SAVANNAH RIVER
ECOLOGY LABORATORY

ANNUAL TECHNICAL PROGRESS REPORT OF ECOLOGICAL RESEARCH FOR FY2013

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SECTION I: Savannah River Ecology Laboratory – FY13 Overview of Achievements

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 62 years. The overall mission of the Laboratory is to enhance our understanding of the environment by acquiring and communicating knowledge of ecological processes and principles that contribute to sound environmental stewardship. In addition, as directed in the Cooperative Agreement with the U.S. Department of Energy (DOE), SREL will provide the public with an independent evaluation of the ecological effects of SRS operations on the environment. Toward these goals, SREL conducts fundamental and applied ecological research, as well as education and outreach programs.

The Laboratory's research mission during the 2013 fiscal year was fulfilled with the publication of 48 journal articles and book chapters by faculty, technical staff, students, and visiting scientists. One book was also authored by SREL faculty and staff members. Additional journal articles and books have been submitted or are in press. Significantly, SREL outreach activities reached over 28,000 people of all ages. Other noteworthy events took place as faculty members, staff, and graduate students received awards for the quality of their research. These are described in Section IX 'Special Accomplishments'.

The vision, structure, and operations of SREL continue to evolve since changes in funding structure were instituted in FY07. However, the Cooperative Agreement between the University of Georgia's Research Foundation and the Department of Energy for support of the Savannah River Ecology Laboratory was renewed in FY12 and funding received from the DOE and other SRS tenants through this agreement reflects the specific needs of EM and NNSA on the Savannah River Site. The current funding model for SREL is entrepreneurial and interdisciplinary, and seeks to pursue funding strategies that are competitive, responsive to sponsors' requirements, and based on a diverse and sustainable foundation. This model has required restructuring of research and supporting infrastructure at the laboratory.

Today, a reduced, but robust SREL presence continues to operate on the SRS. Currently, SREL's total employment is approximately 80 faculty, technicians, students, and support staff. Although the number of employees and level of funding is reduced, SREL continues progress toward stated objectives and does not compromise safety and security. New partnerships and collaborations with the Athens campus (Warnell School of Forestry and Natural Resources, UGA Complex Carbohydrates Center, Odum School of Ecology, College of Agriculture and Environmental Sciences), other universities (University of South Carolina – Aiken, University of South Carolina – Upstate, Georgia Reagents University) and other agencies (US Department of Agriculture, US Department of Defense, Federal Aviation Administration) continue to be explored and developed in order to maximize the use of SREL assets. Graduate student programs have continued with funding provided by DOE, external grants, UGA, or the student's host university.

During FY13, DOE-SR funding was leveraged to acquire over $400,000.00 in new salary and infrastructure investments from the University of Georgia. In addition, DOE funding has been used to leverage new cost shared faculty positions with main campus UGA units (beginning in FY14 and FY15) that will result in the addition of three new tenure track faculty lines at SREL and a portion of three new tenure track faculty lines on the main UGA campus that will contribute to the SREL mission on the SRS during the coming years.

SREL faculty have responded to the revised funding structure for the laboratory and have sought financial support from multiple external funding agencies, DOE-EM, DOE-NNSA (National Nuclear Security Administration), SRNS-ACP (Savannah River Nuclear Solutions-Area Closure Projects), and SRR (Savannah River Remediation) and UGA has provided temporary infrastructure support to SREL. The current Cooperative Agreement with DOE allows SREL/UGA access to the SRS through 30 November

2016. The SREL continues to work closely with local community groups, local schools, and other area stakeholders on a number of research, environmental monitoring, education, and outreach activities.

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 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. In addition, personnel from SREL have been actively engaged in ongoing Strategic Initiatives associated with the Enterprise SRS Vision, including strategic and leadership roles in Radioecology, Next Generation Cleanup Technologies and Renewable Energy.

Researchers at SREL received funding from 37 new and continuing external grants during FY13 and increased non-SRS external funding levels by over 300% from FY12 to FY13. Sources of grant awards range from private foundations to federal and state agencies such as the U.S. Department of Interior, the U.S. Department of Agriculture, the National Science Foundation, and the Department of Defense.

SREL faculty members hold positions in varied departments at the University of Georgia. In addition, several SREL faculty members (and emeritus faculty) 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 SREL hold editorial or committee positions in national groups and organizations and also serve on several UGA academic and administrative committees. SREL faculty members continue to make scientific presentations, contribute posters to scientific meetings, and present seminars at colleges and universities.

Participants in the SREL Education Program increased dramatically during FY13 and included 18 undergraduate students and over 40 graduate students from numerous colleges and universities in the United States.

The SREL Outreach Program communicates scientific awareness to area schools and the general public, an audience which differs from science professionals. During the past year, SREL presented over 300 talks, 44 tours, 20 exhibits, and 42 'Ecologist for a Day' Programs reaching a total of over 28,000 people. Topics for these presentations included ecological studies of reptiles and amphibians, southeastern plants and habitats, long-term research, safety, biodiversity, local wetlands and watersheds, conservation, and careers in ecology and research. In the past year, SREL has participated in the SRS public tour program (~two tours per month of 30-40 citizens). SREL participates by providing presentations on the history and research of the lab as well as a "show and tell" session featuring research animals native to the SRS.

The UGA Conference Center has continued to be a valuable asset to SREL and other groups on the SRS. 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 DOE, the USDA Forest Service, and other site tenants when it is available.

SREL hosted the 12th International Conference on the Biogeochemistry of Trace Elements (ICOBTE) during June 16-20, 2013, at the University of Georgia in Athens. The first ICOBTE conference was organized by Drs. Domy Adriano (SREL) and Albert Page (University of California) in 1990. This biennial event brings together students, professionals, and industry dealing with the source, fate and effects, and pathways of trace elements and metalloids in the environment, with emphasis on their biogeochemistry. Dr. John Seaman (SREL) served as conference chair and host for the 12th ICOBTE, which attracted more than 360 participants from over 50 different countries. The program included the following plenary speakers: Dr. Tom Hinton (Project Coordinator, French Institute of Radiation Protection & Nuclear Safety); Dr. Brian B. Looney (Senior Fellow, Savannah River National Laboratory);

Dr. Bernd Nowack (Empa-Swiss Federal Laboratories for Materials Science and Technology); and Dr. John Zachara (Chief Scientist for Environmental Chemistry, Pacific Northwest National Laboratory).

In summary it is important to note that as one reads through the remainder of this document, the important roles that SREL plays on the SRS unfold prominently in several strategic areas. Such efforts by SREL staff play a critical role in helping the DOE and other SRS tenant organizations reduce costs and continue with their missions on the SRS by assisting them to maintain regulatory compliance, validating remediation efforts, providing basic research for the development of new technologies, promoting sound environmental stewardship of natural resources on the SRS, serving as an independent source of scientific expertise for reviews of technical data and monitoring programs, educating the next generation of radioecologists and nuclear biogeochemists, and conducting outreach efforts to educate local communities about the SRS, its missions, and environmental health. For example, as a critical source of scientific expertise for the Department of Energy on the SRS, SREL provides state of the art scientific support to both DOE-EM and DOE-NNSA. Examples include research on biogeochemical cycling and biological impacts of copper associated with the H-02 mitigation wetlands that provide the data needed to validate regulatory compliance for the DOE-NNSA's Tritium mission on the SRS, research on the ecological impacts and potential options for recovery of function of the U-8 stream drainage associated with DOE-NNSA's construction efforts for the MOX fabrication facility on the SRS, research on the potential for production of biofuels on the SRS to increase energy independence on the SRS, decrease fuel costs for SRS fleet operations and increase the prominence of the SRS in development of green energy alternatives, and development of strategic management plans for Set Asides on the SRS to maintain the SRS designation as DOE's first National Environmental Research Park.

SREL also serves as a source of critical scientific expertise for other SRS tenant organizations, providing analytical and ecological expertise to assist these organizations with issues ranging from regulatory compliance to creative new technologies for remediation of contaminants on the SRS. Examples include research conducted in support of the SRR mission on the SRS to provide accurate and precise data for use in parameterization of models employed to comply with NRC requirements concerning long-term contaminant exposure risk from stored nuclear materials, research conducted in support of SRR and SRNS needs to assess biological exposure risks from leakage events involving stored nuclear materials into soil and groundwater, research on the design and efficiency of strategies for bioremediation of tritium in SRS groundwater for SRNS, and research conducted in support of SRNS ACP's remediation mission to assess radionuclide and heavy metal accumulation in long-lived vertebrates and game species to inform regulatory compliance and risk assessment issues associated with ecosystem and human health.

As a source of regional and national scientific expertise, SREL scientists attract external funding to conduct research that not only contributes to areas of national research priority, but also help contribute to DOE's nuclear and environmental missions on the site. Examples include research on development of technologies for control of feral swine (funded by the US Department of Agriculture), which makes the SRS both a national focal point for feral swine research as well as a recipient of the technologies and strategies as they are developed, research on conservation and management of threatened and endangered species across the nation (funded by the US Department of Defense and the US Fish and Wildlife Service), which contributes to the strategies and tools available for environmental stewardship applications on the SRS, research on avian dispersal technologies (funded by the Federal Aviation Administration and the City of Augusta), which contributes to the ability of SRS tenants to manage nuisance wildlife populations, research on scavenging ecology (funded by the US Department of Agriculture and the Department of Defense), which provides insights into the role of scavengers in recycling of energy and contaminants in the environment and the potential transfer of contaminants off of SRS, and research on risk assessment models for heavy metals in avian species (funded by the US Army Corps of Engineers), which adds to the set of risk assessment modeling expertise available for study of fauna on the SRS.

SECTION II. Cooperative Agreement Key Tasks

TASK 1. SREL will assess the impact of Site operations on the environment, and will continue to provide the public and DOE with an independent view of the environmental management of the SRS

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 quality of research conducted by SREL scientists is facilitated by their unique expertise in 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 62 years.

The FY13 SREL research plan can be divided into three critical research areas:

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 is a critical component of NEPA (National Environmental Policy Act) 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.

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."*

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.

TASK 2. SREL will continue basic and applied environmental research with emphasis upon expanding the understanding of ecological processes and principles, and upon evaluating the impacts of site activities, new mission, and land use practices on the environment

In FY13 the Savannah River Ecology Laboratory received approximately 6 million dollars in total funding from a variety of sources (Figure 2.1). These funds supported around 75 research faculty, staff, and students conducting basic and applied environmental research for at least some portion of FY13 (Table 2.1). In total, University of Georgia funding (both direct and indirect funds returned to the lab) and external dollars received from non-SRS sources were responsible for approximately 40% of the laboratories budget. Laboratory personnel were productive and successful in attracting external funding to the site, and very active in graduate student education and service to their communities and professions (Table 2.2). SREL continues to be a productive, independent partner to DOE on the SRS and an excellent value to both stakeholders on the SRS and taxpayers.

Figure 2.1. Overview of funding received by SREL in FY13. Acronyms are as follows: University of Georgia (UGA), Savannah River Site Office of Department of Energy (DOE-SR), all combined sources of funding received from sources external to the Savannah River Site (External), Department of Energy National Nuclear Security Administration's Mixed Oxide Fuel Production Facility (NNSA-MOX), Department of Energy National Nuclear Security Administration's Tritium Facility (NNSA-Tritium), Savannah River Nuclear Solutions Area Closures Project (ACP) and Savannah River Remediation (SRR)

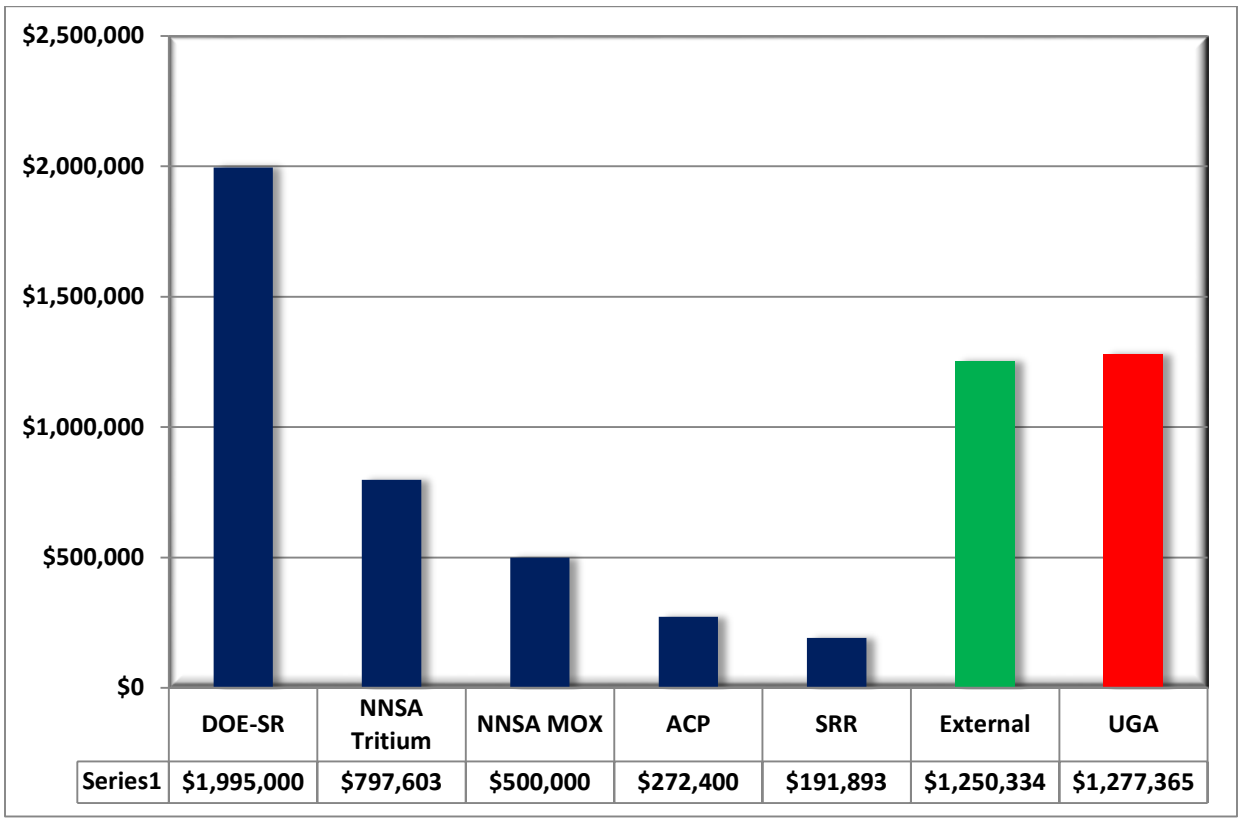

Table 2.1. SREL organizational structure for FY13. This table includes all research faculty, classified staff and Emeritus faculty in residence at the Savannah River Ecology Laboratory for any portion of the FY13 fiscal year.

SREL ORGANIZATIONAL CHART – FY13	
Director Dr. Olin E. Rhodes, Jr.	
Assistant Director Research Dr. J. Seaman **Research Faculty** Dr. J. Beasley Dr. K. Buhlmann Dr. S. Lance Dr. J. Vaun McArthur Dr. G. Mills Dr. J. Seaman Dr. T. Tuberville **Emeritus Faculty in Residence** Dr. D. Adriano Dr. I. Brisbin, Jr. Dr. J.W. Gibbons (Head Outreach) Dr. K. McLeod Dr. R. Sharitz **Post Docs** Dr., H. Chang Dr. E. Burgess Dr. S. Unger **Research Professionals** R. Beasley L. Bryan D. Fletcher R. Kennamer L. Lee A. Lindell B. Metts D. Scott J. Singer P. Stankus **Research Technicians** C. Hagen C. Love D. Soteropoulos A. Grosse S. Weathersbee Z. Smith S. Webster S. Buettner J. O'Brynim N. Fletcher M. Attkinson R. Thomas M. Baker	**Assistant Director Budget and Facilities** C. McBride **Safety and Environmental Manager** D. Mosser **Computer Service and GIS Lab Manager** W. Taylor W. Finney **Outreach Program Staff** Dr. K. Andrews C. Eldridge J. Green-McLeod S. Poppy A. Tucker **Research and Facilities Technical Services** R. Christie M. Edwards D. Kling M. Squires P. Carroll **Administrative Services** M. Roberts C. Summer V. Taylor L. Zweifel M. Wead V. McFarland
(As of 10/1/2013)	

Table 2.2. Summary of professional activities and accomplishments by Savannah River Ecology Laboratory research faculty, research professionals, postdocs and students in FY13.

Publications and Reviews	Total
Peer Reviewed Journal Articles	48
Book and Book Chapters	2
Proceedings Articles	10
Primer or Other Scientific Notes	15
Non-Peer reviewed Articles	16
Articles In Press	32
Articles In Review	40
Peer Review of Manuscripts Conducted	60
External Funding	**Total**
External Grants Submitted as PI or CoPI	43
External Grant Funding Submitted as PI or CoPI	$8,004,365.00
External Grants Funded as PI or CoPI[1]	37
External Grants Funded Dollars as PI or CoPI	$2,543,299.00
Graduate Education and Postdocs	**Total**
MS Graduate Students Chaired	12
MS Graduate Students Completed	0
PhD Graduate Students Chaired	4
PhD Graduate Students Completed	0
Graduate Student Committee Memberships	28
Graduate Students Hosted at SREL	26
Post Docs Supervised	3
Presentations	**Total**
Invited Presentations	27
Professional Oral Presentations	55
Professional Poster Presentations	36
Extension Presentations	50
Extension Publications	15
Other	**Total**
Awards or Honors	11
Professional Society Committee Memberships	23
Staff Teaching Courses for UGA	12
Technical Research Consultations	42

[1] – includes new grants and contracts, renewals and continuations associated with funding sources external to DOE. Total includes multi-year funding commitments received in FY13 and to be received in future fiscal years.

TASK 3. SREL will use the information collected in the environmental research to develop and test hypotheses that will contribute to the scientific foundation necessary to conduct meaningful ecological risk assessments and to understand the environmental consequences of energy technologies, remediation efforts, and other SRS activities

In FY13 SREL faculty, staff, and students conducted and completed a diversity of environmental research projects on the SRS in support of the missions of SRNS, SRR and DOE-SR, specifically in the areas of risk assessment and elucidation of the environmental consequences of energy technologies, legacy contamination, and remediation activities on the SRS. Much of this work was funded through support to the SRNS Area Closures Project, through subcontracts from SRR to perform specialized sampling or analyses, and through commitment of funds received through SREL's Cooperative Agreement with the Department of Energy to address research topics of importance to the continuing missions of DOE on the SRS. The details of these projects are outlined below:

Research Support to SRNS Area Closure Projects, SRR, and DOE-SR

Preliminary Contaminant Analyses in Selected Game Species on the Savannah River Site

Funding Entity
SRNS Area Closures Projects
Start Date and Funding Amount
November 2012; $39,500
PI and co-PI's
Larry Bryan, Dr. Jim Beasley, Bobby Kennamer and Dr. Gary Mills – SREL
Objectives
We are conducting a preliminary study to document levels of radiocesium, mercury, and a suite of metals in tissues of gray squirrels *(Sciurus carolinensis*), waterfowl, and feral hogs (*Sus scrofa*) from various regions on the SRS, over a two-year period.
Summary of Research Activities
We have collected tissue samples from 24 gray squirrels, ~70 samples from waterfowl and ~200 samples from feral hogs. Tissue samples collected are primarily muscle as it is the typical tissue consumed by the public. We also collected liver samples to test for possible correlations with muscle tissues of waterfowl (n=25) and hogs (n=25). We may examine for correlations between these and non-lethal/more easily attained tissues such as hair/feathers in the second year of the study. If such correlations are strong, it would allow the estimation of contaminants in non-lethal samples collected during additional studies and may allow the estimation of contaminants in off-site harvests (e.g.; getting hair/feather samples from off-site hunts/hunters….more likely/simple to provide hair/feather sample than muscle or liver, etc.). We plan to examine the concentration data spatially, to examine for potential sources of the contaminants. All contaminant analyses (radiocesium, metals, mercury) were conducted at SREL.
Conclusions
1) This research is on-going, but chemical analyses thus far suggest that waterfowl, particularly from the D-Area ash basins, can have relatively high concentrations of Hg and Se in the liver and muscle. However, given the seasonal movement patterns of waterfowl, association of contaminants to specific areas can be difficult.
2) Radiocesium levels of feral hog muscle samples were generally at or near background levels.
3) Squirrel muscle samples had low concentrations of metals/Hg and low levels of radiocesium.

Major Impact(s) of Research
1) We will report the concentrations/levels of selected contaminants in game species collected on the SRS
2) We will report on potential contaminants and/or game species of concern for the likelihood of public exposure to contaminants through these sources.

Other Project Personnel
Sarah Webster, Temp. Research Technician - SREL
Zak Smith, Temp. Research Technician - SREL
External Collaborators
None
Products (Publications, Presentations, Technical Reports)
No publications, presentations, or reports have been prepared yet.

