for Amphibian Malformations
Funding Agency	U.S. Department of the Interior-USGS
Period	April 1, 2006—December 31, 2008
Budget	$133,893

PI	Whit Gibbons
Project Title	Investigating Effects of Ecologically Conservative Residential Development on Snake Movement Patterns and Survivorship
Funding Agency	Palmetto Bluff Conservancy
Period	April 1, 2006—March 30, 2009
Budget	$34,006

PI	Whit Gibbons
Project Title	Development of Amphibian Monitoring Methodologies for the Gulf Coast Network
Funding Agency	Cooperative Ecosystem Studies Unit-Piedmont
Period	September 12, 2006—September 31, 2008
Budget	$118,400

PI	Whit Gibbons
Project Title	Modeling Extinction Risk of Native and Translocated Gopher Tortoise Populations: Developing a Decision Tree for Managing “At Risk” Populations
Funding Agency	U.S. Department of the Army
Period	April 27, 2006—August 31, 2008
Budget	$70,099

PI	Whit Gibbons
Project Title	Incidence of Chytrid Fungal Parasitism in Southeastern Parks
Funding Agency	Cooperative Ecosystem Studies Unit-Piedmont
Period	May 1, 2006—December 30 2008
Budget	$31,243

PI	Whit Gibbons
Project Title	H-02 Constructed Wetland Studies- Amphibians and Plants
Funding Agency	Department of Energy-NNSA
Period	October 1, 2007—September 30, 2008
Budget	$100,000

PI	Whit Gibbons
Project Title	Public Outreach Activities
Funding Agency	Department of Energy-NNSA
Period	October 1, 2007—September 30, 2008
Budget	$200,000

PI	Whit Gibbons
Project Title	Assessing the Ecological Health of Stream Systems and Watersheds of SRS Ecosystems: Modeling the Herpetofaunal Habitat-Biodiversity Relationship
Funding Agency	Washington Savannah River Company-SGCP
Period	October 1, 2007—September 30, 2008
Budget	$86,313

PI	Tom Hinton
Project Title	Transgeneration Effects from Chronic Low-Dose Irradiation in a Medaka Fish Model System
Funding Agency	Colorado State University-DOE
Period	July 1, 2005—December 31, 2008
Budget	$318,874

PI	Tom Hinton
Project Title	Estimation of Radioactive Contamination of Media and Terrestrial Biota at the Territories Adjoining Chernobyl NPP’s Cooling Pond
Funding Agency	Civilian Research and Development Foundation
Period	August 1, 2007—July 31, 2009
Budget	$4,500

PI	Tom Hinton
Project Title	C14 Research Used in SRS Composite Analysis
Funding Agency	Washington Savannah River Company-SGCP
Period	March 11, 2008--September 30, 2008
Budget	$59,993

PI	Robert Kennamer
Project Title	Cost of Incubation: Linking incubation-Induced Alterations in Phenotype to Changes in Fitness
Funding Agency	Virginia Polytechnic Institute
Period	January 1, 2007-August 31, 2008
Budget	$31,933

PI	Robert Kennamer
Project Title	Aerial Surveys of Wintering Waterfowl at Lake Murray, SC
Funding Agency	Kleinschmidt Associates
Period	October 1, 2007—February 28, 2009
Budget	$4,467

PI	J Vaun McArthur
Project Title	REU-Effects of Energy Technologies on Environmental Systems
Funding Agency	National Science Foundation
Period	May 1, 2005–September 30, 2008
Budget	$175,400

PI	Gary Mills
Project Title	Water Quality Studies at the A-01 and H-02 Constructed Wetlands
Funding Agency	Department of Energy-NNSA
Period	October 1, 2007—September 30, 2008
Budget	$250,000

PI	Gary Mills
Project Title	Impact of Proposed MOX Facility Effluent Discharges to Upper Three Runs Creek Watershed
Funding Agency	Department of Energy-NNSA
Period	October 1, 2007—September 30, 2008
Budget	$185,000

PI	Christopher Romanek
Project Title	Holocene Shell Accumulation from the Southeast Brazilian Bight: Multi-Centennial Dynamics of Oceanographic, Environmental, and Ecological Changes
Funding Agency	National Science Foundation
Period	July 1, 2006—June 30, 2009
Budget	$94,776

PI	Christopher Romanek
Project Title	Optical Microscopy and Chemical Analysis for Crystal and Liquid Samples
Funding Agency	Washington Savannah River Company
Period	March 4, 2008—February 12, 2009
Budget	$100,500

PI	Christopher Romanek
Project Title	Survey of Environmental Monitoring Techniques for Application to Defense Program Analysis and Monitoring Needs
Funding Agency	Department of Energy-NNSA
Period	October 1, 2007—September 30, 2008
Budget	$160,000

PI	John Seaman
Project Title	Application of Surface Complexation Models to Predicting Actinide Fate and Transport in Variably Saturated Systems
Funding Agency	Clark Atlanta University-DOE
Period	October 1, 2005-February 28, 2008
Budget	$20,193

PI	John Seaman
Project Title	Tritium Distribution at the Tritiated Water Management Facility
Funding Agency	Washington Savannah River Company-SGCP
Period	October 1, 2007—September 30, 2008
Budget	$111,754

PI	John Seaman
Project Title	In-Situ Chemical Oxidation (ISCO) to Address Residual TCE and PCE Contamination on the Savannah River Site
Funding Agency	Savannah River National Laboratory
Period	August 1, 2008—September 30, 2009
Budget	$75,325