Contaminant Bioaccumulation and Trophic Relationships in Beaver Dam Creek Biota from the D-Area Coal Combustion Waste Plume

Funding Entity
SRNS Area Closures Projects
Start Date and Funding Amount
September 2009; $290,000
PI and co-PI's
Dean E. Fletcher, Angela H. Lindell, Dr. Gary Mills, and Dr. J Vaun McArthur – SREL
Objectives
We proposed to establish how and to what extent aquatic organisms in Beaver Dam Creek on the SRS are at risk from contaminant bioaccumulation by documenting inter- and intra-specific variation of levels of a suite of metals and metalloids in species ranging from herbivorous invertebrates (< 2 cm in length) to large predatory fishes (> 1 m in length). We also completed an annotated bibliography of ecological work done in the D Area and Beaver Dam Creek system.
Summary of Research Activities
On the Savannah River Site, coal combustion waste (CCW) had been produced by the D Area Power Plant since the early 1950's and stored in basins that discharge into Beaver Dam Creek (BDC). Beaver Dam Creek is a highly modified system. The headwaters were channelized during the early infrastructure construction of the SRS between 1951 and 1956 to transport effluents from the D Area Power plant and associated ash and coal pile runoff basins to the Savannah River. Flow patterns in the upper three km of BDC were established with field reconnaissance and GIS resources. Stable isotope analyses ($\delta^{13}C$ and $\delta^{15}N$) were employed to establish trophic relationships among study organisms. Trace element analyses (As, Ba, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, TI, V, Zn, Cs and Sr) assessed contaminant bioaccumulation. Over 500 trace element samples and nearly 400 stable isotope samples were analyzed. Field collections were made at two sites in Beaver Dam Creek headwaters that differ in hydrologic regimes.

We are comparing taxa that differ in trophic position, feeding habits, habitat use, size, and longevity. Within taxa, the influence of size and ontogenetic trophic shifts are being accounted for. Inclusion of two invertebrate herbivores that differ significantly in habitat use and feeding behavior is exploring a baseline of the introduction of materials into the food web from primary producers and is a critical component of stable isotope studies. Further movement through or introduction of contaminants into the food web is being addressed in a comparison of eight dragonfly genera that differ in habitat use, particularly in reference to their exposure to sediments. Additionally detailed studies are comparing three species of bullhead catfish (*Ameiurus sp.*) that also differ in morphology and habitat use. Inclusion of four top level predatory fish allowed comparison of elements entering the food web with those in the top predators. Large predatory fish included channel catfish (*Ictalurus punctatus*), largemouth bass (*Micropterus salmoides*), longnose gar (*Lepisosteus osseus*) and bowfin (*Amia calva*). Muscle tissue was analyzed for all fish, and liver and gonad tissues were analyzed from a subset of individuals. Data from exploratory contaminant assays were also conducted on biofilm and sediments. Data collection has been completed and work extracting publications from the final report continue.
Conclusions
1) Contaminants are entering and moving through the food web in species and element specific patterns.
2) Some contaminants are accumulating at levels sufficient to be of ecological and possibly human health concern, although source of contaminants has not been confirmed.
3) Fish livers effectively sequester some elements preventing accumulation in muscle, whereas others bioaccumulate in muscle.

Major Impact(s) of Research
1) Our detailed comparisons between and within species are establishing an information base that can aid in the design of future studies, interpret existing data and support site-wide risk models.

Other Project Personnel

Garrett Stillings, Research Professional - SREL

David Kling, Research Professional - SREL

External Collaborators

Susan Blas – SRNS-ACP

Products

Fletcher, D.E., A.H. Lindell, G.K. Stillings, G.L. Mills, S.A. Blas, and J.V. McArthur. Variation in trace element accumulation in predatory fishes from a stream contaminated by coal combusiont waste. *Archives of Environmental Contamination and Toxicology* (Submitted).

Fletcher, D.E., A.H. Lindell, G.K. Stillings, G.L. Mills, S.A. Blas, and JV. McArthur. Spatial and taxonomic variation in trace element bioaccumulation in two herbivores from a coal combustion waste contaminated stream. *Ecotoxicology and Environmental Safety* (Submitted).

Fletcher, D.E., A.H. Lindell, G.K. Stillings, G.L. Mills, S.A. Blas, and J.V. McArthur. Trophic Variation in coastal plain stream predatory fishes. *Southeastern Naturalist* (Submitted).

Fletcher, D. E., A. H. Lindell, G. K. Stillings, and J .V. McArthur. 2011. Contaminant bioaccumulation and trophic relationships in Beaver Dam Creek, Savannah River Site. Phase I Final report submitted to SRNS-ACP 177 pp.

Lindell, A. H., C. Tant, D. E. Fletcher, and J. V. McArthur. 2011. Annotated bibliography for the Savannah River Site's Beaver Dam Creek. Report to SRNS-ACP, 54 pp.

Lindell, A. H., D. E. Fletcher, G. L. Mills, and J. V. McArthur. Contaminant Bioaccumulation and Trophic Characterization of Top-Level Predatory Fishes. Annual Meeting of the American Fisheries Society. Seattle, Washington, September 2011 *(*Poster*)*

Lindell, A. H., G. L. Mills , G. K. Stillings, J V. McArthur, and D.E. Fletcher. Contaminant Bioaccumulation and Trophic Characterization of Top-Level Predatory Fishes. Annual Meeting of the Southeastern Fishes Council. Chattanooga TN, November 2011 *(*Poster*)*

Stillings, G. K., A. H Lindell, G. L. Mills, J V. McArthur, and D. E Fletcher. Contaminant Bioaccumulation and Trophic Characterization of Two Herbivorous Invertebrates. Annual Meeting of the Southeastern Fishes Council. Chattanooga TN, November 2011 *(*Poster*)*

Fletcher, D.E., A.H. Lindell, G.K. Stillings, G.L. Mills, and J V. McArthur. Trophic Characterization and Differential Trace Element Accumulation in Congeneric Catfishes (Ictaluridae: *Ameiurus*). Annual Meeting of the Society of Environmental Toxicology and Chemistry. Nashville, TN, November 2013 *(*Poster*)*.

Lindell, A.H., G.L. Mills, J V. McArthur, and D.E. Fletcher. 2013. Taxonomic and spatial variation in trace element bioaccumulation in odonate nymphs in a stream receiving coal combustion waste. Annual Meeting of the Society of Environmental Toxicology and Chemistry. Nashville, TN, November 2013 *(*Poster*)*.

Kd Values for the Saltwaste Disposal Facility

Funding Entity
Savannah River Remediation
Start Date and Funding Amount
February 2013; $191,893
PI and co-PI's
Dr. John C. Seaman and Dr. H.S. Chang
Objectives
The project objectives were to: (1) determine the soil partitioning behavior of selenium (Se), niobium (Nb), and radium (Ra) as impacted by solution chemistry; (2) measure the impact of cementitious leachates on *Kd* values for an array of solutes representing a wide range of chemical properties of radionuclides of interest to SRR performance assessments; and (3) to compare the applicability of the centrifugation method (ASTM D6527) with the conventional falling-head method (ASTM D5084) for determining the saturated hydraulic conductivity (HC) of cementitious materials.
Summary of Research Activities
SREL conducted a series of batch experiments to determine the sediment *Kd* values for Se and Nb, and the cementitious-material *Kd* values for ^{226}Ra for use in SRS performance assessment calculations. Similar laboratory batch experiments were also conducted to quantify the impact of cementitious-leachate on the sorption behavior for a disparate range of seventeen contaminants and non-radioactive chemical analogs (Cr, Ni, As, Se, Sr, Cd, I, Sb, Cs, Ba, La, Ce, Eu, Re, Tl, Th, and U). The batch partitioning experiments were designed to provide direct and indirect information about radionuclide behavior related to the Saltstone Disposal Facility (SDF) and Tank Farm Performance Assessments (PAs). Using the four test solutions, 136 site specific *Kd* values were estimated across a pH range from 4.8 to 12.2 under oxic and anoxic conditions. Sixteen of the elements tested were evaluated simultaneously using a "mixed contaminant" spike solution, while iodine (I) partitioning was evaluated in a separate experiment in order to simplify the analytical methodology. The final objective was to compare the novel centrifuge-based technique (ASTM D6527) using the unsaturated flow apparatus (UFA) with the standard falling head method (ASTM D5084) using a flexible-wall permeameter for determining the saturated hydraulic conductivity of saltstone grouts. A small batch of grout simulant was created for hydraulic conductivity testing using a saltwaste simulant recipe and curing routine specified by SRR.
Conclusions
1) Selenium partitioning to the SDF soil was consistent with similar batch results that were determined using a mixed contaminant stock solution (See conclusions #4). Final Se *Kd* values were generally similar regardless of initial redox speciation at the onset of a given partitioning experiment.
2) Niobium *Kd* values for the SDF soil were high for all treatment solution chemistries, regardless of redox status.
3) Radium Kd values were high for both cementitious materials (i.e., reducing saltstone and conventional cement), regardless of background solution chemistry or redox status.
4) The results for fifteen of the 17 elements tested (Ba, Cd, Ce, Cr, Cs, Eu, I, La, Ni, Re, Sb, Se, Sr, Th, and Tl) were consistent with SRS baseline *Kd* values (SRNL-STI-2009-00473) or the discrepancies can be readily explained in terms of the elements chemical speciation and/or the exact conditions of the test system.
5) The baseline *Kd* values for As and U were considerably higher than previous estimates.
6) UFA derived hydraulic conductivity values for saltstone were higher and more variable than those measured using the conventional permeameter. This anomaly was attributed to artifacts associated with the required sample preparation (i.e., effective epoxy coating) for UFA analysis.

Major Impact(s) of Research
1) SREL provided site-specific partitioning estimates for several contaminants that lacked reliable data.
2) The general consistency of the current data set with baseline SRS *Kd* values supports the validity of the multi-element partitioning methodology used in the current study. In some cases, experimental *Kd*

values generated in the presence of cement leachates differed greatly from estimated values. In many cases the values were considerably higher than previous nonsite-specific estimates derived from the literature.

3) Potential sample preparation artifacts were identified in using the UFA to evaluate the hydraulic conductivity of cementitious materials.

Other Project Personnel

Shea Buettner, Research Professional – SREL

Diana Soteropoulos, Research Professional - SREL

External Collaborators

Dr. D. Kaplan - SRNL

Dr. D. Li - SRNL

Products

Seaman, J.C. and H.S. Chang. 2013. Impact of Cementitious Material Leachate on Contaminant Partitioning. SREL Doc. R-13-0004, ver. 1.0. Submitted to SRR September 5, 2013.

Seaman, J.C. and H.S. Chang. 2013. Impact of Cementitious Leachate on Se, Nb and Ra Partitioning. SREL Doc. R-13-0005, ver. 1.0. Submitted to SRR September 5, 2013.

Seaman, J.C., H.S. Chang, and S.W. Buettner. 2013. Comparison of Hydraulic Property Measurement Techniques for Simulated Saltstone. SREL Doc. R-13-0006, ver. 1.0. Submitted to SRR September 4, 2013.

Tritium Distribution at the Tritiated Water Management Facility - Southwest Plume Interim Measures P-Area wetland studies of soils and biota

Funding Entity
SRNS Area Closures Projects
Start Date and Funding Amount
November, 2012; $120,032
PI and co-PI's
Dr. John C. Seaman
Objective
Evaluate the efficacy of ongoing remediation efforts at the SRS Mixed Waste Phytoremediation Management Facility.
Summary of Research Activities
In FY 2013, SREL worked collaboratively with the SRS-US Forest Service, SRNS-ACP and DOE to complete the following activities: (1) collect multiple intact soil cores from the recent western expansion area to characterize the soil profile; (2) collect and analyze soil core samples to evaluate tritium distribution as an estimate of irrigation efficiency; (2) maintain and update the Cornell Model for estimating water-use efficiency, including updating the model to account for recent site expansion; and (3) expansion of the existing automated site monitoring instrumentation, including the site weather station, the seepline retention pond for collecting tritiated water (^3H_2O), and in-line flow meters installed within select irrigation plots.
Conclusions
1) Soil cores from the 23-acre Eastern Expansion Area were characterized in an effort to parameterize the updated "Cornell 1D" model and establish a baseline for subsequent phytoremediation activities.
2) Water balance calculations based on soil cores from the original irrigation plots indicated very limited tritium leaching, similar to results from 2010 and 2011 due to the ongoing drought.
3) The estimated tritium evapo-transpiration efficiency for individual irrigation plots ranged from ≈ 81.8 to 94.4%, with an average efficiency of approximately 88.6 ± 4.5%, slightly higher than observed for 2010 and 2011.
4) Efficiency results derived from the Cornell 1D model were consistent with the soil-based calculations, ranging from 84.4 to 88.5% between plots, with a yearly average of 86.3 ± 1.2% for all plots.

Other Project Personnel
Julian Singer, Research Professional - SREL
Shea Buettner, Research Professional - SREL
External Collaborators
NA
Products
Seaman, J.C. and J.H. Singer. 2013. Soil Characterization Report for the Eastern Expansion Area of the Mixed Waste Management Facility Irrigation System. Final report submitted to SRNS-ACP February 2013.

Seaman, J.C. and J.H. Singer. 2013. Estimating Evapo-Transpiration Losses for Tritium at the MWMF: 2012 End of Year Summary Report. Final report submitted to SRNS-ACP March 15, 2013.

Effects of Matrix Heterogeneity and Aqueous Humic Acid on Transport and Deposition of Mineral Colloids in Sandy Sediments

Funding Entity

Savannah River National Laboratory (SRNL)

Start Date and Funding Amount

October 2012, No Funding Provided

SREL Collaborators

Dr. John Seaman and Dr. Hyunshik Chang

Objectives

The objective of this study was to evaluate the effect of cellulosic materials and natural organic matter and porous media heterogeneity on mineral colloid migration using laboratory experiments and reactive transport modeling.

Summary of Research Activities

Cellulosic materials, such as paper, cardboard and wood, are commonly co-disposed with low-level radioactive wastes. These materials may not only enhance subsurface contaminant transport through complexation, but also promote colloid dispersion. Thus, this study evaluated the effect of humic acid (HA; as a surrogate for cellulosic materials and natural organic matters) and porous media heterogeneity on mineral colloid migration.

Several batch and column experiments were conducted with Ottawa sand and the Savannah River Site (SRS) sediment using quartz colloids, SRS colloids, and SRS colloids with HA. A conceptual reactive transport model was developed using PHREEQC-2 code to test the hypothesized colloidal behavior by comparing simulated results with experimental data.

Conclusions

1) The presence of HA in the subsurface sediments can increase the dispersion and mobility of mineral colloids, which potentially increases the risk of the transport of metal contaminants and radionuclides.
2) The HA and colloid concentration ratio of 0.025 appeared to be a critical threshold, above which the transport of colloids through Ottawa sand column is greatly increased.
3) The transport of colloids is much slower through a heterogeneous matrix than through a simple matrix material. Thus, the working conceptual model is that the attached colloids might create additional attachment sites and clog pores, reducing the flow of subsequent colloids through the porous media.

Major Impact(s) of Research

1) Cement materials used as engineered barriers and waste-forms for radiological waste disposal, like at the SRS, create extreme alkaline pH environments may change mineral surface charges and temporarily promote the formation of mobile colloids. However, this study shows that under the experimental conditions the transport of the mobilized mineral colloids may be limited.
2) The sediment can naturally filter mineral colloids due to coherent particle-collector attraction and straining. Therefore, the colloid-facilitated transport of radionuclides through the subsurface sediments would be restricted.

Other Project Personnel

Shea Buettner, Research Professional - SREL

External Collaborators

Dr. Dien Li, SRNL

Dr. Dan I. Kaplan, SRNL

Products

Li, D.; Chang, H.; Seaman, J.C.; Kaplan, D.I. 2013. Effects of Matrix Heterogeneity and Aqueous Humic Acid on Transport and Deposition of Mineral Colloids in Sandy Sediments. *J. Environmental Chemical Engineering* 1:875 – 883.

Reptiles as long-lived bioaccumulators of contaminants & potential exposure risk to local residents through consumption

Funding Entity
SRNS Area Closures Projects
Start Date and Funding Amount
November 2012; $108,400
PI and co-PI's
Dr. Tracey D. Tuberville, David Scott and Dr. Stacey Lance
Objectives

1) Assess body burdens of select metals and cesium-137 in alligators and aquatic turtles from IOUs where known contaminant issues occur and that are likely to experience trespass by humans (i.e., Lower Three Runs, Savannah River and adjacent swamp, and Par Pond).
2) Survey / interview local hunters and fishermen in communities surrounding SRS with regard to harvesting and consumption of aquatic turtles and alligators. Consumption rate by individuals in vicinity of SRS is identified as a major knowledge gap in the ASTDR 2011 report.
3) Evaluate alternative fitness-related endpoints using standard veterinary diagnostic tools & health parameters (e.g., see Perrault et al. 2012) for assessing the biological implications of contaminant exposure and bioaccumulation in alligators and aquatic turtles, thereby addressing the ecological risk of contaminants.

Summary of Research Activities
We collected biological samples from alligators, turtles, and watersnakes from contaminated and uncontaminated aquatic habitats on the SRS. In addition, we have identified the master's student's alligator project, which will focus on the effects of contaminants (both radiological and trace element) on stress and immunity in wild alligators by measuring long-term corticosterone (CORT) deposition in scute and nail tissue. We have collected the samples necessary to evaluate whether CORT in these tissues are likely to serve as a good metric for chronic stress. We are in the process of developing the questionnaire for hunters and fisherman and have discussed with our ACP contact expanding the questions, in collaboration with other SREL researchers funded by ACP, to include not just alligators and turtles but other game species. Finally, we are awaiting approval of the UGA IACUC committee to initiate an experiment examining the effects of dietary uptake of selenium on stress and immunity in captive alligators. This project will be conducted by a PhD student at UGA.
Conclusions
We are still in the process of sample processing and data analysis, so we do not have the data available at this time to make any conclusions.
Major Impact(s) of Research
Our primary objective is to identify and develop non-destructive metrics that can help us evaluate the biological effects of SRS contaminants on reptiles, an area of research that has received very little attention in the literature. Our findings will help provide valuable information relevant not only to management of SRS contaminated habitats but also identify metrics that can be applied to contaminated systems elsewhere.
Other Project Personnel
Brian Metts, Research Professional - SREL
Matt Hamilton, MS Student – UGA/SREL
Paul Thomas, Summer Undergraduate Intern – USC-Aiken
Matt Atkinson, Summer Undergraduate Intern – UGA
External Collaborators
John Finger – UGA
Dr. Terry Norton – Georgia Sea Turtle Center
Dr. Travis Glenn - UGA

Products

Thomas, P., M. Atkinson, B.S. Metts, and T.D. Tuberville. Terrestrial and aquatic performance of banded watersnakes (*N. fasciata*) from contaminated wetlands. SREL Undergraduate Research Symposium, July 2013 (Oral Presentation).

Atkinson, M., J.W. Finger, M. Hamilton, and T.D. Tuberville. Evaluating the use of PHA in testing the immunity of banded water snakes (*Nerodia fasciata*). SREL Undergraduate Research Symposium, July 2013 (Oral Presentation).

Effects of coal combustion wastes on amphibians

Funding Entity
SREL / previous funding from ACP
Start Date and Funding Amount
November 2010; $265,000
SREL Collaborators
Dr. Tracey Tuberville, Dr. Brian Metts and David Scott
Objectives
Determine effects of coal combustion wastes on amphibians, focusing on effects on egg and larval stages.
Summary of Research Activities
All data and samples had been collected in prior fiscal years. However, data were synthesized and prepared for publication during the FY13 as part of the dissertation research of Dr. Brian Metts.
Conclusions
Several contaminants of interest in the D-Area ash basin system (including the Ash Plume wetland) were found to be maternally transferred from mother to offspring in southern toads (*Anaxyrus terrestris*). Both maternal and paternal effects (i.e., whether collected from the Ash Basin, Ash Plume wetland or a reference site) strongly influenced hatching success, offspring viability, size and time to metamorphosis in offspring.
Major Impact(s) of Research
Add to the growing body of literature demonstrating the effects of contaminants, presumably Selenium and Arsenic in our study system, on amphibians. In addition, ours is among the first to demonstrate a paternal effect due to male contaminant exposure on offspring viability in amphibians.
Other Project Personnel
None
External Collaborators
Dr. William Hopkins – Virginia Tech University
Products
Metts, B., K.A. Buhlmann, T.D. Tuberville, D.E. Scott, W.A. Hopkins.. Maternal transfer of contaminants and reduced reproductive success of southern toads (*Bufo* [*Anaxyrus*] *terrestris*) exposed to coal combustion waste. International Conference on the Biogechemistry of Trace Elements meeting in Athens, GA., June 2013. (Oral Presentation).

Metts, B.S., T.D. Tuberville, D.E. Scott, K.A. Buhlmann, and W.A. Hopkins. Maternal transfer of trace element contaminants and its effect on reproductive success of southern toads (*Bufo terrestris*). International Conference on the Biogeochemistry of Trace Elements meeting, Athens, GA, June 2013. (Oral Presentation).

TASK 4. SREL public outreach and communication programs will focus on the SRS environment and ecological research to increase the public's understanding of scientific issues affecting the Site and to increase general ecological awareness

SREL Outreach Activities in FY13

The primary focus of SREL's public outreach and communication programs is on habitats and environments on the SRS and the ecological research that is conducted, with the purpose of increasing public understanding of scientific issues that affect the Site and bringing general ecological awareness to the public in the region and at large.

SREL Outreach Activities in FY13

The SREL Environmental Outreach Program mission has historically been to educate the public about ecological research and environmental issues. SREL has also worked with the Citizens Advisory Board, various on site organizations, state and federal regulatory authorities, and other stakeholder groups to raise awareness of the SRS and of regional ecological issues and opportunities. The program highlights SREL ecological research on the SRS through oral presentations, exhibits, tours, and various electronic media and encourages participation by students, regional teachers, resident and visiting faculty and by organized training programs. SREL actively communicates information to the popular press. To accomplish these goals and provide an overall educational outreach program, SREL has focused on the following specific objectives since its inception:

A. Publish articles on environmental issues and ecological research in popular press outlets including newspaper columns, popular magazines, University of Georgia publications, Department of Energy publications, encyclopedias, special publications such as alumni magazines and ancillary publications of scientific societies.

B. Provide news releases, to newspapers and other appropriate media that relate to environmental activities of SREL, with particular emphasis on the SRS.

C. Develop an on-site tour program that focuses on the environments of the SRS and the ecological projects of SREL.

D. Give presentations to the public, including schools, civic groups, and other organizations that focus on environments of the SRS region and on SREL ecological projects.

E. Develop portable and permanent exhibits appropriate for use at special presentations at SREL, schools, other organizations, and at special events.

F. Develop video and slide shows for presentations to groups or for use by onsite organizations, emphasizing SREL environmental programs and projects on the SRS.

G. Investigate opportunities for radio and television programs that focus on environmental issues, SREL ecological research, and ecological projects on the SRS.

H. Develop and distribute brochures and other in-house publications that are informative about SREL's ecological research and environments on the SRS.

I. Organize display presentations of SREL research projects in appropriate areas of the SREL facilities.

J. Publish an SREL newsletter (the Grape Vine) as a means of internal communication.

K. Develop the UGA conference center as a focal site for environmental education.

L. Establish a photographic collection of slides and prints that documents the history of the SREL research programs, is informative about the plants, animals and habitats of the SRS region, and that emphasize current ecological projects of SREL.

M. Maintain a collection of live plants and animals that can be used to educate the public about environmental issues and the conduct of ecological research.

N. Maintain an educational website of wildlife native to the SRS with emphasis on identification of regional species and wildlife safety

O. Develop and provide SRS wildlife safety talks for site tenants and visitors

In accomplishing the goal of communicating ecological information to non-scientists, the Outreach program has provided on-site training and services to demonstrate the potential sources of injury from animals and plants found on the SRS and the CSRA that could occur to remote workers engaged in field activities or to employees and their families at home. The Outreach program has conducted workshops and training sessions and has attended site monthly safety meetings to deliver PowerPoint presentations as well as live animals and native plants. The Outreach program has also developed and distributed safety materials (protocol badge cards and safety fact sheets) to SRS employees, and has managed an educational website. While the primary focus of most of these wildlife safety programs has been on snakes and alligators, the programs have also provided information on plants, insects, spiders, snapping turtles, and mammals of concern.

The Outreach Program has participated in SRS outreach to the general public via the SRNS Public Tours program, with SREL providing a 45-60 minute presentation each month year-round (23 scheduled and more than 20 additional lab tours and impromptu presentations). Our presentations provide a general introduction about the history and ongoing mission of SREL and the lab's involvement with research, teaching, and community service. The programs are concluded by fielding questions from participants on wildlife identification, site environmental research programs, safety, and other ecological matters of public interest.

SREL also hosts a seminar program, which is open to SRS employees, on a variety of research and educational topics which are pertinent to the SRS mission. Speakers include SREL research scientists, invited scientists from other university or agency programs, and graduate students who are conducting research on the SRS.

Other programs in which Outreach personnel participate include: ***Ecotalks***, 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; the ***Ecologist for a Day*** program 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 at the UGA Conference Center; 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, Outreach offers an annual free program, ***Touch an Animal Day***, to the CSRA community at the UGA Conference Center, which allows the public of all ages to interact with live animal and plant species, to meet site researchers, and to learn more about SRS efforts. Lastly, the Outreach Program offers tours of SREL facilities, as well as exhibits and workshops for the general public as well as onsite personnel.

The main SREL Outreach website receives numerous hits, as it has links to the popular ***Ecologist for a Day*** program, Outreach fact sheets and products, the **Ecoviews** weekly newspaper column, and also invites questions about SRS wildlife that are answered by Outreach personnel. This website 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.

TASK 5. SREL will maintain ecological data bases for use by the public, SRS, governmental, academic, and private organizations. These databases incorporate more than 60 years of data collection on the SRS and provide a resource for understanding changes impacting ecosystems on the SRS and elsewhere in the southeastern United States

SREL Data Management Activities in FY13

IT Infrastructure

Over the past year The Savannah River Ecology Lab (SREL) experienced a number of IT related challenges. These challenges included the failure of our proprietary e-mail server, the failure of several virtual servers that controlled our network, and in general, reliance on outdated and unreliable hardware to run our IT processes. To address these challenges SREL management developed a strategic plan for IT infrastructure investment and allocated over $50,000 in FY13 to correct critical deficiencies. Some of the major improvements to our IT systems for FY13 included:

1. **The replacement of our outdated server with a new Windows 2012 file server**. This provided us greatly improved capability to backup desktops, store our internal data, and handle print and file duties along with various network administration tasks.
2. **The replacement of all of our older 10/100 megabit switches with new system manageable gigabit switches**. This allowed us better interaction between the various components of our network thereby increasing the efficiency of our IT system.
3. **The installation of two new data backup servers**. Prior to this year, SREL's backup servers were not functioning reliably. This year we installed two new backup servers to protect the data on our main network server. One of the new back up servers is located in our main server room and the other is located in a secure location in one of the adjacent building within our complex. These servers working in conjunction with each other insure the protection of critical data
4. **The installation of a ZENworks administrative server.** This server facilitates the processing and distribution of critical updates, desk top configurations, and network encryption duties.
5. **The upgrading of one SREL office wing to a higher efficiency network wiring**. The office wing located the furthest from the server room was operating with outdated Cat 3 network wiring and is scheduled to be upgraded to the latest Cat 6 wiring. A fiber optic trunk line also is to be added to eliminate signal degradation between this wing and the server room.
6. **The transition from a proprietary internal email server to an offsite server providing email service**. After the failure of our internal email server, we were able to transition our email needs over to the University of Georgia's core email system. This move provided us with greater technical support and process reliability, and it also removed a layer of hardware that had to be maintained at SREL.

In addition to these improvements, we also worked to make sure that we were ready for Microsoft's termination of support for the Windows XP operating platform. Our inventory included a large number of XP computers that we have either upgraded to a Windows 7 platform or removed them from our network. Because of this XP event, we have purchased over 10 new computers to replace those that were rendered obsolete.

In the face of constrained budgets and limited IT personnel, we have made positive strides this year in rebuilding our network into a reliable, more efficient platform. We will remain committed to creating a network that protects our valuable data and meets the work requirements of our researchers and staff.

Database Management

Responsible management of research data plays an important role in preserving SREL's institutional memory. SREL has 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.

Loss of access to a secure SREL server due to security concerns in 2007 reduced our ability to interactively 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 has begun to return these data archive files to their previous condition. It is anticipated that this effort will assist SRS site tenants with accomplishing various missions on the SRS, interacting with relevant state and federal regulators, and collaborating with researchers from other universities in the preparation of funding proposals and manuscripts.

Currently, the recovered archive exists as a MS Access database. Linkages from the Access database to the accompanying data files were restored in FY11. In FY12, an assessment was conducted of the recovered data files. Since data have been archived over a long period of time, and technology continues to evolve, an analysis was conducted on file formats, using the file extensions. The vast majority are tagged with widely recognized extensions that are still supported. Files with custom extensions were found to be plain text files. A handful of files (14) were found in a proprietary format that is less widely supported than it used to be (Lotus). We may consider converting these files since some common software vendors have dropped support for this format. The overall number of projects and data files were also tallied, both from within the database, and from the external files. A total of 483/516 projects have both data and metadata at this time.

In FY13, SREL began conversations with National Science Foundation funded Long Term Ecological Research Site data managers currently housed at the University of Georgia. Currently it is the intention of SREL management to cost share a portion of the salary of data management personnel at the University of Georgia to assist in restructuring the data management systems at SREL to be compatible with NSF standards for long-term data archives. These activities are slated to begin in FY14.

TASK 6. SREL will serve as the point-of-contact for the "DOE Research Set-Aside" areas that are protected from Site impacts so that they are available for environmental research and can serve to establish representative standards for comparison to impacted areas on the SRS. Currently SRS has 30 'set-aside" areas. SREL will also continue to promote the role of the SRS as a National Environmental Research Park

SREL Set Aside and National Environmental Research Park Activities in FY13

The SRS's Set-Aside Program began in the 1960s when the Atomic Energy Commission (AEC) 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 Upper Three Runs Creek, 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 the DOE, SREL serves as the point of contact for the 30 Set-Asides and provides custodial oversight of the SRS Set-Aside Program. SREL chairs the DOE's Set-Aside Task Group which approves management prescriptions, evaluates proposed ecological research, and ensures protection from onsite land use activities. SREL serves as the representative for the Set-Aside program in the SRS Site Use process and in the military training coordination meetings, reviewing activities in both venues for potential impacts.

Set-Aside Oversight -- In recent years SREL has taken a more active approach to managing these areas, with reintroduction of prescribed fire to some sites, as well as some timber management. Management is conducted with an adaptive approach that gives the flexibility to address changing environmental conditions as well as research needs.

- Compartment 24, adjacent to E.P. Odum Wetland Set-Aside, was burned in late growing season 2012. As agreed upon previously, fire was not deliberately excluded from the Set-Aside during the burn. The initial burn stayed in the uplands; however, unusual weather conditions associated with superstorm Sandy re-ignited the burn and carried it through the floodplain. Although an improbable event, it does not appear to have led to any major vegetation changes. It will be a useful observation point for maximal effect of growing season fire.

- Dry Bay was burned in winter 2013 to improve habitat for aquatic turtles, as well as to promote plant diversity within the bay. Repeated burns when conditions permit will be necessary to increase plant diversity, but habitat conditions for turtles improved notably with only one burn. In all, researchers were very pleased with the results of this burn. Due to smoke management issues associated with this area of the SRS, only the wetland interior was burned, and no regular burn schedule has been designated for this site. It will be burned as habitat conditions indicate and as water levels permit.

- The Sandhills Fire Site was also burned in winter 2013. This site has had some fire at irregular intervals through its history. The last burn was in 2008. Although scrub oak's optimal fire regime is longer than some other Coastal Plain communities, conditions on the ground indicated that it may benefit from something more frequent than 5 years.

- Also in FY2013, a timber prescription was completed for Flamingo Bay. The aging slash pine stand will be thinned and underplanted with longleaf, with regular fire. The wetland as well as upland are expected to benefit from reintroduction of regular prescribed fire, which will begin in FY2014. The prescription was modeled after existing longleaf research at the Joseph W. Jones Ecological Research Center.

National Environmental Research Park Support - SREL serves as the official SRS point of contact for the DOE National Environmental Research Park System. In its role as a point of contact, SREL conducts a variety of functions, one of which is the improvement and archiving of critical historical research data on the SRS. For example, SREL began developing a spatial component to the long-term turtle data that has been collected over several decades on the SRS. Existing GIS data from other sources have been cross-walked with the turtle database to fill in all previously documented locations. The resulting geographic data set has been mapped to provide an easy reference point for digitizing the remaining missing locations. Capturing the spatial component will greatly enhance the value of this important long-term dataset.

Current research on SRS Set Asides

- Archaeologists with the USC-Savannah River Archaeologist Research Program (SRARP) continued their investigations at Flamingo Bay. Human use of this site is now known to span ~13,000 years. Their current work is yielding important insights into both bay formation processes and patterns of human activity in the early Holocene. SRARP research in Flamingo was featured in Archaeology magazine, a publication of the Archaeological institute of America (Nov/Dec 2012).

- Researchers at SREL and a collaborating institution are examining predator-prey interactions between snakes and songbirds in Field 3-412. The research includes using videography to document nest predators and radio telemetry to explore links between snake movement patterns and predation rates of songbird nests.

- A mark-recapture population analysis of greater sirens and two-toed amphiumas continues 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.

- Mark-recapture studies of black swamp snakes continue at Ellenton Bay. 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.

- Long-term mark-recapture studies of aquatic turtles continue at Ellenton Bay and Dry Bay. SREL began marking turtles in Ellenton Bay in 1967.

- UGA graduate researchers continue to sample zooplankton assemblages in several Set-Asides containing seasonal wetlands. Comparison with existing scientific literature indicates that the SRS zooplankton community is the most species-rich of any comparable system yet studied. Their research attempts to uncover the reasons behind this remarkable diversity.

- The plankton dispersal mesocosm study at Ellenton Bay, conducted as part of a UGA student's graduate research, was completed this year. The student is now writing his dissertation.

- Researchers continue to maintain duck boxes at Ellenton Bay, Steel Creek Bay, and Flamingo Bay, as part of a long-term (since the 1970s) study of the breeding ecology of wood ducks on the SRS.

- Research on habitat use of state-endangered gopher frogs continues at Craig's Pond and Sarracenia Bay SA. Data will be useful in management of this Set-Aside as well as Mona Bay, which is also gopher frog habitat.

- Several Set Asides and other isolated wetlands, primarily in the central and northeast regions of the SRS, continue to be monitored as egg-laying sites for the state-endangered gopher frog, *Lithobates capito*, and as part of a regional southeastern phylogeographic study.

- Rainbow Bay, Ellenton Bay, Ginger's Bay, and Flamingo Bay continue to serve as reference sites for several amphibian ecotoxicology studies, including effects of copper in the Tritium Facility's H-02 Treatment Wetlands and metals uptake in the D-Area Ash Basin system.

- The amphibian community at the Rainbow Bay Amphibian Reserve Set Aside has been monitored for 35 consecutive years, during which time local extinctions, species colonizations, and dramatic population fluctuations have occurred. Researchers are also investigating genetic changes over time for mole and marbled salamanders to better understand how population size relates to genetic diversity, which is important for conservation efforts.

- SREL researchers continue collecting amphibian tissue samples to gather pilot data for future studies of amphibian landscape genetics and effects of future climate change. Samples from eight species have been collected from ~42 isolated wetlands across the SRS, including the following Set Asides: Rainbow Bay Amphibian Reserve, Cypress Bay, Dry Bay, Ellenton Bay, Mona and Woodward Bays, Flamingo Bay, Thunder Bay, Craig's Pond and Sarracenia Bay, Ginger's Bay, and Road 6 Bay.

- Amphibian species in bay Set Asides and other site wetlands are being monitored for two amphibian diseases of concern —- chytrid and ranavirus -- to determine disease prevalence on the SRS and possible relationships to contaminant distributions.

- SREL's Outreach Program continues to use the E.P. Odum Wetland Set-Aside as an outdoor classroom during its enormously popular "Ecologist for a Day" programs. This program gives K-12 students hands-on experiences in ecological research, foster understanding of environmental issues, promote environmental stewardship, and encourage students to consider careers in science.

- Researchers from SREL, USFS-SR, and University of Kentucky continue stream characterization in the UTRC/Tinker Creek and Meyers Branch set-asides. This research will be used to inform future DOE restoration and mitigation efforts.

- Field 3-412 was used as a seed collection site for Project Baseline, a seedbank to study plant evolutionary response to environmental change.

TASK 7. Through general research and public outreach programs, SREL will increase scientific understanding in the general areas of environmental characterization, ecological risk assessment, and environmental remediation and restoration. This will require research on topics such as terrestrial and aquatic ecology, environmental chemistry, molecular ecology and genetics, microbial ecology, radiation ecology, and ecotoxicology. SREL will also continue to communicate and coordinate with SRS contractors and the public on these issues

In FY13 SREL faculty, staff, and students conducted and completed a diversity of outreach and education programs for the public and environmental research projects on the SRS in support of the missions of DOE-NNSA on the site. Specifically, outreach programs were conducted for local community residents on behalf of DOE as part of ongoing community education programs to increase environmental awareness of citizens and provide independent information to community residents relative to the activities of site tenants. In addition, specific research programs were conducted for NNSA to assess the environmental consequences of the Mixed Oxide Fuel Fabrication Facility on local stream quality and function as well as to assess the function, performance, and environmental consequences of constructed wetland treatment systems for metal sequestration associated with the NNSA Tritium facility on the SRS. These programs were funded by NNSA and the details of these projects are outlined below:

Research Support to DOE National Nuclear Security Agency

Environmental Outreach Programs

Funding Entity
NNSA - MOX
Start Date and Funding Amount
March 2013; $280,000
PI and co-PI's
Dr. J Whitfield Gibbons - SREL
Objectives
SREL will assist the SRS NNSA mission and MOX Project by educating the public through community outreach activities that include organizing tours and exhibits featuring the local ecology and associated research; conducting environmental education workshops for teachers, students and the general public as well as for site personnel; development of a variety of environmental education materials for diverse audiences; increasing internet accessibility of information ; distributing ecological information; presentation of data and reports on the local and regional environment; and assisting in educational efforts about the importance of environmental stewardship and National Environmental Research Park programs at the SRS. Accomplishments relative to these tasks will be summarized in an annual report.
Summary of Program Activities
The SREL Environmental Outreach Program uses information from SREL research that is ongoing currently as well as from long-term research efforts to provide training and services to MOX and other SRS employees and to educate the public locally, regionally, and nationally about ecological research findings associated with onsite activities.

NNSA has provided critical funding that has allowed SREL to accomplish the goal of maintaining SRS and public outreach programs in order to enhance the understanding of environmental issues affecting the SRS and to increase general ecological awareness. Consistent with the goals of DOE and NNSA, SREL this past year provided information and presentations to schools and programs in addition to resource materials to demonstrate the ecological health of the SRS, and the importance of environmental stewardship and National Environmental Research Park (NERP) programs on the SRS. Accordingly, the Outreach program remained available to conduct Lunch and Learn presentations to site personnel at the MOX facility and provide tours for DOE site interns and new MOX employees. SREL produced and

distributed literature on native SRS plants and animals and on specific research programs, and maintained the MOX Conservation Garden at the facility.

The SREL Outreach Program is designed to enhance SREL's overall mission of acquiring and communicating environmental knowledge and to highlight NNSA's and DOE's focus on environmental issues on the SRS. To accomplish these goals, education initiatives are used that include 1) Environmental safety on the SRS, 2) On-site outreach to the general public and site personnel, and 3) Off-site outreach activities at schools and community events. Issues as diverse as wildlife safety in the field, wildlife population declines, potential responses of organisms to contamination, distribution and abundance of sensitive species, wetland dynamics and remediation, water quality, and dispersal of organisms from radioactively or chemically contaminated sites all are important to onsite personnel and the general public.

Major Impact(s) of Program

1) SREL has been heavily involved in assisting the MOX project by facilitating the environmental component of the LEED (Leadership in Energy and Environmental Design) certification requirements.
2) SREL's Outreach program has communicated information about environmental activities on the SRS for more than two decades based on ecological research conducted onsite by SREL scientists. The Outreach programs communication efforts through numerous presentations and exhibits annually, coupled with SREL's credibility with the general public, have greatly aided in raising awareness of the rich ecological diversity of the MOX area on the SRS and the region in general in order to encourage people to appreciate their setting, engage in environmental stewardship, and protect environmental integrity on and off the site.

Other Project Personnel

Sean Poppy, Outreach Coordinator - SREL
Angela Tucker, Animal Caretaker - SREL
Judy Green-McLeod, Research Professional - SREL
Cris Hagen, Research Technician – SREL
Carol Eldridge, Research Technician - SREL

External Collaborators

Dr. Kimberly Andrews - Georgia Sea Turtle Center

Products

1) Conducted 44 scheduled Public Tours and tours for onsite personnel; estimated number of attendees - 998
2) Provided 4 Wildlife safety talks for SRS employees; estimated number of attendees - 174.
3) Presented 244 classroom education programs for elementary and secondary students; estimated number of attendees - 12,613.
4) Provided 35 environmental outreach presentations to college, civic, and professional groups; estimated attendees – 1,591.
5) Provided 20 Exhibits at local and regional events; estimated number of attendees - 9,609. [Includes 5 career exhibits at schools (estimated 1,549 attendees); 4 science night exhibits at schools (estimated 684 attendees)].
6) Conducted 42 Ecologist for a Day Programs (school field trips to SREL's Conference Center); estimated number of attendees - 1,080.
7) Conducted 1 Touch an Animal Day (August 24, 2013, at UGA Conference Center - estimated number of attendees - 567.
8) Provided 18 presentations at regional library summer reading programs – estimated 1,553 attendees

*Total Outreach events: 408; Total estimated attendance: 28,185

H-02 Constructed Wetland Studies: Amphibians

Funding Entity
NNSA Tritium Facility
Start Date and Funding Amount
October 1, 2012; $381,000
PI and co-PI's
Dr. Stacey Lance and David Scott - SREL
Objectives
Our research at the H-02 constructed wetland complex focuses primarily on several questions related to these treatment wetlands: 1) Over time, what amphibians, reptiles, and plants have become established in the wetlands? 2) Do the elevated trace metal levels (e.g., copper and zinc) in the wetlands affect amphibian reproductive success, disease ecology, and population dynamics? 3) How do the amphibian diversity and numbers compare to other, more natural, wetlands? and 4) As the constructed wetlands age, how will the amphibian community respond?
Summary of Research Activities
This report summarizes our amphibian studies related to the H-02 treatment wetlands from October 2012 to September 2013. We used aquatic trapping and adjacent drift fence arrays with pitfall traps to characterize biota of the treatment wetlands. We estimated the tissue concentrations of Cu, Zn, and lead (Pb) of amphibians inhabiting the wetlands, and conducted field and laboratory tests on effects of Cu concentration on amphibian development. We conducted an *in situ* field study of both southern toads and southern leopard frogs. We also completed a mesocosm study of southern toads examining multiple stressors, including Cu and short hydroperiods. We began an investigation into the prevalence of two amphibian diseases at the treatment wetlands and other wetlands on site.