PI	John Seaman
Project Title	Survey of Environmental Monitoring Techniques for Application to Defense Program Analysis and Monitoring Needs
Funding Agency	Department of Energy-NNSA
Period	October 1, 2007—September 30, 2008
Budget	$60,000

PI	John Seaman
Project Title	Development of Characterization Methodologies for Environmental Nano-Particles
Funding Agency	Washington Savannah River Company-SGCP
Period	August 18, 2008—November 30, 2008
Budget	$15,092

PI	John Seaman
Project Title	Cavity Ring Down Spectroscopy: Proof of Concept for Environmental Analysis and Monitoring of Process Systems of Defense Programs at DOE's Savannah River Site
Funding Agency	Department of Energy-NNSA
Period	August 1, 2008—Septmeber 30, 2009
Budget	$140,000

PI	John Seaman
Project Title	Molecular Mechanisms of Bacterial Attachments to Fe(III) – Oxide Surfaces
Funding Agency	US Department of Energy
Period	September 15, 2005—September 14, 2009
Budget	$684,403

PI	John Seaman
Project Title	Improved Modeling of Inorganic Contaminant Transport in the Vadose Zone: A Defensible Basis for MN/EA
Funding Agency	US Department of Energy
Period	August 15, 2008—September 30, 2009
Budget	$100,000

PI	John Seaman
Project Title	Preparing Sediments at a Steady State Moisture Content Using the Unsaturated Flow Apparatus and for BET Surface Area Measurements
Funding Agency	Washington Savannah River Company
Period	September 12, 2007—September 30, 2008
Budget	$19,966

PI	Rebecca Sharitz
Project Title	On-Site Field Studies and Long-Term Monitoring Required for BRAC Implementation, Environmental Compliance, Technology Integration Assistance…
Funding Agency	Cooperative Ecosystem Studies Unit-Gulf
Period	September 16, 2006—October 31, 2008
Budget	$362,889

PI	Barbara Taylor
Project Title	Enhancement of Disturbed Upper Coastal Plain Stream Systems: Establishing Restoration Criteria and Strategies for a Stream Mitigation Bank
Funding Agency	University of Kentucky-U.S. Forest Service
Period	February 1, 2006—September 30, 2008
Budget	$223,946

PI	Tracey Tuberville
Project Title	Genetic Mating System of Translocated Gopher Tortoises
Funding Agency	Riverbanks Zoo
Period	June 1, 2008—December 31, 2010
Budget	$4,804

PI	Tracey Tuberville
Project Title	Using Individual Behavior-Based Modeling to Predict Population Response and Long-Term Viability of “Species At Risk”
Funding Agency	US Department of Army
Period	August 26, 2008—December 31, 2008
Budget	$28,080

Publications

Journal Articles Published In FY2008

3047 Unrine, J. M., W. A. Hopkins, C. S. Romanek and B. P. Jackson. 2007. Bioaccumulation of trace elements in omnivorous amphibian larvae: Implications for amphibian health and contaminant transport. Environmental Pollution 149: 182-192.

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3049 Todd, B. D. 2007. Parasites Lost? An Overlooked Hypothesis for the Evolution of Alternative Reproductive Strategies in Amphibians. The American Naturalist 170(5):793-799.

3050 Hopkins, W. A., L. B. Hopkins, J. M. Unrine, J. Snodgrass, and J. D. Elliott 2007. Mercury Concentrations in Tissues of Osprey from the Carolinas, USA. Journal of Wildlife Management 71(6):1819-1829.

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3059 Landman, G. B., R. K. Kolka, and R. R. Sharitz. 2007. Soil Seed Bank Analysis of Planted and Naturally Revegetating Thermally-Disturbed Riparian Wetland Forests. Wetlands 27(2): 211-223.

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3061 Balbach, H., R. Sharitz, D. W. Imm, T. D. Tuberville, and G. R. Wein. 2007. Strategy for in situ conservation of at-risk and declining sandhills species. 3rd Global Botanic Gardens Congress, Conservation International, Surrey, UK.

3062 Koler-Matznick, J., B. C. Yates, S. Bulmer, and I. L. Brisbin, Jr. 2007. The New Guinea Singing Dog: Its Status and Scientific Importance. Australian Mammalogy 29: 47-56.

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SREL Organizational Chart

Co-Directors
Carl W. Bergmann and Kenneth W. McLeod

Faculty
- Kurt A. Buhlmann
- J Vaun McArthur
- Gary L. Mills
- Christopher S. Romanek
- John C. Seaman
- Rebecca R. Sharitz
- Tracey D. Tuberville

Adjunct Faculty
- Travis C. Glenn
- Thomas G. Hinton
- Lee A. Newman
- Chuanlun Zhang

Emeritus Faculty
- Domy C. Adriano
- I. Lehr Brisbin, Jr.
- Justin D. Congdon
- J. Whitfield Gibbons

Administrative Financial Director
- Robert L. Nestor

Safety and Environmental Manager
- Donald R. Mosser

Computer Service and GIS Lab Manager
- Joshua Dooley

Education Program
- Gary L. Mills
- Tracey Tuberville

Outreach Program
- J. Whitfield Gibbons

Research and Facilities Technical Services
- Mark Edwards
- Malcolm Squires

Administrative Services
- Marie Roberts
- Cherie Summer
- Vera Taylor

(As of 10/1/2008)