Rainbow Bay and other isolated wetlands serve as comparison sites for the H-02 amphibian studies. We completed the 35th year of monitoring at RB, and have begun analyzing the data in the context of community shifts in response to environmental change and altered hydrology.
Conclusions
1. Southern toads had higher survivorship in the *in situ* study than they have in our laboratory studies. These data suggest that the Cu in the treatment wetlands is less bioavailable than in our controlled laboratory studies. This is likely due to the amount of dissolved organic carbon in the wetlands.
2. Southern leopard frogs also had higher survivorship in the *in situ* study. They also exhibited significant delays in development in the influent end of the wetlands relative to the effluent ends.
3. In our mesocosm study we found significant interactions of hydroperiod duration on survival to metamorphosis, with reduced survivorship in longer hydroperiods. However, although toads survived well in elevated Cu mesocosms there were significant latent effects with reduced physiological performance, size, and survivorship measured one month after metamorphosis.
4. Incidence of the fungus that causes chytridiomycosis, *Batrachochytrium dendrobatidis*, is significantly higher in the H-02 wetlands and similar A-01 wetlands than it is in reference wetlands.
5. The amphibian community at Rainbow Bay has shifted from long- to short-hydroperiod species over three decades in response to drought and associated shortened wetland hydroperiods. The RB data are useful to build a conceptual model of the impact of climate change on southeastern isolated wetlands.

Major Impact(s) of Research
1. Our research provides data through which DOE NNSA can satisfy regulatory requirements pertaining to the operation and function of the H-02 treatment wetlands, insuring the continuation of tritium operations on the SRS and providing DOE NNSA with state of the art scientific data with which to

respond to inquiry regarding he the environmental and ecosystem level impacts of their mission on the SRS.

2. Our continued time series of metal concentrations in the H-02 system (in sediments, water, and biota) will enable informed assessment of how this type of constructed treatment wetland functions, and whether it provides suitable wildlife habitat in addition to enhancing water quality.
3. Our focus on variation in tolerance to metals, as well as underlying differences in gene expression profiles, will provide a better understanding of whether, and how, a species can adapt to elevated environmental contaminant loads.
4. Our *in situ* field studies demonstrate the importance of comparing laboratory toxicity studies to more natural conditions. Results from our field studies suggest much lower toxicity and even reversal of relative sensitivity to metals among species.
5. Our mesocosm studies demonstrate the importance of looking beyond the larval period in amphibian ecotoxicology studies. We found significant latent effects that lead to completely different conclusions than the larval study alone.
6. Our understanding of the factors that drive the population dynamics of amphibians in natural systems, based on the long-term RB study, will allow predictions of the effects of climate change, and insights to land managers who may need to design protective measures for rare species.

Other Project Personnel

Wes Flynn, PhD student - UGA
Diana Soteropoulos, Research Technician - SREL
Caitlin Rumrill, MS student - UGA
Megan Winzeler, MS student - UGA

External Collaborators

Wendy Kuhne – SRNL
Schyler Nunziata – University of Kentucky

Products

Soteropoulos DL, S.L. Lance, R.W. Flynn, D.E. Scott. 2013. Effects of copper exposure on hatching success and early larval survival in marbled salamanders, *Ambystoma opacum*. *Environmental Toxicology and Chemistry* (In Press)**.**

Lance S.L.,M.R. Erickson, R.W. Flynn, and D.E. Scott. 2013. Individual and Population Level Differences in Tolerance to Chronic Copper Exposure in Southern Toads, *Anaxyrus terrestris. Environmental Pollution* 177:135-142

Love C.N., R.W. Flynn, S.O. Nunziata, K.L. Jones, S.L. Lance. 2013. Development of polymorphic microsatellite markers for the Mole Salamander (*Ambystoma talpoideum*) using Illumina paired-end sequencing. *Conservation Genetics Resources* 5:951-954.

Scott, D.E., M.J. Komoroski, D.A. Croshaw, and P.M. Dixon. 2013. Terrestrial distribution of ambystomatids around an isolated wetland. *Ecology* 94:2537-2546.

Walls, S.C, W.J.Barichivich, M.E. Brown, and D.E. Scott. 2013. Influence of drought on salamander occupancy of isolated wetlands on the southeastern Coastal Plain of the United States. *Wetlands* 33:345-354.

Lance, S.L., Ponds, pollutants and parents: what every amphibian should know about chronic copper exposure. Invited talk at the College of Charleston, SC. May 2013 (Oral Presentation).

Lance, S.L.,C.N. Love, M. Winzler, S.O. Nunziata and D.E. Scott. Ponds, pollutants and parents: what every amphibian should know about chronic copper exposure. Invited talk at the University of Regina, Saskatchewan, Canada. . September 2013. (Oral Presentation).

Lance, S.L. Prevalence of two amphibian diseases, ranavirus and chytridiomycosis, in contaminated and uncontaminated sites on the Savannah River Site. Annual meeting of the Wildlife Disease Association, Knoxville, TN. July 2013 (Oral Presentation).

Flynn, R.W., D.E. Scott and S.L. Lance. An examination of maternal and paternal contributions to responses of embryonic and larval southern toads, *Anaxyrus terrestris*, to copper. Odum School of Ecology Graduate Student Symposium. January 2013. (Oral Presentation).

Flynn, R.W., D.E. Scott and S.L. Lance. An examination of maternal and paternal contributions to responses of embryonic and larval southern toads, *Anaxyrus terrestris*, to copper. Gordon Research Conference on Ecological and Evolutionary Genomics. Biddeford, ME. August 2013 (Poster)

Winzeler, M.E., S.L. Lance, S.N. Love, S.O. Nunziata and D.E. Scott. Prevalence of two diseases on the Savannah River Site. University of Georgia Chapter of The Wildlife Society, Athens, Ga. September 2013. (Poster).

Microbial antibiotic resistance characterization of the MOX stream (U8)

Funding Entity
NNSA - MOX
Start Date and Funding Amount
March 2012; $220,000
PI and co-PI's
Dr. J Vaun McArthur – SREL
Objectives
1) Determine whether the MOX stream (U8) is acting as a gene nursery for antibiotic resistance genes.
2) Determine whether any resistant bacteria or resistance genes are being transported into Upper Three Runs Creek which flows directly into the Savannah River.
3) Characterize the bacteria and antibiotic resistance genes found in this stream and monitor the bacteria and antibiotic resistance genes being transported out of the stream.
4) Recommend possible remediation strategies for consideration.

Summary of Research Activities
Pathogenic/Non-Pathogenic Differences –We expect ash basins to behave as a kind-of bioreactor or "gene nursery", a site for cultivating increased abundance of resistance traits in bacterioplankton. It is not known whether these increases occur due to vertical or horizontal processes. To address these unknowns we determined the relationship among resistance traits in environmental bacteria and those found in water-borne pathogens.

AR Traits and Downstream Distance – We have collected over 3,000 isolates from eleven locations on eight streams including the MOX stream (U8) and Upper Three Runs Creek. From these samples we have isolated and screened over 3,000 *E. coli* for resistance profiles. From these analyses we have found that the bacteria from the MOX stream (U8) and from U4 (F-area) were resistant to nearly twice as many antibiotics as the other streams sampled. Both U4 and the MOX stream (U8) have been heavily impacted by site operations. In the headwaters of the MOX stream (U8) is an active coal ash basin which is not on the MOX property. However during storm flows water percolating through this basin transports leached metals into the flowing section of the MOX stream (U8). It is not clear what the selective pressure on the U4 bacteria is at this time but these results suggest the need for additional studies.

Conclusions
1) *E. coli* isolated from the MOX stream (U8) and U4 harbor more antibiotic resistance traits than similar isolates collected at other SRS streams

Major Impact(s) of Research
1) Knowing whether anthropogenic effects on freshwater ecosystems can affect the ability of environmental bacteria to transfer resistance traits to water-borne pathogens is of significant evolutionary and ecological importance.
2) Results from this aspect of the study will greatly increase our knowledge about the role of environmental stresses in the maintenance and dissemination of antibiotic resistance traits.

Other Project Personnel
Paul Stankus, Research Professional - SREL
External Collaborators
Dr. R. Cary Tuckfield - Ecostatys, LLC
Products
Final report completed.

Restoration of the MOX stream (U8): Initial efforts

Funding Entity
NNSA - MOX
Start Date and Funding Amount
March 2013; $220,000
PI and co-PI's
Dr. J Vaun McArthur and Dean Fletcher – SREL
Objectives
The overarching goal of this study is a systematic restoration of the MOX stream (U8). During this budget year we will continue to obtain and process hydrologic data. We anticipate that most of the invertebrate samples will be identified and analyzed for metal concentrations.
Summary of Research Activities
In FY13 we collected over 2400 dragonfly nymphs, over 650 crayfish and over 400 crane fly larvae. Collections were made from five streams. Streams include three streams potentially disturbed by excessive stormwater runoff including the stream beside the MOX facility (Stream U8) and two references streams. Having a gradient of disturbance will allow greater ability to assess cause and effect. All dragonfly nymphs have been identified, head capsule width and body length measured, freeze dried and weighed for community and life history analyses. Size frequencies of body measures were used to establish instars. Individuals have been assigned to composites for contaminant analyses. Dragonfly collections included 5 families and 11 genera. Sensitive genera have been identified. Identification of crayfish and crane fly larvae has begun and will be completed in FY14. Additionally 80 composite sediment samples were collected. Sediment has been freeze dried and homogenized and percent organic matter was determined from each sediment sample. Preliminary analyses suggest sediment in the disturbed streams to be retaining less organic matter. Geomorphic and hydrologic assessments are being done in collaboration with the University of Kentucky.

Total mercury concentrations (*u*g/g dry wt) will be determined with a DMA 80 direct mercury analyzer and metal/metaloid concentrations (*u*g/g dry wt) for) will be determined on an ICP-MS. Development of the analyte list is in progress, but will include at least As, Cd, Cr, Cu, Ni, Pb, Se, Sr, and Zn. For quality assurance, samples will be analyzed in batches with blanks and standard reference material of known concentration. Stream depth and temperature are being continuously monitored in stream U8 with data loggers. Stream depth will be converted to discharge using a rating curve.
Conclusions
1) This research is currently being conducted and as such there are no conclusions at this time.
Major Impact(s) of Research
1) SREL will assess potential impacts of MOX construction and other activities in the U8 drainage. Analyzed stressors will include both physical alterations of stream channel and hydrology as well as potential contaminants in the study systems. Our results could assist the SRS NNSA mission and MOX Project in beginning a future restoration of the stream that drains the MOX complex. This stream prior to MOX construction harbored a healthy stream invertebrate assemblage.
2) We will enable the determination of possible effects caused by MOX operation in the future and meet the expectation of the Environmental Impact assessment for no impacts.
Other Project Personnel
Paul Stankus, Research Professional - SREL
Angela Lindell, Research Professional - SREL
External Collaborators
Dr. Christopher Barton - University of Kentucky
Richard Biemiller - University of Kentucky
Products (Publications, Presentations, Technical Reports)
No publications, presentations, or reports have been prepared yet.

H-02 Constructed Wetland Studies—Metal Biogeochemistry

Funding Entity
NNSA - Tritium
Start Date and Funding Amount
October 2012; $314,384
PI and co-PI's
Dr. Gary Mills and Dean Fletcher - SREL
Objectives
This research seeks to support, assess and improve operations of the tritium constructed wetlands. Constructed wetlands play an important role in the SRS environmental plan to achieve both federal and state regulatory compliance for the discharge of effluent waters. A fundamental understanding of the biogeochemical processes underlying metal sequestration and the reduction of toxicity in effluent waters will serve to better predict the seasonal variability in metal dynamics and potential impacts to receiving streams. In addition, this research will improve the database, including biogeochemical markers, for predicting the temporal evolution of a newly constructed wetland to a mature, functioning steady-state system.
Summary of Research Activities
In FY-13, we continued our monthly monitoring of metal concentrations and water quality parameters in surface waters as well as our seasonal collection of sediment. Water samples were collected at the primary discharge pipes from the Tritium Facility, the retention basin, influent and effluent in both wetland cells, and the discharge stream that carries the effluent to Upper Three Runs (UTR). This data is consistent with results from previous years and demonstrates that the wetland continues to function well. There is some seasonal variation but the average removal for Cu and Zn are 64% and 52%, respectively, and concentrations were well below SCDHEC regulatory limits. During 2013, we added a research component to include additional monitoring of metal concentrations during storm events. Our results for FY-13 demonstrate the concentrations and the effluent flux of both Cu and Zn is affected by storm water entering the system. This is especially true for Zn which resulted not only in a significant increase in concentration but also a major increase in the particulate relative to the dissolved form of the metal. This concentration increase combined with the increase in effluent flow rate resulted in an order of magnitude increase in Zn flux to UTR. Studies on the effects of storm events on metal concentrations and flux will continue in FY-14.

Metals are known to cause both acute and chronic toxicity to aquatic organisms at low concentrations. The common practice of analyzing water or sediment for total or dissolved (<0.45 μm) metals does not accurately assess the impact of metals on organisms since not all chemical forms of the metal are available for uptake (i.e., bioavailable). Several chemical techniques have been employed to measure the bioavailable fraction of metals but none of these methods can be readily done in-situ and thus, extrapolating these results to the natural environment continues to present difficulties. Diffusive gradient thin films (DGT) are a passive, diffusion-based, *in-situ* sampling device designed to mimic a biological membrane. DGT are becoming more widely employed to provide a rapid method for determining the bioavailable fraction of metal in natural waters and sediments. In FY-13 we initiated a study to evaluate the use of DGT to predict the accumulation from solution of Cu by tadpoles. The results of this study indicated that the DGT are a promising tool for assessing Cu bioavailability. Further assessment using different organisms and refinement of the deployment conditions are on-going.

Sediment cores were collected during summer and winter seasons in the influent and effluent sections of both wetland cells. Analyses of sections of these cores at intervals of increasing depth indicated that Cu and Zn continue to increase in the upper 5 cm of the wetland sediments. We have also found an increase in lead (Pb) concentrations but at much lower levels. The overall results indicate that the metals removed

from the surface waters accumulate in the organic rich layer (detritus) near the sediment-water interface. There is no significant accumulation of metals in the black, sulfide mineral layer deeper in the sediments. This suggests that the metals may be susceptible to mobilization by re-suspension and oxidation under certain conditions such as increased flows during major storm events. Studies examining the propensity for potential mobilization are on-going.

In FY-13, we initiated additional studies evaluating the accumulation of metals in aquatic macroinvertebrates (e.g., dragonfly larvae) in the H-02 wetland system. Aquatic macroinvertebrates are an important component of the food web in wetland ecosystems and also provide a potential pathway for transfer of contaminants to the adjacent terrestrial environment as the adult insect completes metamorphosis and disperses from the wetland. Macroinvertebrates were collected during the spring from the wetland cells, retention basin, stream and reference wetlands. These samples were frozen for metal analysis later this year. Since large numbers of macroinvertebrates were found in the retention basin, we initiated a more detailed study of the distribution of metals in the retention basin sediments and these analyses are on-going.

Conclusions

1) The H-02 constructed wetland effectively reduces Cu and Zn concentrations in the Tritium Facility discharge waste water to achieve SCDEHC regulatory limits. Preliminary results indicate that storm events have a significant effect on the metal flux and concentration.
2) The high biological productivity of the wetland also generates high concentrations of dissolved organic matter which complexes the metal discharged from the wetland which reduces the metal bioavailability and, consequently, the toxicity of the waste water entering the tributary to UTR.

Major Impacts of Research

1) This research supports the use of cost effective constructed wetlands for the treatment of metal contaminated waste water and supports DOE's goal of employing "green technologies" for waste cleanup and remediation. Constructed wetlands play an important role in the SRS environmental plan to achieve both federal and state regulatory compliance for the discharge of effluent waters.
2) Results of our studies support the EPA's goal of advancing our understanding of metal biogeochemistry in wetland systems and developing better tools for predicting the fate and effects of metals in aquatic ecosystems.

Other Project Personnel

Angela Lindell, Research Professional - SREL
Shelby Weathersbee, Undergraduate - USC-Aiken
Nathaniel Fletcher – Undergraduate – College of Charleston
Lauren Cameron, MS Student – UGA/SREL
Rebecca Philipps, MS Student – UGA/SREL

External Collaborators

Dr. Michele Harmon - USC-Aiken

Products

Burgess, E.A., G.L. Mills, S.M. Harmon, R. Sharitz, and E.A. Nelson. 2012. Development and functioning of a wetland constructed for copper and zinc removal. *Science of the Total Environment*. (Submitted).

Philipps, R.R., S.L. Lance, D.E. Scott, and G.L. Mills. 2013. Evaluation of diffusive gradients in thin films for predicting bioaccumulation of copper in southern toads (*Anaxyrus terrestris*). Annual Meeting of the Society of Environmental Toxicology and Chemistry. (Oral Presentation).

Mills, G.L. 2013. Biogeochemical changes in a constructed wetland receiving metal contaminated waters during the initial two years of development. Platform presentation at the 12th International Conference on the Biogeochemistry of Soils. (Oral Presentation).

Mills, G.L. 2013. Evaluation of a constructed wetland for removal of copper and zinc from surface waters: Biogeochemistry and bioavailability. Warnell School of Forestry and Natural Resources, University of Georgia. (Oral Presentation).

Tritium Distribution and Cycling on the Savannah River Site

Funding Entity
NNSA - Tritium
Start Date and Funding Amount
November, 2013; $90,790
PI and co-PI's
Dr. John C. Seaman - SREL
Objectives
The primary objective of the current project is to develop monitoring protocols for evaluating OBT levels in various plant and animal receptor species. The SRS provides an excellent setting for evaluating low-level tritium cycling dynamics in the environment, including the transformation of tritiated hydrogen gas (HT) and water (HTO) to organically bound tritium, OBT.
Summary of Research Activities
SREL is developing an OBT combustion/extraction line capable of handling large biological samples (commercially available extraction lines are designed for small quantities of radiolabeled (^{3}H and ^{14}C) compounds). The relative efficiency of the extraction system is under evaluating using traceable ^{3}H-labeled organic compounds. Once the analytical protocol is optimized, a limited set of plant and animal specimens from multiple SRS locations that reflect a range of low-level tritium exposure will be analyzed for tritium by conventional methods (lyophilization), and the sample combustion method.

To date we have collected and archived soil and vegetation sample materials, including woody and herbaceous plant tissues, from various locations in the central SRS area, including sites within and adjacent to the tritium phytoremediation plots. Conventional fluid extraction for the existing soil samples has been completed, and vegetation extraction is underway. In collaboration with Dr. J. Beasley, we are also in the process of collecting a limited number of receptor species (e.g., rodents) from various SRS "control' locations. Additional soil, vegetation and receptor animal samples will be collected starting May 2014 and continuing through the summer.
Conclusions
Conclusions to date are based on conventional tritium extractions methods.
1) When exposed to a tritium source other than atmospheric deposition, fluid tritium levels in plants and animals increase with increasing exposure level and decrease with precipitation.
2) When the tritium source is removed, the biological half-life of fluid based tritium is relatively short, ≈ 2 days for rodent species.

Major Impact(s) of Research
Tritium accounts for >65% of the atmospheric and >99% of the stream water environmental releases of radioactivity from the SRS. Factors such as biological half-life and isotope discrimination can have a significant impact on tritium dose calculations in risk assessment scenarios, particularly under specific management strategies such as prescribed burns on the SRS where OBT may be released to the environment in a more available form (e.g., water vapor). However, such factors are not currently addressed through regulatory driven monitoring programs. The tritium compartmentalization data (i.e., free water vs. OBT) can be incorporated in existing dose models to better understand the effects of site practices on tritium exposure pathways. These activities will enable site management to estimate potential human and ecological tritium exposure levels associated with new SRS mission activities, ongoing site cleanup efforts, accidental release, and routine site custodial activities.
Other Project Personnel
Shea Buettner, Research Professional - SREL
Dr. Hyun-shik Chang, Postdoctoral Research Associate – SREL
Dr. James Beasley – Assistant Research Scientist - SREL
External Collaborators
NA

Products

This is the first year of funding for this project. A summary report will be provided at the end of FY2014

TASK 8. SREL will continue to serve as a regional resource for scientific expertise and environmental research. SREL staff scientists will continue to provide special technical assistance to other site contractors, area stakeholders, other researchers, and the public. SREL will also continue to collaborate with scientist from other institutions

In FY13 SREL faculty, staff, and students conducted a diversity of environmental research projects both on and off of the SRS in support of their mission to pursue collaborations and funding to serve as a region source of scientific expertise and to provide technical assistance to other site contractors, stakeholders, other researchers, and the public. Due to both the specific technical expertise represented by research faculty and staff at SREL and the unique opportunities for scientific research represented on the Savannah River Site, SREL scientists are often sought out as potential collaborators by researchers across the globe. SREL staff served as collaborators on both funded and non-funded research involving environmental remediation, ecotoxicology and environmental stewardship and, as Principal Investigators or co-Investigators on funded research all over the United States and Internationally. In addition, SREL faculty, staff and students served as hosts for over 187 researchers from other universities, federal and state agencies, and non-governmental organizations to discuss and conduct collaborative research and funding. Research, external funding, and requests for technical assistance conducted in support of this task are outlined below:

Collaborations and Externally Funded Research on the SRS

Can We Measure And Achieve Functional Restoration Objectives And Regulatory Standards By Applying Specific Treatments To SRS Streams?

Funding Entity
USDA Forest Service-Savannah River
Start Date and Funding Amount
September 2011; $123,216
SREL Collaborators
Dean E. Fletcher
Objectives
Our overall goal is to provide assessments of legacy and current stream disturbances to enable Savannah River Site management organizations and regulatory oversight agencies to move forward, if appropriate, with specific treatments and a monitoring plan for a stream restoration-mitigation project.
Summary of Research Activities
Stream restoration and enhancement provides opportunity to correct or improve previous alterations that have destroyed, diminished, or impaired the character and function of stream systems. The Savannah River Site (SRS) provides an ideal research opportunity for restoration of coastal plain streams. The temporal range of disturbances to SRS streams span the range of pre-SRS legacy impacts, through the early infrastructure development in the early 1950s to more recent and current industrial activities. In a collaborative effort, a multiphase program has been established to characterize SRS streams, identify risks of legacy and recent disturbances, and identify disturbed stream reaches with potential for restoration. Three levels of assessments have been initiated and each level provides an increased level of detail and scientific rigor. A Level I assessment involved a broad scale survey of potential stream disturbances and stream basin characterization. Level II assessments are assessing the effects of stream alterations in a subset of Phase I identified streams (55 streams). Stream hydrology, geomorphology, and habitat availability at the reach, segment and basin level are being assessed. Level III assessments are further evaluating a selected subset of stream reaches (21 streams) by measuring additional hydrology, physicochemistry, biology, and geomorphology features. This comprehensive stream evaluation will provide management options and guide prescriptions for potential restorative actions.

Throughout FY2013, data collection for various aspects of the physical stream characterizations including chemical, hydrologic, and geomorphic features was completed. As raw data sets were complete, calculations were conducted to produce ecologically meaningful variables that were organized for future analyses. Water quality parameters that include measures such as major nutrients, dissolved oxygen, conductivity, pH, alkalinity and TOC were completed. Calculations of base flow discharge and indices of stream flashiness using data from the pressure transducers are in progress. Geomorphic data from established transects within sites were analyzed using RIVERMorph software to provide variables for stream channel characterization. Variables quantifying habitat availability were calculated from transect data. Stream canopy and riparian vegetation data has been entered. Soil cores from channels were collected and currently being processed. Macroinvertebrates were sorted and identified from leaf pack and Hester-Dendy multiplate samplers. Efforts in data processing and preliminary analyses have begun.

Conclusions

1) Preliminary analyses is identifying streams receiving excessive stormwater runoff to be the most disturbed systems in our study streams

Major Impact(s) of Research

1) We will verify the effects of legacy and current disturbances on stream chemistry, hydrology, geomorphology and biology on select SRS streams.
2) We will provide stream restoration alternatives and post restoration monitoring plans.

Other Project Personnel

Garrett Stillings, Research Professional - SREL
Hannah Angel, Temporary Research Technician - USDA Forest Service-SR

External Collaborators

Dr. Christopher Barton - University of Kentucky
Richard Biemiller - University of Kentucky
Dr. John Blake - USDA Forest Service-SR
James Fudge – SRNS-NEPA & Wetlands
Dr. Michael Paller - SRNL

Products

Fletcher, D. E., G. K. Stillings, and C. D. Barton. 2012. Stream system field condition assessments-level I surveys. Final report submitted to SRNS-ACP and USDA Forest Service-SR. 219pp.

Fletcher, D. E., G. K. Stillings, M. H. Paller, and C. D. Barton. Legacy Disturbances and Restoration Potential of Coastal Plain Streams. Annual Meeting of the Southeastern Fishes Council. Chattanooga TN, November 2011. (Oral Presentation).

Fletcher, D. E., G. K. Stillings, M. H. Paller, and C. D. Barton. Legacy Disturbances and Restoration Potential of Coastal Plain Streams. Annual Meeting of the American Fisheries Society. Seattle, Washington, September 2011. (Oral Presentation).

Fletcher, D.E., G.K. Stillings, and C.D. Barton. 2012. Can we measure and achieve functional restoration objectives and regulatory standards by applying specific treatments to SRS streams? Task 1. Stream Basin and Valley Characterization, Establishing a Framework. Annual report submitted to USDA Forest Service-Savannah River, 58 pp.

Barton C., D. Fletcher, R. Biemiller, and G. Stillings. 2012. Assessment of Structure, Function and Stability in a Gradient of Disturbed SRS Streams - Phase III. Annual report submitted to USDA Forest Service-Savannah River, 9 pp.

Fletcher, D.E., R. Biemiller, M.H. Paller, C.D. Barton. 2013. Legacy disturbances and restoration potential of coastal plain streams. *SRS Wetland and Aquatic Issues Task Group*, September 2013. (Oral Presentation).

Fletcher, D.E., R. Biemiller, and C.D. Barton. 2013. Can we measure and achieve functional restoration objectives and regulatory standards by applying specific treatments to SRS streams? Annual report submitted to USDA Forest Service-Savannah River, 3 pp.

Habitats Associated with Vehicle Collisions with Wild Pigs

Funding Entity
SREL
Start Date and Funding Amount
May 1, 2013; NFP
SREL Collaborators
Dr. James C. Beasley
Objectives
The objective of this study is to characterize habitat attributes associated with wild pig vehicle collision locations on the SRS to test the hypothesis that vehicle collisions with pigs occur more frequently in areas proximal to preferred habitats (i.e. riparian and bottomland hardwood habitats).
Summary of Research Activities
We quantified habitat attributes associated with 311WPVC locations occurring between 1983 and 2012 on the SRS to test the hypothesis that WPVCs occur more frequently in areas proximal to preferred habitats (i.e. riparian and bottomland hardwood habitats). Sex, age, and location were recorded for all collision locations used in this dataset. At each collision site we measured the distance to the nearest wetland and stream, as well as the composition of habitats adjacent to collision locations at two spatial scales. At the local scale, attributes were characterized within a 100-m buffer surrounding locations, whereas landscape-level attributes were quantified within a 1,699-m buffer, representing an area equivalent to the average home range size of wild pigs on the SRS. We then contrasted habitat attributes associated with collision sites with those from randomly selected locations along the same roads using regression modeling procedures to identify habitat characteristics contributing to a higher incidence of these accidents.
Conclusions
1) Vehicle collisions with wild pigs were non-randomly distributed at both spatial scales evaluated
2) Collisions occurred in areas closer to streams and containing less pine forest than random locations

Major Impact(s) of Research
1) Similar to vehicle accidents with other ungulate species, this study suggests that vehicle collisions involving wild pigs are spatially clustered around preferred habitat types. Management efforts to reduce vehicle collisions with wild pigs should be focused in areas where roadways bisect preferred habitats such as stream crossings and bottomland hardwood or other riparian habitats.
2) These data will aid in the development of mitigation strategies to reduce the frequency and impacts of wild pig vehicle collisions in areas of high wild pig densities.

Other Project Personnel
NA
External Collaborators
Dr. John Mayer – SRNL
Tracy Grazia – USFS
Products
Beasley, J.C., T.E. Grazia, P.E. Johns, and J.J. Mayer. (2014). Characterization of habitat attributes associated with wild pig-vehicle collision locations. *Wildlife Research*. (In Press).

Beasley, J.C., T. Grazia, P. Johns, and J. Mayer.(2013). Characterization of Habitat Attributes Associated with Wild Pig Vehicle Collision Locations. Wildlife Damage Management Conference, Clemson, SC, March 2013. (Oral Presentation).

Sub-lethal health effects of chronic exposure to contaminants in raccoons and feral pigs

Funding Entity
SREL, University of Florida
Start Date and Funding Amount
August 1, 2013; NFP
SREL Collaborators
Dr. James C. Beasley
Objectives
The overall goals of this research are to quantify body burdens of contaminants in raccoons and feral pigs from both control and contaminated sites on the SRS and evaluate a suite of potential sub-lethal health effects in those animals. Specifically, we are looking at the effects of contaminants on blood chemistry, parasite burdens, and changes in gut microbiota in both species.
Summary of Research Activities
From August-December 2013, samples (blood, muscle, liver, feces, etc.) were collected from wild pigs and raccoons captured throughout the SRS. Upon collection, samples were frozen or shipped to a diagnostic laboratory for further analysis. To date, a total of 9 feral pigs and 28 raccoons have been collected and necropsied for this research. Preliminary data indicate raccoons from contaminated sites have elevated body burdens of heavy metals, but no differences in blood chemistry analyses (e.g., red blood cell counts, white blood cell counts, etc.) have been documented thus far.
Conclusions
This research has just begun, thus there are no conclusions at this time.
Major Impact(s) of Research
1) Quantify prevalence of zoonotic and infectious pathogens in wild pigs and raccoons
2) Determine the sub-lethal impacts of environmental contamination on wild pigs and raccoons through quantification of blood chemistry, parasite burdens, and gut microbiota in animals from contaminated and reference sites

Other Project Personnel
Sarah Webster, MS Student – UGA/SREL
External Collaborators
Dr. Samantha Wisely – University of Florida
Felipe Hernandez – University of Florida
Products
No publications, presentations, or reports have been prepared yet.

Efficacy of the LRAD weapon system as an avian dispersal tool on airports

Funding Entity
USDA Wildlife Services/Federal Aviation Authority
Start Date and Funding Amount
April 12, 2013; $187,914
SREL Collaborators
Dr. O.E. Rhodes, Dr. J. Beasley, A.L. Bryan, R.A. Kennamer and A.E. Holland
Objectives
The overall goal of this research is to test the efficiency of a long range acoustic device (LRAD) on dispersing nuisance birds from unwanted and/or dangerous locations and to see how sound treatments with the LRAD affect avian behavior. Sound treatments will occur at either existing sites where these birds congregate (e.g.; roosts, landfill) or created sites (e.g.; bait sites) with our goal to "defend" these sites (prevent or limit occupancy).
Summary of Research Activities
We targeted several species with a history of aviation collisions: vultures, gulls, waterfowl and blackbirds. Our goal for the 1st 3 of these species groups was to "mark" a number of each group and treat them with the LRAD, with pre- and post-treatment surveys documenting the effectiveness of the treatment (numbers at site pre- and post-treatment). Blackbirds, which number in the thousands, will not be marked.

Approximately 100 vultures were captured this year and marked with highly visible wing tags. Twenty received satellite transmitters which provide 100-300 locations per day. We are using the 1st year of telemetry data to establish a baseline of movements, both local (SRS vicinity) and regional. We plan to mark more vultures with wing tags in the 2nd year, and then use the LRAD treatments on bait sites.

Ring-neck ducks were captured and marked with nasal saddles (n~130) and 25 were outfitted with radio transmitters. We conducted one series of sound treatments/monitoring in 2013 with plans to do additional treatments in year 2.

Blackbirds returning to a major roost near Bush Field (Augusta, GA) and on the SRS (A01 wetlands) were treated multiple times in 2013 with varying results. These results were affected by the transitory nature of these birds at this time of year.

Marking and treatment of gulls at the landfill was postponed to year 2 of the study.
Conclusions
1) This project is on-going and all results are preliminary.
2) Blackbird flocks flying to roost could be diverted, but birds near/in the roost vegetation were not dispersed by the treatments.
3) Over 500,000 locations have been provided by the transmittered vultures. Most stayed near the SRS/CSRA, but several exhibited regional movements (as far as Florida).

Major Impact(s) of Research
1) This project is on-going.

Other Project Personnel
Sarah Webster, MS Student – UGA/SREL
Zak Smith, Temp. Research Technician - SREL
External Collaborators
Drs. Travis DeVault - USDA APHIS/Wildlife Services
Dr. Bradley Blackwell - USDA APHIS/Wildlife Services
Products
No publications, presentations, or reports have been prepared yet.

Contaminant uptake by hatchling alligators via dietary exposure

Funding Entity
SREL
Start Date and Funding Amount
June 1, 2011; NFP
SREL Collaborators
Dr. Tracey Tuberville, Dr. Brian Metts, Dr. Stacey Lance and David Scott
Objectives
1) Determine the biological effects of dietary uptake of coal combustion wastes on juvenile alligators experimentally exposed to one of four diet treatments
2) Determine the feasibility of using non-destructively collected tissue samples (i.e., blood, scutes) to predict tissue concentrations in organs (i.e., liver).
3) Identify useful biological endpoints for assessing individual-level effects of contaminants on reptiles.

Summary of Research Activities
We initiated diet exposure treatments in June 2011 concluded our experiment in June 2013. At the beginning of the study, we collected pre-exposure samples for each alligator and collected serial samples from the same individuals every 3 months once diet exposures were initiated. Samples include whole blood for metals analysis, blood for RNA extraction, plasma, and small volume blood samples for analysis of packed cell volume. Additionally, alligators are weighed and measured monthly to monitor growth. Alligators were euthanized and we collected additional organ and other tissue samples to determine the distribution of contaminants across tissues and determine if values among tissues are correlated. The tissue and blood samples have been analyzed to collect body burden data.

Conclusions
We did observe a treatment effect (frequency of feeding with contaminated vs uncontaminated food) on body burdens of alligators, demonstrating that our experimental design could potentially be useful for examining effects of contaminants at individual level. However, overall body burdens for the trace elements of interest (Arsenic and Selenium) were low, primarily due to the challenges of formulating food with high (and biologically relevant) levels of contaminants using wild-caught prey items. Thus, our next contaminant feeding study will focus on obtaining higher, more controlled diet concentrations of a single contaminant by feeding alligators thawed mice injected with either 1, 10, or 20 ppm selenomethionine to replicate body burdens detected in wild-caught alligators and their prey at D-Area ash basins.

In our current experiment, we did not see a treatment effect on growth, hematology (packed cell volume or total solids), or one measure of immunity (PHA), but are continuing to conduct data analysis on other samples collected for additional immunity measures, hematology parameters (complete blood counts, leukocyte differentials), corticosterone levels, and organ weight.

Major Impact(s) of Research
1) Develop much needed biological endpoints for assessing the effects of contaminants on reptiles.
2) Evaluate whether experimental dietary exposure is a feasible approach for examining the effects of contaminants on long-lived species such as alligators and turtles.
3) Determine whether non-destructively sampled tissues can be used as a proxy for tissues requiring euthanasia of experimental animals.

Other Project Personnel
Caitlin Kupar, undergraduate – UGA
John Finger, PhD student – UGA
Matt Hamilton, MS student – UGA/SREL

External Collaborators
Dr. Terry Norton –Georgia Sea Turtle Center

Products (Publications, Presentations, Technical Reports)
No publications, presentations, or reports have been prepared yet.

Effects of landscape disturbance on stream condition in southeastern sandhills

Funding Entity
SREL/prior funding by SERDP (via subcontract with SRNL)
Start Date and Funding Amount
August 1, 2011; NFP
SREL Collaborators
Dean Fletcher and Dr. Tracey Tuberville
Objectives
Evaluate the effects of landscape cover and landscape disturbance on stream quality, using both GIS data and field-collected on stream morphology, water quality, and fish and aquatic invertebrate community structure.
Summary of Research Activities
All field work and GIS analyses had been previously completed. Efforts during FY13 focused on preparing manuscripts for publication.
Conclusions
Even relatively small disturbances (road crossings, wiers, etc) can have detectible impacts on stream biotic communities. However, most streams on SRS had relatively lower levels of disturbance compared to two military installations where intensive military training occurs. Macroinvertebrates were more affected by in-stream habitat quality whereas fish were more affected by the presence of a reservoir in the catchment.
Major Impact(s) of Research
This work will contribute to the identification of "reference" conditions for wadeable streams in the Sandhills ecoregion and providing a benchmark against which to measure stream restoration efforts.
Other Project Personnel
None
External Collaborators
Dr. Michael Paller – SRNL
Ely Kosnicki – Auburn University
Andrew Grosse - SREL
Dr. Jack Feminella – Auburn University
Stephen Sefick –UGA
Sean Sterrett – UGA
Products
Paller, M.H., S.C. Sterrett, T.D. Tuberville, D.E. Fletcher, and A.M. Grosse. Effects of disturbance at two spatial scales on macroinvertebrate and fish metrics of stream health. Journal of Freshwater Ecology 29:83-100. (In Press).

Kosnicki, E., S.A. Sefick, M.H. Paller, M.S. Jarrell, B.A. Prusha, S.C. Sterrett, T.D. Tuberville, and J.W. Feminella. 2013. Defining the reference condition for wadeable streams in the Sand Hills subdivision of the Southeastern Plains ecoregion, USA. Environmental Management (Submitted).

Costs of Incubation: Linking Incubation-Induced Alterations in Phenotype to Changes in Fitness

Funding Entity
National Science Foundation
Start Date and Funding Amount
September 1, 2006; NFP in FY13
SREL Collaborator
Robert Kennamer
Objectives
Our overall goals have been to examine the importance of incubation temperature during early development, and to provide a better understanding of how reproductive tradeoffs made by females influence their fitness.
Summary of Research Activities
This research project has been a multi-year investigation. In the last year, we completed manipulations of down insulation in wood duck nests and follow-on examinations of trade-offs between female self-maintenance and nest incubation temperature. In these manipulations, we used reduced insulation (0.5 g of down) versus typical insulation (4.0 g of down) and predicted that nests with reduced insulation would cool faster during incubation recesses and produce changes in female behavior. Because we know from earlier our work that low incubation temperature in wood ducks lengthens the incubation period and influences offspring quality, we predicted that females with reduced insulation would attempt to maintain optimal incubation temperature by taking shorter incubation recesses and spending more time on the nest. However, investment decisions of incubating females should be condition-dependent. Therefore, we also predicted that females starting incubation at relatively low body mass would be more likely to invest in self-maintenance than in maintaining proper egg temperatures. Papers from earlier parts of this research were submitted or published in the last year as well.
Conclusions
1) Incubating females increased incubation effort when faced with faster egg cooling rates in nests with reduced down, leading to an increase in incubation constancy.
2) This increase in incubation constancy was sufficient to maintain proper thermal environment so that there was no effect of reduced down on average nest temperatures or duckling quality.
3) While effort was apparently increased, it was not sufficient to challenge the energetic demands of females.

Major Impacts of Research
1) Novel approach to altering bird nest temperatures by manipulating insulating down amounts.
2) Forces incubating parents to make decisions potentially affecting current versus future reproduction.
3) Illustrates the importance of nest micro-climate in studies of incubation costs.

Other Project Personnel
Maureen McClintock, MS Student - Auburn University
External Collaborators
Dr. Gary Hepp - Auburn University
Dr. Bill Hopkins - Virginia Tech University
Dr. Sarah DuRant - Oklahoma State University
Products
McClintock, M.E., G.R. Hepp, and R.A. Kennamer. 2014. Plasticity of incubation behaviors helps Wood Ducks (*Aix sponsa*) maintain an optimal thermal environment for developing embryos. Auk. (Submitted).

DuRant, S.E., W.A. Hopkins, G.R. Hepp, and L. M. Romero. 2013. Energetic constraints and parental care: is corticosterone an important mediator of incubation behavior in a precocial bird? *Hormones and Behavior* 63: 385-391.

Efficacy of Rhodamine B as a biomarker for bait uptake in feral swine

Funding Entity
USDA – Wildlife Services – National Wildlife Research Center
Start Date and Funding Amount
July 18, 2013; $11,660
SREL Collaborators
Dr. James C. Beasley and Dr. Olin E. Rhodes, Jr.
Objectives
The objective of this study is to evaluate the potential utility of Rhodamine B as a biomarker for use in feral pigs by quantifying presence in both guard hair and vibrissae of male and female feral pigs of various age classes at one and two weeks post-exposure.
Summary of Research Activities
Feral pigs were live-trapped throughout the SRS during fall 2013 to quantify uptake of Rhodamine B (RB) in vibrissae and guard hairs. Thirty feral pigs of varying sex, age, and weight were trapped, transported to a captive facility on the SRS, and administered RB orally at a dosage of 30 mg/kg. Eight vibrissae and guard hairs were collected prior to the administration of Rhodamine B as control samples. Pigs were maintained in captivity for 7 or 14 days post Rhodamine B administration and euthanized in accordance with UGA Animal Care and Use Protocols. Additional vibrissae and guard hair samples were collected post Rhodamine B exposure. All samples collected were evaluated for the presence of RB using fluorescence microscopy and the number of samples exhibiting marking consistent with Rhodamine B exposure was quantified for each individual and for each sample type (guard hair vs. vibrissae).
Conclusions
1) Rhodamine B was absent from all control samples but observed in samples collected from all 30 pigs post-exposure, regardless of sex, age, or weight
2) Evidence of Rhodamine B marking was observed in (98%) of sampled vibrissae and 100% of sampled guard hairs

Major Impact(s) of Research
1) The results of this research suggest Rhodamine B can be used as an effective biomarker in the development of baiting programs to deliver pharmaceuticals to free-ranging feral pigs, as well as evaluate the potential impacts of pig baits on non-target species.

Other Project Personnel
Sarah Webster, MS Student – UGA/SREL
Zachary Smith, Research Technician - SREL
Lincoln Oliver, Research Technician - SREL
External Collaborators
Dr. Frederick Cunningham - USDA Wildlife Services
Products
No publications, presentations, or reports have been prepared yet.

Effect of Carcass Size and Habitat on Vertebrate Scavenging Dynamics

Funding Entity
Joseph Jones Ecological Research Center, SREL
Start Date and Funding Amount
May 1, 2013; $21,665
SREL Collaborators
Dr. James C. Beasley and Dr. Olin E. Rhodes, Jr.
Objectives
The objective of this study is to evaluate the influence of 1) carcass size, 2) habitat, 3) season, and the interaction of these variables on the composition and efficiency of vertebrate scavenging communities in the southeastern U.S.
Summary of Research Activities
For this research, rat, rabbit, and feral pig carcasses were placed within each of 4 habitat types common throughout the SRS: 1) clearcuts, 2) mature pine stands, 3) young pine stands, and 4) bottomland hardwoods. Twelve stands of each habitat type were selected for this study, for a total of 48 trials of each carcass type. Trials were conducted during summer 2013 and will be repeated during winter 2014 to elucidate the effects of temperature on scavenger community composition and efficiency of carrion removal. For each trial, we placed a single remote camera proximal to the carcass and monitored scavenger activity for up to 1 month, or until the carcass was completely removed. Camera images currently are being analyzed to determine scavenger visitation and carcass removal patterns.
Conclusions
This research has just begun, thus there are no conclusions at this time.
Major Impact(s) of Research
1) This is the most comprehensive study of the effects of habitat and carcass size on scavenging dynamics and nutrient cycling to date and will greatly enhance our understanding of energy flow, and potentially contaminant transport, within food webs.
2) This research will greatly inform our understanding of the effects of forestry practices on the fate of carrion in southeastern landscapes.

Other Project Personnel
Kelsey Turner, MS Student – UGA/SREL
Erin Abernathy, MS Student – UGA/SREL
Zachary Smith, Research Technician – SREL
Lincoln Oliver, Research Technician – SREL
External Collaborators
Dr. Mike Conner – Joseph Jones Ecological Research Center
Products (Publications, Presentations, Technical Reports)
No publications, presentations, or reports have been prepared yet.

Sub-lethal reproductive effects of chronic exposure to contaminants in free-ranging small mammals on the SRS

Funding Entity
SREL, U.S. Army Center for Health Promotion and Preventative Medicine
Start Date and Funding Amount
September 1, 2013; NFP
SREL Collaborators
Dr. James C. Beasley
Objectives
The objective of this research is to determine whether small mammals residing in habitats contaminated with radionuclides, heavy metals, or a combination of these contaminants exhibit impaired reproductive parameter thresholds in comparison with individuals captured at uncontaminated sites.
Summary of Research Activities
All sites have been selected for this research and trapping activities will begin in March 2014. Sites to be sampled include areas contaminated with radionuclides, heavy metals, and a mixture of these contaminants on the SRS. All captured individuals will be necropsied and various organs and tissues will be collected to conduct body burden assessments of contaminants and determine if elevated exposures have contributed to altered reproductive parameters (e.g., sperm counts).
Conclusions
This research has just begun, thus there are no conclusions at this time.
Major Impact(s) of Research
4) Determine whether small mammals residing in contaminated habitats exhibit reduced reproductive parameters consistent with levels that could impede long-term sustainability of populations.

Other Project Personnel
Lincoln Oliver, Research Technician – SREL
External Collaborators
Dr. Lawrence Tannenbaum – U.S. Army Center for Health Promotion and Preventative Medicine
Products
No publications, presentations, or reports have been prepared yet.

Collaborations and Externally Funded Research Non - SRS

Experimental Evaluation of Trophic Transfer of Toxicants Used for Insular Rodents

Funding Entity
USDA – Wildlife Services – National Wildlife Research Center
Start Date and Funding Amount
September 21, 2013; $29,986
SREL Collaborators
Dr. Olin Rhodes, Jr. and Dr. James Beasley
Objectives
The overall goal of this research is to elucidate the transfer of toxicants/contaminants through the food chain as scavenging occurs on rodent carcasses resulting from island rodent eradication programs.
Summary of Research Activities
Rodent species commonly targeted for island eradication programs will be placed in conjunction with camera traps to experimentally evaluate the influence of temperature, precipitation, and climatic zone on the time to removal and diversity of species associated with carcass scavenging events on Hilo, HI. In each of two years, 2013 and 2014, two trials of two weeks in duration will be conducted. Each trial will utilize 25 camera traps (13 Rattus sp. and 12 Mus sp.) which will be deployed in a specific climate zone in a particular seasonal period of the annual cycle (e.g., wet vs dry season). In total, two climate zones will be evaluated for each of two seasonal periods over the course of this experiment. Rodents used for each of the four trials will be obtained as donations from ongoing trapping programs for rats and mice in the agricultural production areas of Hilo, HI. No live animals or active trapping of live animals will be conducted by the personnel associated with this research project.

During the experiment, the following data will be recorded for each camera trap trial: Climatic zone, average temperature during the trial, total precipitation during the trial, elevation, GPS coordinate, species of carcass, time to removal of carcass, species of scavenger to remove carcass, camera or trial failure due to missed detection or equipment failure. Subsequent to the collection of this information, data will be analyzed using logistic regression and categorical data modeling to evaluate the influence of climatic zone, temperature, and precipitation on the time to removal and the diversity of scavengers utilizing rodent carcasses. In addition, data will be evaluated relative to the proportional frequency of utilization of rodent carcasses by scavenger species under differing climatic zone and environmental conditions to develop contaminant transfer factors for each species of scavenger encountered during the experiment. These data can be used to parameterize risk models for trophic transfer of contaminants and toxicants associated with island rodent eradication programs in the pacific region.
Conclusions
1) Invasive vertebrates do scavenge upon invasive amphibians and reptiles extensively in HI.
2) Energy flow through island ecosystems can be fundamentally altered by invasive species scavenging.
Major Impact(s) of Research
1) Novel data on scavenging community structure for an island ecosystem
2) Experimental evaluation of competition between invasive and native scavengers in island ecosystems
3) Data for parameterization of transfer factors for toxicants through trophic pathways
Other Project Personnel
Erin Abernathy, MS Student – UGA/SREL
External Collaborators
Dr. Will Pitt – USDA Wildlife Services
Dr. Travis DeVault – USDA Wildlife Services

Products

Abernathy, E.F., K.L. Turner, J.C. Beasley, T.L. DeVault, W.C. Pitt and O.E. Rhodes, Jr. 2013. Impacts of invasive species on ecosystem energy flow on the big island of Hawai'i: Excuse me but are you going to eat that cane toad? *Proceedings of the 26th Annual Vertebrate Pest Conference*. (Submitted**).**

Occurrence of Avian Malaria in Wading Bird Species of the South Atlantic Region: Prevalence and Assessment of Potential Links to Mercury Uptake

Funding Entity

US Fish & Wildlife Service

Start Date and Funding Amount

June 1, 2012; $27,399

SREL Collaborators

Larry Bryan, Dr. Stacey Lance and Dr. Gary Mills

Objectives

The overall goals of this research are to establish a baseline of occurrence/prevalence of avian malaria in wading bird nestlings in FL, GA and SC, document mercury levels in wading bird nestlings, and assess whether malaria occurrence is linked to mercury uptake.

Summary of Research Activities

We collected blood and feather samples from 171 individual wading bird nestlings and 23 free-ranging/flighted birds. These included 8 different species from 11 different colonies. All blood samples have been analyzed for malaria and mercury.

Conclusions

1) Nine storks (8 adults, 1 nestling) and 2 adult ibis tested positive for malaria. There was no obvious link between malaria infection and mercury levels. We suggest that malaria infection is more influenced by age/length of time for potential exposure and/or, in certain cases, location,
2) Mercury analysis follows general expectations, with the more piscivorous species having higher mercury concentrations.

Major Impact(s) of Research

1) Occurrence of malaria primarily in the older birds suggests that the longer exposure time of the adults may be necessary for infection by malaria or possibly that one location/region may have problems.

Other Project Personnel

David Kling, Research Professional – SREL
Cara Love, Research Technician – SREL
Angela Lindell, Research Technician - SREL

External Collaborators

Dr. Rena Borkhataria - University of Florida
Dr. Donna Bear - Jacksonville Zoo

Products

Bryan, A.L, S.L Lance and G.L Mills. 2013. Occurrence of avian malaria in wading bird species of the South Atlantic region: Prevalence and assessment of potential links to mercury uptake. Final Project Report to the US Fish & Wildlife Service, Avian Disease and Health Program, NC. pp. 14.

Bryan, A.L. Jr., C.N.Love, G.L. Mills, R.R. Borkhataria, and S.L. Lance. Is avian malaria associated with mercury uptake in wading bird nestlings? *Journal of Wildlife Diseases* (Submitted).

Foraging Ecology of Coastal-breeding Wood Storks in the Northern Portion of Their Range

Funding Entity
US Fish & Wildlife Service
Start Date and Funding Amount
September 2012; $78,910
SREL Collaborators
Larry Bryan
Objectives
The overall goals of this research were to 1) document foraging range and habitat use by Wood Storks nesting in North Carolina and 2) characterize tidal stork foraging habitats in coastal Georgia.
Summary of Research Activities
An observer in an airplane followed 34 storks from the Lay Lake colony in NC to foraging locations in eastern NC and SC. Average foraging range was approximately 11km in direct distance (47 km max distance), which is fairly typical for storks, and they utilized forested wetlands more so than expected, possibly due to climatic (rainfall) conditions.

We sampled 17 known stork salt marsh foraging sites in near the Harris Neck NWR and 20 randomly selected marsh sites as alternate sites/controls. Both types of sites were dominated by Mummichogs (*Fundulus*) and shrimp as potential prey. Prey densities did not vary between site types and were quite high (averaged >150 prey items/m^2) when compared to reported inland prey densities (<10 prey-items/m^2)
Conclusions
1) Foraging travel by breeding storks in NC was fairly typical for storks in this part of their range.
2) Potential prey densities in the tidal salt marsh habitats were quite high, and indicate why storks nesting in this region are generally more successful than inland nesters.

Major Impact(s) of Research
1) This was the first study of foraging ecology of the NC storks, who reside on the northern extremity of their range.
2) This is the 1st ground-level characterization of salt marsh wetlands as stork foraging.

Other Project Personnel
David Kling, Research Professional - SREL
External Collaborators
Dr. Rena Borkhataria - University of Florida
Products
Bryan,A.L. Jr., and R.R. Borkhataria. 2012. Foraging ecology of coastal Wood Storks in the northern portion of their range. Final Project Report to the U.S. Fish & Wildlife Service, N. Florida Field Station, Jacksonville, Florida. pp. 14.

Bryan, A.L. Jr., and R.R. Borkhataria. 2013. Characterization of tidally-influenced wood stork foraging habitat in Georgia. *Southeastern Naturalist* 12:843-850.

Analysis of wood stork satellite telemetry location data relative to regulatory guidelines: The core foraging area concept.

Funding Entity
US Fish & Wildlife Service
Start Date and Funding Amount
January 15, 2012; $19,077
SREL Collaborators
Larry Bryan
Objectives
The overall goal of this research is examine archived satellite telemetry data for Wood Storks during the breeding season relative to listed regulatory guidelines (foraging range and associated habitat protection) and also compare the findings to existing follow flight data.
Summary of Research Activities
We used archived Wood Stork satellite telemetry data to compare to the foraging ranges employed in the Core Foraging Area (CFA) regulatory guidelines, which were based primarily of follow flight data (using an airplane to follow nesting birds from their colony to foraging sites). We directly compared selected portions of the archived data with follow flight data.

Breeding season foraging ranges based on satellite transmitter locations produced varied overall ranges. This is not surprising considering the data spanned regions, years, and environmental conditions. Follow flight data generally resulted in shorter foraging ranges than satellite telemetry data, but this was strongly influenced by region.
Conclusions
1) We found a regional difference in foraging range with South Florida apparently requiring a greater range than other Florida regions, Georgia and/or the Carolinas.
2) We believe a 20 km conservation buffer will be sufficient for most of their breeding range, but a 30 km range is needed for South Florida/

Major Impact(s) of Research
1) Core foraging areas (CFA) are a regulatory tool that has employed follow flight data to determine foraging ranges, and essentially define habitats to be protected for endangered Wood Storks and other wading birds.
2) This project provided confirmatory data for the CFA areas necessary for storks.

Other Project Personnel
None.
External Collaborators
Dr. Rena Borkhataria – University of Florida
Kenia Fritz - University of Florida
Products
Borkhataria, R.R., A.L. Bryan, and K. Fritz. 2013. Analysis of Wood Stork satellite telemetry location data relative to regulatory guidelines: The core foraging area concept. Final Project Report to the U.S. Fish & Wildlife Service, N. Florida Field Station, Jacksonville, Florida. pp. 53.

Kings Bay Rare, Threatened, and Endangered Wildlife Surveys: Aquatic Avifauna and Marsh Hammocks

Funding Entity
DoD-Navy/USFWS
Start Date and Funding Amount
January 15, 2012; $56,753
SREL Collaborators
Larry Bryan
Objectives
The overall goal of this research is to document the year-round avian community utilizing aquatic habitats on the Kings Bay Submarine Base (southeastern Georgia) and to characterize the vegetative characteristics of marsh hammocks, which are unique landscape features within the salt marshes of the base.
Summary of Research Activities
The avifauna surveys of aquatic habitats were the 2nd stage of monitoring at Kings Bay (terrestrial habitats were monitored in the previous year). We conducted timed, pedestrian surveys of aquatic habitats, including the marsh hammocks, during the winter period and point counts during the spring/summer (breeding) period. In addition, we characterized the vegetation on the marsh using line transects and 10-m^2 plots.
Conclusions
1) Over both years, we documented 175 total avian species as residents or migratory species on the Kings bay installation, including 56 listed as species of concern on state or regional (USFWS, SAMBI) lists.
2) We characterized four on-site marsh hammocks and one (Drum Point) island on the base facility and four marsh hammocks on the Harris Neck National Wildlife Refuge. Canopy coverages were dominated by live oak, eastern red cedar and pine, with saw palmetto as the primary low cover/mid-story species

Major Impact(s) of Research
1) Kings Bay, due to its geospatial location and diverse habitats, supports a wide variety of avifauna, including many listed species.
2) Live Oak maritime forest habitat on the Kings Bay mainland and fragmented parcels on the marsh hammocks provide habitat for many Neotropical migrants.

Other Project Personnel
Chris Depkin, Research Technician - UGA
External Collaborators
Dr. Susan Wilde – UGA
Products
Bryan, A.L. Jr., F.C. Depkin, and S.B. Wilde. 2012. Kings Bay rare, threatened, and endangered wildlife surveys: Aquatic avifauna and marsh hammocks 2011/2012. Final Project Report to the US Fish and Wildlife Service, North Florida Field Office (Jacksonville) and SUBASE Kings Bay Environmental/Natural Resources Division, Kings Bay Submarine Base. pp. 74.

Bryan, A.L. Jr., F.C. Depkin, P.H. Schoenfeld, and S.B. Wilde. Avifauna in maritime forest and shrub habitats on Navy Submarine Base Kings Bay in southeastern Georgia. *Oriole* (In Press).

The Ecological Study of Birds in the Vicinity of Augusta Regional Airport at Bush Field

Funding Entity
City of Augusta, GA
Start Date and Funding Amount
October 1, 2012; $100,695
SREL Collaborator
Robert Kennamer and Dr. Lehr Brisbin, Jr.
Objectives
Conduct bird hazard research associated with the placement of a wastewater treatment wetland system adjacent to a commercial airport and provide wildlife hazard consultation to airport and wastewater treatment plant personnel.
Summary of Research Activities
Since December 2001, we have been monitoring temporal and spatial activities of birds around Augusta Regional Airport. Within 2 years of the 2001 completion, the 360-acre wastewater treatment wetlands served as a nighttime roost for millions of migratory blackbirds that crossed the airfield daily at sunrise and sunset during fall/winter periods. We have been investigating the use of habitat alteration techniques to displace blackbirds, including use of airboats since 2008 to mechanically crush wetland vegetation in treatment wetlands each fall. Results have been highly significant, with long-term post-crush bird monitoring indicating that blackbird roosting within the wetlands became almost non-existent and blackbird activity around the airport was reduced. The ability of the wetland vegetation to process wastewater effluent was not negatively affected by vegetation alteration.
Conclusions
1) Long-term monitoring showed a reduction in blackbirds around the airport by 2 orders of magnitude.
2) Fall crushing of wastewater treatment wetlands vegetation did not harm regrowth the next spring.

Major Impacts of Research
1) The work demonstrated that with thoughtful wildlife hazard management, including the use of novel techniques, one can mitigate undesirable wildlife attraction associated with certain land-use activities.
2) Successful reduction of the bird-aircraft strike hazard was accomplished through non-lethal means.
3) Wastewater effluent concentrations of TSS, NH_3-N, and BOD_5 were reduced (improved) as a result of the vegetation crushing (i.e., vegetation crushing contributed an added benefit).

Other Project Personnel
Carol Eldridge, Research Professional - SREL
External Collaborators
D. Allen Saxon, Jr. - Augusta, GA Utilities Department
Products
Kennamer, R.A., I.L. Brisbin, Jr., C.S. Eldridge, and D.A. Saxon, Jr. 2013. Wastewater treatment wetlands: potential hazardous wildlife attractants for airports. *Proceedings of the 15th Wildlife Damage Management Conference***.** (In Review).

Kennamer, R.A., I.L. Brisbin, Jr., and C.S. Eldridge. 2013. Abundance, Distribution, and Movement Patterns of Avifauna in the Vicinity of Bush Field Airport: 2012–2013 Report. Savannah River Ecology Laboratory, Aiken, SC, 192pp.

Kennamer, R.A. Recent airport projects and constructed wetlands mitigation: effects on local wildlife activity. Wildlife Hazard Group Meeting, Augusta Regional Airport, GA. January 2013. (Oral Presentation).

Kennamer, R.A. A review of Augusta Regional Airport wildlife strike records and airfield wildlife activity from the previous year. Wildlife Hazard Group Meeting, Augusta Regional Airport, GA. January 2013. (Oral Presentation).

Kennamer, R.A. I.L. Brisbin, Jr., C.S. Eldridge, and D.A. Saxon, Jr. Wastewater treatment wetlands: potential hazardous wildlife attractants for airports. 15th Wildlife Damage Management Conference, Clemson University, SC. March 2013. (Oral Presentation).

Kennamer, R.A. A landscape view of wildlife activity affecting Augusta Regional Airport. Wildlife Hazard Group Meeting, Augusta Regional Airport, GA. June 2013. (Oral Presentation).

Kennamer, R.A. Acoustic Hailing Devices (AHDs): what are they and what are they useful for? Wildlife Hazard Group Meeting, Augusta Regional Airport, GA. June 2013. (Oral Presentation).

Kennamer, R.A. Augusta Regional Airport bird strikes: long- and short-term trends. Wildlife Hazard Group Meeting, Augusta Regional Airport, GA. November 2013. (Oral Presentation).

Phylogenetic analysis of Virginia opossum populations across the range of this species

Funding Entity
SREL
Start Date and Funding Amount
May 1, 2013; NFP
SREL Collaborators
Dr. James C. Beasley
Objectives
This research is in collaboration with researchers from UCLA to conduct phylogenetic studies on the Virginia opossum across its range. Specific objectives of this research include 1) sequence the skin transcriptome of opossums from different populations to find genes with differential expression in individuals with different color phenotypes, and 2) estimate allele frequencies in different populations of Virginia opossums across their range.
Summary of Research Activities
From May-July 2013, 20 Virginia opossums were captured throughout the SRS. From each individual we collected measurements, tissue samples (ear biopsy, hair etc.), and used a chroma meter to analyze pelage coloration patterns. All samples and measurement data are currently being analyzed by personnel at UCLA.
Conclusions
This research has just begun, thus there are no conclusions at this time.
Major Impact(s) of Research
1) This research represents the most comprehensive phylogenetic study of Virginia opossums to date
Other Project Personnel
Sarah Webster, M.S. Student – UGA/SREL
External Collaborators
Sergio Nigenda – UCLA
Products
No publications, presentations, or reports have been prepared yet.

Sub-lethal effects of chronic exposure to radiation in gray wolves (Canis lupus) at Chernobyl

Funding Entity
National Geographic Society; Institute for Radiological Protection and Nuclear Safety (IRSN)
Start Date and Funding Amount
June 1, 2012; $63,575
SREL Collaborators
Dr. James C. Beasley and Dr. Stacey L. Lance
Objectives
The overall objective in this project is to measure the spatial and temporal variation in radiation dose that individual wolves experience throughout the Chernobyl exclusion zone (CEZ) and quantify the relationship between dose and sub-lethal effects.
Summary of Research Activities
During the summer of 2012 we established initial hypotheses and research plans. In October 2012, we participated in a workshop at the Polesye State Radioecological Reserve (PSRER) in Belarus. The purpose of this workshop was to identify common research interests between SREL, IRSN, and Belarus scientists and develop proposals to submit to funding agencies to begin collaborative research in the Belarus portion of the CEZ. While in Belarus we met with leadership from Minsk, several scientists that work at the PSRER, and a scientist from Minsk in the National Academy of Sciences and were given the green light by the Ministry for Emergency Situations to move forward with submitting proposals to work in Belarus. This is a huge step as no western scientists have been permitted to conduct research on the Belarusian side of the Chernobyl Exclusion Zone. Since this workshop we have submitted multiple proposals to various organizations and foundations. We have received funding from the National Geographic Society and IRSN and are in the planning phases of a spring 2014 field season.
Conclusions
This research has just begun, thus there are no major conclusions at this time. However we have validated the GPS/dosimetry technology on three hogs at the SRS and also have successfully performed evaluations of this equipment in the laboratory.
Major Impact(s) of Research
1) For the first time use coupled GPS-dosimetry to directly measure radiation dose rates for free-ranging animals in the CEZ as they move through habitats with heterogeneous levels of contamination.
2) Use our telemetry/dosimetry data to directly examine the relationship between sub-lethal effects (e.g., disease, immunosuppression, stress) and exposure.
3) Use our telemetry/dosimetry data to directly examine the relationship between exposure and movement rates, home range/core area size and shape, and resource selection.

Other Project Personnel
Mike Byrne, Postdoctoral Researcher - SREL
Sarah Webster, MS Student – UGA/SREL
Cara Love, PhD Student – UGA/SREL
External Collaborators
Dr. Thomas Hinton - IRSN
Dr. Brant Ulsh - MH Chew Corporation
Dr. Susan Collins - Colorado State University
Dr. Yuri Bondar - Polesye State Radioecological Reserve
Dr. Vadim Sidorovich – Belarus National Academy of Science
Products
No publications, presentations, or reports have been prepared yet.

Population genetic analysis of whitefish in the Great Lakes

Funding Entity
Bruce Power funded the primary PI Dr. Christopher Somers
Start Date and Funding Amount
January 1, 2011; NFP to SREL, SREL has invoiced for 9K and will invoice for 10K in 2014
SREL Collaborators
Dr. Stacey L. Lance
Objectives
The overall objective in this project is to examine whether thermal emissions from industry affect unique populations of lake and round whitefish on the Great Lakes.
Summary of Research Activities
Whitefish are of special economic and ecological significance in Lake Huron. Numerous industries are located on the banks of Lake Huron, including Bruce Power, Canada's first private nuclear energy generator. Bruce Power has funded several groups to examine the potential impact of their operations on whitefish populations. In collaboration with Chris Somers at the University of Regina we have conducted initial pilot studies on the use of single nucleotide polymorphisms on whitefish. In addition we have developed and optimized microsatellite loci for the lake whitefish (*Coregonus clupeaformis*) and are currently developing loci for the round whitefish (*Prosopium cylindraceum*). We are also genotyping ~300 lake whitefish across 10 loci.
Conclusions
The project is at its early stages and we have no conclusions.
Major Impact(s) of Research
Until the data are fully acquired and analyzed we will not know the major impacts.
Other Project Personnel
Jason O'Bryhim, PhD Student, George Mason University
External Collaborators
Dr. Christopher Somers - University of Regina
Jessica Martino- University of Regina
Carly Graham- University of Regina
Dr. Sean Rogers - University of Calgary
Products
Presentations and technical reports have been provided to Bruce Power.

Population genetic analysis of two snake species at their northern range limits

Funding Entity

Multiple Canadian agencies funded the primary PI Dr. Christopher Somers

Start Date and Funding Amount

January 1, 2011; NFP to SREL

SREL Collaborators

Dr. Stacey L. Lance

Objectives

The overall objective in this project was to define management units for the eastern yellow-bellied racer and bullsnakes in Saskatchewan, Canada.

Summary of Research Activities

The study sites for this project included three large river valleys in southwestern Saskathewan. These river valleys represent the entire Canadian range for both eastern yellow-bellied racers (*Coluber constrictor flaviventris*) and bullsnakes (*Pituophis catenifer sayi*). We captured snakes at hibernacula and drew blood for DNA analysis. A total of 150 racers and 70 bullsnakes were then genotyped across a panel of 10 microsatellite loci. We examined population structure, relatedness among individuals, and the relationship between geographic and genetic distance.

Conclusions

1) River valleys contain discrete populations of each species
2) Inbreeding is occurring within den sites due to either site fidelity and/or lack of suitable habitat for dispersal to neighboring den sites
3) Populations at the northern limit of the range (Canada) have less genetic diversity than those in the core of the range

Major Impact(s) of Research

1) Eastern yellow-bellied racers are considered threatened in Canada and are the subject of active conservation planning. Our findings suggest two of the river valleys should be considered designatable units.
2) It is possible that racers in the northern extent of their range have locally adapted
3) Bullsnakes are considered "Data Deficient" in Canada. Our data indicate strong population structuring among river valleys and limited dispersal among hibernacula. These data should be considered when the status is reassessed.

Other Project Personnel

None

External Collaborators

Dr. Christopher Somers - University of Regina
Jessica Martino - University of Regina
Dr. Timothy Frasier - Saint Mary's University
Dr. Ray Poulin - Royal Saskatchewan Museum
Laura Gardiner - University of Regina

Products

Martino, J.A., R.G. Poulin, T.R. Frasier, S.L. Lance, L. Gardiner and C.M. Somers. 2013. Subdivision among snake populations at northern range limits: river valleys contain discreet groups**.** *Journal of Nature Conservation* (Submitted).

Population genetic analysis of gopher frogs

Funding Entity
GA DNR to UGA and Florida State Wildlife Grant to Kevin Enge and Anna Farmer
Start Date and Funding Amount
January 2013; $11,820 from GA DNR to SREL. SREL will invoice Florida Fish and Wildlife Commission for up to $31,000 from their State Wildlife Grant. SREL will invoice Eastern Kentucky University for ~ $4,000.
SREL Collaborators
Dr. Stacey L. Lance
Objectives
1) Determine the amount of gene flow and degree of genetic variation among gopher frog populations in different regions in Florida. To do this, 30–35 genetic samples will be collected from at least 1 breeding pond in each of 15 regions across the state.

2) Examine the rates of gene flow and genetic variation among breeding ponds within the same region. To do this, 30–35 genetic samples will be analyzed from 3–5 breeding ponds within 2–3 of the different regions.

3) Assess the population genetics of gopher frogs in Georgia, South Carolina (focusing on the SRS), and Alabama with an emphasis on quantifying the amount of genetic variation in each wetland surveyed and the degree of differentiation among wetlands. Interpret contemporary genetic variation in the context of historical and current landscape configuration, distance to nearest populations, and to variation in populations from other regions, especially panhandle Florida.

Summary of Research Activities
Kevin Enge has collected over 500 samples from Florida and John Jensen and Laura Smith have collected ~300 from Georgia. Additional samples will be collected in Spring 2014 and Stacey Lance will hire Kristin Hinkson from Eastern Kentucky University to complete the genotyping during the summer of 2014.
Conclusions
The project is at its early stages and we have no conclusions.
Major Impact(s) of Research
Until the data are fully acquired and analyzed we will not know the major impacts.
Other Project Personnel
David Scott, Research Professional - SREL
External Collaborators
Dr. Stephen Richter - Eastern Kentucky University
Kristin Hinkson - Eastern Kentucky University
John Jensen - Georgia Department of Natural Resources
Lora Smith - Joseph Jones Ecological Research Center
Kevin Enge - Florida Fish and Wildlife Commission
Anna Farmer - Florida Fish and Wildlife Commission
Products
No publications, presentations, or reports have been prepared yet.

Effects of contaminant exposure on the mating system and reproductive success of American alligators

Funding Entity

SC-DNR

Start Date and Funding Amount (If no funding involved indicate No Funding Provided (NFP))

April 15, 2012; MUSC is purchasing some of the supplies needed and we have acquired funding from SC DNR that will be transferred to UGA (~10K).

SREL Collaborators

Dr. Stacey L. Lance

Objectives

The overall objective in this project is to determine if contaminant loads influence reproductive success in American alligators.

Summary of Research Activities (1-2 PARAGRAPHS MAX)

Lou Guillette and Ben Parrott (Medical University of South Carolina), Thomas Rainwater (USFWS), and Phil Wilkinson (Yawkey Wildlife Refuge) have been collecting samples from adult alligators and nests at Yawkey Wildlife Refuge in conjunction with the SC DNR. To date they have sampled eggs from ~30 clutches. In addition they have sampled females at nests over several nesting seasons in Yawkey. Together, at SREL we are now analyzing the microsatellite genotypes of over 800 individuals across a panel of loci. Initial screens indicated very low genetic diversity and we developed additional loci to increase our power. The goals of the project include identifying maternity, quantifying levels of multiple paternity, and determining whether paternity relates to male phenotype, including contaminant load. The project is expanding to include population genetics of alligator populations along the Atlantic coast.

Conclusions (TOP 1-3)

Data are still being collected, thus there are no conclusions at this time.

Major Impact(s) of Research (TOP 1-3)

1) As long-lived species, alligators have the potential to be exposed to a large variety of contaminants over a long period of time—similar to humans. Sublethal endpoints of contaminant exposure are difficult to measure, but critical for understanding the environmental implications. Our approach will allow us to look at reproductive success in males and females as a function of contaminant loads.

Other Project Personnel (technical staff, graduate students, undergraduates, postdocs, etc.)

Cara Love, PhD Student – UGA/SREL

Jason O'Bryhim, PhD Student – George Mason University

External Collaborators (and Affiliations)

Dr. Lou Guillette, Medical University of South Carolina

Dr. Ben Parrott, Medical University of South Carolina

Dr. Thomas Rainwater, United States Fish and Wildlife Service

Products (Publications, Presentations, Technical Reports)

Lance, S.L. and B. Parrott. Population Genetics of Yawkey Alligators. Alligator Workshop, Medical University of South Carolina, Charleston, SC. January 2013. (Oral Presentation).

Combining genetic and sociological techniques to evaluate the status of shark populations in Costa Rica

Funding Entity

Rufford Small Grants for Nature Conservation, Explorers Club Grant, George Mason University

Start Date and Funding Amount

January 1, 2013; SREL will be invoicing for $4,000 from the Rufford Grant and $2,000 from the GMU grant

SREL Collaborators

Dr. Stacey L. Lance

Objectives

The objective of this project is to determine the quantities and types of shark species being landed at docks and sold in local markets on Costa Rica's Pacific coast and to determine how fishermen's knowledge of sharks and their fishery impacts shark conservation.

Summary of Research Activities

Jason has made 2 collection trips to Costa Rica. We have collected ~200 samples from the central markets of San Jose and Heredia, ~120 samples from fishermen in Playa Tortuga, and ~110 samples from fishermen in Coyote. We have now recruited an undergraduate student from the University of Costa Rica to continue weekly collections from the central markets. We have funding for collection trips in the spring, summer, and fall of 2014. We have also hired a Costa Rican to administer the social surveys to fishermen in Coyote. In addition, we have developed microsatellite markers for silky sharks and scalloped hammerhead sharks to do population studies from samples collected in Costa Rica.

Conclusions

The project is at its early stages and we have no conclusions.

Major Impact(s) of Research

Until the data are fully acquired and analyzed we will not know the major impacts.

Other Project Personnel

Jason O'Bryhim, PhD Student – George Mason University

External Collaborators

Dr. Chris Parsons, George Mason University
Dr. Ingo Whertman, University of Costa Rica
Dr. Randall Arauz, PRETOMA
Taylor Clark, University of Costa Rica

Products

O'Bryhim, J.O., J. Spacet, J.R. Hyde, K.L. Jones, D.H. Adams and S.L. Lance. 2013. Development of microsatellite markers for globally distributed population of the threatened Silky Shark, (*Carcharhinus falciformis*). *Journal of Fish Biology (*Submitted*).*

Bonnethead sharks as an indicator of estuary health in coastal Georgia

Funding Entity
SREL
Start Date and Funding Amount
January 15, 2013; NFP
SREL Collaborators
Dr. Stacey L. Lance and Dr. Gary Mills
Objectives
The objectives of this project are to analyze the contaminant loads of bonnethead sharks caught off the coast of St. Catherine's Island.
Summary of Research Activities
We have collected 48 bonnethead sharks. For all 48 we have taken morphometric data and analyzed mercury content in the liver and dorsal muscle. For a subsample of sharks we have analyzed a suite of metals from the liver and dorsal muscle, analyzed mercury in all organs and fins, are analyzing for organic (PCB) contaminants in the liver, and did a complete dietary analysis of the stomachs. We have also prepared muscle, liver, and vertebral tissue for stable isotope analysis from all of the sharks.
Conclusions
The project is at its early stages and we have no conclusions.
Major Impact(s) of Research
Until the data are fully acquired and analyzed we will not know the major impacts.
Other Project Personnel
Jason O'Bryhim, PhD Student – George Mason University
Kimberly Price, Undergraduate Researcher, Georgia Regents University
Citiyah Burton, Undergraduate Researcher, USC-Aiken
Sierra Mannix, Undergraduate Researcher, Georgia Regents University
Charles Best, Undergraduate Researcher, Georgia Regents University
External Collaborators
Dr. Bruce Saul - Georgia Regents University
Dr. Chris Somers - University of Regina
David Shiffman - University of Miami
Products
No publications, presentations, or reports have been prepared yet.

Extra-pair paternity, breeding synchrony, and nesting density in Blue-footed boobies

Funding Entity
Contract with Universidad Nacional Autónoma de México
Start Date and Funding Amount
August 15, 2011; $16,720
SREL Collaborators
Dr. Stacey L. Lance
Objectives
The main objective of the research is to examine how extra-pair paternity varies with breeding synchrony and nesting density in neighborhoods of blue-footed boobies.
Summary of Research Activities
Collaborators in Mexico sampled tissue and extracted DNA from adult and nestling Blue-footed boobies (BFBs) representing roughly 500 families from an 11,500 m^2 study area on Isla Isabel off the coast of Mexico. BFBs in this study area have been banded and observed since 1989. At SREL all 1693 (444 adult males, 432 adult females, 817 nestlings) DNA samples were genotyped across a panel of 10 microsatellite loci. All parentage analyses were conducted using a likelihood-based approach in CERVUS 2.0. Individuals genotyped at fewer than 6 loci were excluded from analyses. We used 10,000 tests, and assumed 90% of both males and females were sampled from the population. Assignment levels were set to a relaxed value of 80% and a strict value of 95%. We have written up the methods and results of the study and currently our collaborators in Mexico are analyzing the nesting synchrony data and putting together a manuscript.
Conclusions
1) We found evidence suggestive of egg dumping by female BFBs
2) Young and old females were more likely to engage in extra-pair paternity
3) Habitat characteristics strongly influenced male behavior
Major Impact(s) of Research
Our data suggest that young, inexperienced females mate multiply and select sires older than their social partners while older females select extra-pair sires that are younger than their social partners. This is the first study of avian mating systems to examine the full age range of both sexes and addresses a long-standing question concerning female choice. Our system also allowed us to examine the role of habitat structure and nest density on mating behavior because the BFBs nest and feed in different locations and have few predators, thus habitat was not confounded with food availability or predation pressure. We demonstrated, for the first time, that individual variation in mating behavior is associated with habitat structure (density of obstacles) and density of nesting males.
Other Project Personnel
Schyler Nunziata, PhD Student – University of Kentucky
External Collaborators
Dr. Hugh Drummond - Instituto de Ecología, Universidad Nacional Autónoma de México
Alejandra Ramos - Instituto de Ecología, Universidad Nacional Autónoma de México
Products
Ramos, A., S.O. Nunziata, S.L. Lance, C. Rodriguez, B.C. Faircloth. P.A. Gowaty and H. Drummond. 2013. Habitat structure and colony structure constrain extra-pair paternity in a colonial bird. *Animal Behavior* (Accepted).

Assessing vulnerability of priority sandhills fauna to climate and landscape changes

Funding Entity
US Department of Army, ERDC-CERL
Start Date and Funding Amount
March 28, 2011; $246,659
SREL Collaborators
Dr. Tracey Tuberville and Dr. Kimberly Andrews
Objectives
Assess herpetofauna in sandhills ecoregion in terms of their relative vulnerability to climate change
Summary of Research Activities
1) Evaluate the vulnerability of reptiles and amphibians in the Sandhills Ecoregion to climate change.
2) Develop ecological models to identify environmental thresholds to species persistence for at least three species of reptiles and amphibians predicted to be vulnerable to climate change.
3) Conduct SRS-wide sampling of amphibians for chytrid.
4) Assist with laboratory experiments to investigate the effects of temperature on foraging behavior of an obligate diurnal forager (black racer) and facultative diurnal forager (rat snake).

Conclusions
Of the 113 reptiles and amphibians occurring in the Sandhills Ecoregion, more amphibians than reptiles are predicted to be vulnerable to anticipated climate change scenarios. Most of the species deemed vulnerable are associated with isolated ephemeral wetlands, thus wetland hydrology (and the environmental and landscape factors influencing hydrology) will play a major role in species persistence and should be incorporated into ecological models. Information gaps identified during vulnerability analysis and that limit ability to assess vulnerability include how environmental variation influences breeding phenology and genetic variability of species within assessment area.

Major Impact(s) of Research
1) First study to rank a large suite of reptile and amphibian species in terms of predicted climate change vulnerability using the NatureServe Climate Change Vulnerability Assessment Tool.
2) We will develop ecological models to identify environmental thresholds for species in terms of their persistence in the landscape to inform management of natural resources on military installations throughout the Southeastern U.S.

Other Project Personnel
Bess Harris, MS Student – UGA/SREL
Dr. Brian Metts, Research Professional - SREL
Dean Fletcher, Research Professional - SREL

External Collaborators
Dr. Nathan Nibbelink – UGA
Dr. James Westervelt - ERDC-CERL
Dr. Tim Hayden - ERDC-CERL
Dr. Jinelle Sperry - ERDC-CERL

Products
Andrews, K.M., and T.D. Tuberville. Evaluating climate change vulnerability of reptiles and amphibians in the sandhills ecoregion. Southeastern Partners in Amphibian and Reptile Conservation, Sumter National Forest, SC, February 2013 (Oral Presentation).

Tuberville, T.D., and K.M. Andrews. Evaluating climate change vulnerability of reptiles and amphibians in the sandhills ecoregion, USA, using the NatureServe assessment tool. Landscape Ecology Meetings, Austin, TX, April 2013 (Oral Presentation).

Andrews, K.M., N.P. Nibbelink, J.D. Westervelt, and T.D. Tuberville. Identifying landscape metrics for predicting persistence of gopher tortoise (*Gopherus polyphemus*) populations on a military installation using a spatially-explicit individual-based model. Landscape Ecology Meetings, Austin, TX, April 2013 (Oral Presentation).

Survivorship of juvenile gopher tortoises

Funding Entity

Riverbanks Zoo Conservation Fund, Friends of Georgia Department of Natural Resources, St. Catherines Island Research Foundation

Start Date and Funding Amount

June 1, 2013; $334,771

SREL Collaborators

Dr. Tracey Tuberville

Objectives

Characterize the ecology of juvenile gopher tortoises in terms of survivorship, spatial ecology and growth rates and inform management of this critical but poorly understood lifestage.

Summary of Research Activities

We deployed standard radio-transmitters on 20 juvenile gopher tortoises at St. Catherines Island, GA to monitor their movement patterns and burrow use. We also attached miniature temperature dataloggers (i-buttons) to characterize daily and seasonal surface activity of juveniles. We also initiated a pilot study to evaluate the effectiveness of miniaturized GPS dataloggers for studying the spatial ecology of the species rarely observed away from its burrow and that presumably uses their habitat at very small spatial scales. Finally, we analyzed mark-recapture rates to calculate growth rates of individual juvenile tortoises.

Conclusions

Calculating home ranges for juveniles proved to be challenging as they are rarely encountered outside their burrows and they used only 1 or 2 burrows per tortoise, precluding any area-based movement estimates. The GPS dataloggers did not have sufficient spatial resolution given the scale of movements by individuals to provide meaningful space use estimates. However, i-button temperature loggers were useful in characterizing winter behavior of these ectotherms and revealed a surprising level of surface activity during winter months. Growth rates we observed are among the highest reported for any juvenile tortoises, even at more southerly locations where activity season is presumably longer.

Major Impact(s) of Research

1) Ours will be only the second study to investigate the spatial ecology of juvenile gopher tortoises, a candidate species for federal listing.
2) Novel data comparing spatial data collected from GPS dataloggers compared to traditional tracking methods in a species in which traditional tracking locations are centered on very few numbers of burrows.
3) Growth data will provide useful data for evaluating the suitability of ruderal habitats (such as that at our study site), to which gopher tortoises are increasingly being confined to throughout their range.

Other Project Personnel

Bess Harris, MS Student – UGA/SREL

External Collaborators

Dr. Nathan Nibbelink – UGA
Dr. Terry Norton - St. Catherines Island / Georgia Sea Turtle Center
Dr. Nicole Hodges – Mississippi State University
Dr. Jeanne Jones - Mississippi State University

Products

K.E. Nussear, and T.D. Tuberville. 2013. Habitat characteristics of North American tortoises. Editors: D. Rostal, H. Mushinsky, & E. McCoy. Book title: *The Biology and Conservation of North American Tortoises*. Publisher: John Hopkins Press. (In Press)

Tuberville, T.D., T.M. Norton, K.A. Buhlmann, and V. Greco. 2013. Head-starting as a management component for gopher tortoises (*Gopherus polyphemus*). Journal: Herpetological Conservation and Biology (Special Issue on Turtle Head-starting, edited by Dr. Russell Burke). (In Press)

Harris, B.B., T.D. Tuberville, N.P. Nibbelink, and T.M. Norton. Movements and activity of juvenile gopher tortoises (*Gopherus polyphemus*) on St. Catherines Island, Georgia. Gopher Tortoise Council Meetings, Bainbridge, GA. (Oral Presentation).

Sonderman, K.F., T.M. Norton, T.D. Tuberville, R. Lock, and M.J. Yabsley. Haemogregarine parasite of gopher tortoises (*Gopherus polyphemus*): search for a vector. American Society of Parasitologists, Quebec, 2013 (Poster).

Sonderman, K.F., R.M. Lock, J.L. McGuire, T.M. Norton, T.D. Tuberville, L.R. Smith, and M.J. Yabsley. Haemogregarine parasite of gopher tortoises (*Gopherus polyphemus*): search for a vector. Wildlife Disease Association, Knoxville, TN, 2013 (Poster).

Habitat Suitability Models and Use of Head-Start Techniques as Planning and Mitigation Tools for Ensured Persistence of Mojave Desert Tortoises to Offset Solar Energy Projects

Funding Entity

National Park Service
California Energy Commission (via subcontract from University of California, Davis)

Start Date and Funding Amount

October 1, 2013; $7,151

SREL Collaborators

Dr. Tracey Tuberville and Dr. Kurt Buhlmann

Objectives

1) Determine behavior, survivorship, and habitat use of head-started juvenile desert tortoises compared to direct-release hatchings (i.e., juveniles released shortly after hatching).
2) Develop habitat suitability models for juvenile desert tortoises to identify optimal desert tortoise habitat.

Summary of Research Activities

We initiated the desert tortoise head-starting program in 2011 by capturing females to radio-track and to monitor their reproductive status with xradiography. During FY13, gravid females were brought back to the head-starting facility, allowed to nest, and the nests were monitored for hatching. We monitored growth and body condition of head-started and released hatchlings via twice yearly health assessments. In addition, we monitored survivorship and movements of fall- released and spring-released hatchlings at high- and low-elevation siteshatchlings releasedinto the wild using radio-telemetry. In addition to tracking both the released juveniles and the adult females, we are also collecting habitat data at tracking locations to characterize habitat selection in juveniles and how selected microhabitat characteristics vary between adults and juveniles.

Conclusions

Data are still being collected to evaluate the effectiveness of head-starting and different release protocols (time of year, habitat) on juvenile survivorship and movement. However, based on preliminary data analysis, most movement occurred within 30 days of release, and those with the greatest movements during that time were less likely to survive through the winter dormancy period. Animals head-started for 1 year in outdoor pens exhibited greater post-release survivorship than animals released immediately after hatching, but rearing animals for longer than 1 year in the enclosures may significantly reduce native forage inside pens. Although longer retention in pens may provide extended protection from predators it is unlikely to result in significant benefits in terms of growth. Although adult female survivorship was higher in high elevation than low elevation habitats, we did not observe the same pattern in released juveniles.

Major Impact(s) of Research

1) Important life history data for a poorly understood life stage of a federally listed species
2) Improve management for species by factoring juvenile requirements into management and policy decisions, such as identifying habitats likely to serve as important areas of juvenile recruitment. These data will be helpful when selecting potential solar development sites by identifying areas to avoid.

Other Project Personnel

None

External Collaborators

Dr. Brian Todd - University of California - Davis
Melia Nafus - University of California - Davis
Mark Peaden – University of California - Davis

Products

Nafus, M.G., T.D. Tuberville, K.A. Buhlmann, and B.D. Todd. 2013. Relative abundance and demographic structure of Agassiz's desert tortoise (*Gopherus agassizii*) along roads of varying size and traffic volume. *Journal Biological Conservation* 162:100-106.

Buhlmann, K.A., T.D. Tuberville, M.G. Nafus, M. Peaden, and B.D. Todd. Desert tortoise head-starting project in Mojave National Preserve: an update. Desert Tortoise Council Meetings, Las Vegas, NV, February 2013. (Oral Presentation).

Nafus, M.G., T.D. Tuberville, K.A. Buhlmann, and B.D. Todd. Differential habitat use by female desert tortoises (*Gopherus agassizii*) in relation to forage availability. Desert Tortoise Council Meetings, Las Vegas, NV, February 2013. (Oral Presentation).

Nafus, M.G., B.D. Todd, T.D. Tuberville, and K.A. Buhlmann. Differential habitat use by desert tortoises (*Gopherus agassizii*) in relation to forage availability. Joint Meetings of Ichthyologists and Herpetologists, Albuquerque, NM, July 2013. (Oral Presentation).

Effects of road fencing on desert tortoises

Funding Entity
Bureau of Land Management (via subcontract from University of California, Davis)
Start Date and Funding Amount
September 16, 2011; $40,686
SREL Collaborators
Dr. Tracey Tuberville and Dr. Kurt Buhlmann
Objectives
Investigate the effects of road fencing installed as a mitigation tool on desert tortoises.
Summary of Research Activities
We initiated field work to investigate the "road zone effect" on desert tortoises by conducting transect surveys for desert tortoises sign at varying distances from roads of different size and traffic volume. Radio-tracking of desert tortoises along roads will be initiated in the upcoming field season.
Conclusions
1) This research has just begun, thus there are no conclusions at this time.
Major Impact(s) of Research
1) Data on long-term demographic effects of roads on desert tortoise populations adjacent to roads and how effects vary as function of road size and traffic volume.
2) Comparison of pre- and post-fencing spatial ecology of desert tortoises living adjacent to roads and whose home ranges bisected by road to determine the potential positive and negative effects of fencing on desert tortoises.
Other Project Personnel
None
External Collaborators
Dr. Brian Todd - University of California - Davis
Mark Peaden - University of California - Davis
Products
No publications, presentations, or reports have been prepared yet.

Status of and threats to gopher tortoise populations on military installations in the southeastern U.S.

Funding Entity
US Department of Navy
Start Date and Funding Amount
August 16, 2013; $34,947
SREL Collaborators
Dr. Tracey Tuberville, Larry Bryan and Dr. Brian Metts
Objectives
1) Estimate population sizes of gopher tortoises on specific Department of Navy lands as part of their long-term monitoring efforts.
2) When available, compare historical data to contemporary date to document population trends.
3) When requested by Navy, provide in-depth evaluation of threats to existing populations on Navy lands and provide management recommendations based on those threats.

Summary of Research Activities
We completed a survey of Jacksonville Naval Air Station and associated properties, documented more than 717 burrows occupied by at least 209 tortoises. In addition, we initiated in in-depth analysis of threats to the species on Whiting Naval Air Station and Holley Outlying Air Field, where we had previously conducted population surveys. Effort at Whiting and Holley during FY13 and FY14 will be to use wildlife cameras to monitor social interactions and potential predators.
Conclusions
Research is still ongoing so there are no conclusions to report at this time.
Major Impact(s) of Research
This work will contribute to the commitment by the Department of Navy, who is a signatory on the gopher tortoise Memorandum of Understanding, to provide population assessment data for populations occurring on their lands.
Other Project Personnel
Jared Green, Research Technician - SREL
Nicole White, Research Technician - SREL
External Collaborators
Robby Smith – Department of Navy
Ron Cherry – Department of Navy
Products
Tuberville, T.D., B.S. Metts, J. Green, and A. Bryan. A survey for gopher tortoises and burrow commensals on Jacksonville Naval Air Station and associated properties. Final Report, July 2013. 59 pp.

Head-starting as a population recovery tool for Blanding's turtles

Funding Entity
USFWS, Disney Worldwide Conservation Fund
Start Date and Funding Amount
September 1, 2013; $24,950
SREL Collaborators
Dr. Kurt Buhlmann, Dr. Tracey Tuberville and Larry Bryan
Objectives
1) Evaluate the effectiveness of head-starting as a means of establishing viable populations of Blanding's turtles
2) Compare survivorship of head-started vs. directly-released hatchling Blanding's turtles
3) Compare growth rates of head-started vs. directly-released hatchling Blanding's turtles

Summary of Research Activities
We conducted radio-telemetry on a subset of both directly-released and head-started hatchlings and monitored movement and survivorship. In addition, we also conducted intensive trapping to estimate survival of non-telemetered animals released in previous years and to document their distribution throughout the study site wetland. Finally, we also protected nests to obtain hatchlings for an additional cohort to continue the study.

Conclusions
Survivorship of head-started hatchlings is significantly higher than those directly-released into the wetland shortly following hatching. In addition, survivorship has been significantly higher than values reported in the literature for wild populations, suggesting that fewer head-starts may be needed than originally anticipated based our preliminary population viability analyses.

Major Impact(s) of Research
This work is among the first to experimentally evaluate the effects of head-starting freshwater turtles on post-release survival and growth. We hope that this research will provide information useful for determining whether head-starting is an appropriate management technique for other species of freshwater turtles.

Other Project Personnel
Jared Green, MS Student – UGA/SREL

External Collaborators
Dr. Stephanie Koch – USFWS
Brian Bastarache - Bristol County Agricultural High School
Brian Butler – Oxbow Associates

Products
Buhlmann, K.A., S. Koch, B. Butler, T.D. Tuberville, V. Palmero, and B. Bastarache. 2013. Reintroduction and head-starting: Tools for Blanding's turtle (*Emydoidea blandingii)* conservation. Herpetological Conservation and Biology (Special Issue on Turtle Head-starting to be edited by Dr. Russell Burke) (In Press).

The effect of lead (Pb) on the incidence of antibiotic resistance in E. coli isolated from the intestines of chicks

Funding Entity
SREL
Start Date and Funding Amount
March 1, 2012; NFP
SREL Collaborators
Dr. J Vaun McArthur
Objectives
The overall goal of this research is to demonstrate whether Pb found in drinking water or commercially prepared chicken feeds affects the incidence of antibiotic resistance in bacteria obtained from cloacal swabs or the intestines of chickens.
Summary of Research Activities
Chickens are a potentially important zoonotic species because of close interactions with humans through handling during meat and egg production, and through food processing and consumption. For instance, a recent evaluation of zoonotic transfer of *Salmonella enteritidis* from chicken layers to handlers showed that flocks with >60% infection were a high risk for handlers to contract infection. The possibility has not been investigated that these bacteria may show elevated antibiotic resistance if isolated from chickens that were exposed to Pb. Should this occur, efficacy of antimicrobial therapies may be reduced and disease threat to humans exacerbated. The present study was conducted to determine if Pb exposure in chickens may enhance microbial antibiotic resistance in normal intestinal microbial flora of the chicken.
A reanalysis of the data collected using commercially prepared antibiotic resistance plate found striking differences among treatments. Bacteria collected from the higher Pb concentration treatments had significantly elevated antibiotic resistance patterns than controls that were not exposed to Pb. In addition bacteria collected from the higher Pb treatments were resistant to significantly more antibiotics and at higher concentrations.
Conclusions
1) Resistance profiles obtained from the initial study were suggestive but not conclusive.
2) We are waiting for the results from the commercially prepared plates.

Major Impact(s) of Research
1) Pb greatly affects the overall condition of the chickens
2) Pb in the water does select for resistance in enterobacteria with clearly apparent patterns with Pb concentration.
3) Chickens raised in environments where Pb exposure can occur will produce antibiotic resistant bacteria that will enter the litter which will become a reservoir of resistant bacteria and traits.

Other Project Personnel
Paul Stankus, Research Professional - SREL
Mandana Nisanian, Graduate Student - UGA Vet Medicine
External Collaborators
Dr. Robert Gogal – UGA
Dr. Stephen Holladay - UGA
Dr. Cary Tuckfield - Ecostatys, LLC
Products
Nisanian, M., S. D. Holladay, E. Karpuzoglu, R. P. Kerr, S. M. Williams, L. Stabler, J. V. McArthur, R. C. Tuckfield, and R. M. Gogal Jr. 2013. Exposure of juvenile Leghorn chickens to lead acetate enhances antibiotic resistance in enteric bacterial flora. *Poultry Science* (In Press).

Mercury bioaccumulation in fish in in-land and coastal waters in South Carolina

Funding Entity
Nuclear Workforce Initiative-Community Reuse Organization/ USC-Aiken; NOAA MARMAP
Start Date and Funding Amount
September 1, 2012; $10,000
SREL Collaborators
Dr. Gary Mills and Angela Lindell
Objectives
The goal of this study is to quantify the Hg concentration in edible muscle tissue from fish in South Carolina waters.
Summary of Research Activities
Muscle from grouper and snapper species was collected during the Marine Resources Monitoring, Assessment, and Prediction (MARMAP) Program's research cruise season from May-October 2013; Muscle from gray triggerfish was obtained from fishery-dependent samples from June 2012-September 2013. Axial muscle tissue was removed from above the lateral line, near the insertion point of the first dorsal fin and then samples were frozen until Hg analysis. Hg concentrations were determined using a Direct Mercury Analyzer (DMA-80). Fish tissues included 6 speckled hind, 12 red grouper, 22 scamp, 23 gag grouper, 17 red snapper, and 41 gray triggerfish; currently we have age determinations for all of the gray triggerfish. The remaining age determination are on-going. Preliminary results indicate a non-linear increase in Hg concentrations with fish size.
Conclusions
Hg concentrations in edible fish tissue from coastal South Carolina are similar to those reported for the same species in coastal waters of North Carolina, Louisiana, and the Florida Gulf.
Hg concentrations increases non-linearly with fish size and age (Triggerfish only).
Major Impact(s) of Research
1) Fish are an integral part of diets in the Southeast. Eating fish provides an array of nutritional benefits; however, concerns of Hg exposure from the consumption of fish continues to be controversial with regard to risks versus benefits. This research contributes to a better understanding of the potential risk.
2) Care must be taken when issuing region- and nation-wide advisories for fish species or groups in which Hg data are only documented from one area for a wide-ranging species or from a small sample of individuals within a species. This research contributes to the data need to provide more specific and better informed consumption advisories.

Other Project Personnel
B. Bossle, Undergraduate - USC-Aiken
B. Corley, Undergraduate - USC-Aiken
B. White, Undergraduate - USC-Aiken
External Collaborators
Dr. Virginia Shervette - USC-Aiken
B. White – SC Department of Natural Resources
Dr. J. Dean – Baruch Institute, University of South Carolina
Products
Corley, B., V. Shervette, B. White, J. Dean, A. Lindell and G. Mills. Mercury bioaccumulation of reef fishes form the South Atlantic Bight. Southern Division of America Fisheries Society Annual Meeting, Charleston, SC. January 2014. (Oral Presentation).
Bossle, B., V. Shervette, J. Dean, A. Lindell, and G. Mills. Mercury bioaccumulation in bluegill and largemouth bass from a hunting and fishing site in South Carolina. National Meeting of the American Fisheries Societies, Little Rock Arkansas. September 2013 (Poster).

External (non-SRS) Funding Received in FY13

The Ecological Study of Birds in the Vicinity of Augusta Regional Airport at Bush Field
Funding Entity
City of Augusta, GA
Start Date and Funding Amount
October 1, 2012; $100,695
SREL Investigators and Roles
R. Kennamer, and Dr. I. L. Brisbin, Jr. (PIs)
Co-Investigators and Affiliations
D. A. Saxon, Jr., Augusta, GA Utilities Department

Assessing vulnerability of priority sandhills fauna to climate and landscape changes
Funding Entity
US Army Corps of Engineers – ERDC CERL
Start Date and Funding Amount
March 2011; $246,659
SREL Investigators and Roles
Dr. Tracey Tuberville (PI), Dr. Kimberly Andrews (co-PI), Bess Harris (graduate student)
Co-Investigators and Affiliations
Dr. James Westervelt & Dr. Jinelle Sperry, ERDC-CERL

Establishing viable Blanding's turtle populations
Funding Entity
Disney Worldwide Conservation Fund
Start Date and Funding Amount
September 2013; $24,950
SREL Investigators and Roles
Dr. Tracey Tuberville (PI), Dr. Kurt Buhlmann (co-PI), Jared Green (graduate student)
Co-Investigators and Affiliations
Dr. Stephanie Koch, USFWS

Blanding's turtle research at Eastern Massachusetts NWR complex
Funding Entity
USFWS
Start Date and Funding Amount
September 2013; $18,559
SREL Investigators and Roles
Dr. Kurt Buhlmann (PI), Dr. Tracey Tuberville (co-PI), Jared Green (graduate student)
Co-Investigators and Affiliations
Dr. Stephanie Koch, USFWS

Desert tortoise juvenile survivorship at Mojave National Preserve
Funding Entity
National Park Service
Start Date and Funding Amount
June 2013; $334,771
SREL Investigators and Roles
Dr. Tracey Tuberville (PI), Dr. Kurt Buhlmann (co-PI)
Co-Investigators and Affiliations
Dr. Brian Todd, Melia Nafus, Mark Peaden – University of California-Davis

Effect of Carcass Size and Habitat on Vertebrate Scavenging Dynamics
Funding Entity
Joseph Jones Ecological Research Center, SREL
Start Date and Funding Amount
May 2013; $21,665; SREL
SREL Investigators and Roles
Dr. James C. Beasley (PI)
Co-Investigators and Affiliations
Dr. Mike Conner – Joseph Jones Ecological Research Center

Efficacy of Rhodamine B as a biomarker for bait uptake in feral swine
Funding Entity
USDA – Wildlife Services – National Wildlife Research Center
Start Date and Funding Amount
July, 2013; $11,660.00
SREL Investigators and Roles
Dr. James C. Beasley (PI) and Dr. Olin E. Rhodes, Jr. (co-PI)
Co-Investigators and Affiliations
Dr. Frederick Cunningham, USDA – Wildlife Services – National Wildlife Research Center

Habitat Suitability Models and Use of Head-Start Techniques as Planning and Mitigation Tools for Ensured Persistence of Mojave Desert Tortoises to Offset Solar Energy Projects.

Funding Entity
California Energy Commission
Start Date and Funding Amount
November 2010; $89,008
SREL Investigators and Roles
Dr. Tracey Tuberville (PI), Dr. Kurt Buhlmann (co-PI)
Co-Investigators and Affiliations
Dr. Brian Todd, Melia Nafus, Mark Peaden – University of California-Davis

Effects of road fencing on desert tortoises

Funding Entity
Bureau of Land Management
Start Date and Funding Amount
September 2011; $40,686
SREL Investigators and Roles
Dr. Tracey Tuberville (PI), Dr. Kurt Buhlmann (co-PI)
Co-Investigators and Affiliations
Dr. Brian Todd, Mark Peaden – University of California-Davis

Chicken Turtle Reintroduction Assessment in Virginia.

Funding Entity
Virginia Department of Game and Inland Fisheries
Start Date and Funding Amount
November 2012; $20,000
SREL Investigators and Roles
Dr. K. Buhlmann (PI)
Co-Investigators and Affiliations
J.D. Kleopfer, VADGF
E. Molleen, VA State Parks
S. Roble, VA Natural Heritage Program
C. Hobson, VA Natural Heritage Program
W. Dillman, SC DNR

Head-starting, Reintroduction, and Habitat Use of Wood Turtles (Glyptemys insculpta) on the Great Swamp National Wildlife Refuge, New Jersey

Funding Entity
Friends of the Great Swamp National Wildlife Refuge, Pleasantville, NJ
Start Date and Funding Amount
April 2013; $12,000
SREL Investigators and Roles
Dr. K. Buhlmann (PI)
Co-Investigators and Affiliations
C. Osborn (Collaborator), USFWS
A. Frediani (Technician), USFWS

Blandings Turtle Research at Eastern Massachusetts National Wildlife Refuge Complex, Massachusetts

Funding Entity
USFWS, Assabet River National Wildlife Refuge, Sudbury, Mass.
Start Date and Funding Amount
September 2013; $18,559
SREL Investigators and Roles
Dr. K. Buhlmann (PI)
Dr. T. Tuberville (Co-P.I.)
Co-Investigators and Affiliations
S. Koch, USFWS
J. Green, UGA

Analysis of wood stork satellite telemetry location data relative to regulatory guidelines: The core foraging area concept.

Funding Entity
US Fish & Wildlife Service / University of Florida
Start Date and Funding Amount
June 2012; $30,000
SREL Investigators and Roles
L. Bryan (coPI)
Co-Investigators and Affiliations
Dr. R. Borkhataria, University of Florida

Foraging Ecology of Coastal-breeding Wood Storks in the Northern Portion of Their Range
Funding Entity
US Fish & Wildlife Service
Start Date and Funding Amount
September 2012; $78,910
SREL Investigators and Roles
Larry Bryan (PI)
Co-Investigators and Affiliations
Dr. R. Borkhataria, University of Florida

Occurrence of Avian Malaria in Wading Bird Species of the South Atlantic Region: Prevalence and Assessment of Potential Links to Mercury Uptake
Funding Entity
US Fish & Wildlife Service
Start Date and Funding Amount
March 2012; $27,400
SREL Investigators and Roles
Larry Bryan (PI), Dr. Stacey Lance (Co-PI) and Dr. Gary Mills (Co-PI)
Co-Investigators and Affiliations
None

Efficacy of the LRAD weapon system as an avian dispersal tool on airports
Funding Entity
USDA Wildlife Services/FAA
Start Date and Funding Amount
May 2013; $340,000
SREL Investigators and Roles
Dr. O.E. Rhodes (PI), Dr. J. Beasley (Co-PI), A.L. Bryan (Co-PI)
Co-Investigators and Affiliations
Drs. Travis DeVault and Bradley Blackwell, USDA Wildlife Services

Experimental Evaluation of Trophic Transfer of Toxicants Used for Insular Rodents
Funding Entity
USDA
Start Date and Funding Amount
September 2013; $29,990
SREL Investigators and Roles
Dr. O. Rhodes (PI), Dr. J. Beasley (co-PI)
Co-Investigators and Affiliations
Drs. Will Pitt and Travis DeVault, USDA Wildlife Services
Erin Abernathy, UGA

Chernobyl Wolves
Funding Entity
National Geographic Society
Start Date and Funding Amount
August 2013; $8,200
SREL Investigators and Roles
S. Webster (PI), Dr. J. Beasley (Co-PI), Dr. S. Lance (Co-PI)
Co-Investigators and Affiliations
Dr. Tom Hinton, IRSN
Dr. Brant Ulsh, M.H. Chew Corp.

Population genetics of Gopher Frogs in Georgia and South Carolina
Funding Entity
Georgia Department of Natural Resources
Start Date and Funding Amount
July 2013; $11,151
SREL Investigators and Roles
Dr. S. Lance (Co-PI)
Co-Investigators and Affiliations
Dr. S. Richter, Eastern Kentucky University

Sub-lethal effects of chronic exposure to radiation in gray wolves (*Canis lupus*) at Chernobyl
Funding Entity
National Geographic Society
Start Date and Funding Amount
July 2013; $22,000
SREL Investigators and Roles
Dr. J. Beasley (PI), Dr. S. Lance (Co-PI)
Co-Investigators and Affiliations
Dr. Tom Hinton, IRSN
Dr. Brant Ulsh, M.H. Chew Corp.
Dr. Susan Bailey, Colorado State University

Technical Expertise Requests in FY13

SREL Investigator
R. Kennamer
Date of Request
October 2012
Requesting Entity
Augusta Regional Airport at Bush Field
Nature of Request
Wildlife hazard consultant for Augusta Regional Airport at Bush Field, under contract with City of Augusta, GA

SREL Investigator
Larry Bryan
Date of Request
January 2013
Requesting Entity
U.S. Fish and Wildlife Service
Nature of Request
Federal Register review. Peer review the following proposed rule: Docket No. FWS-R4-ES-2012-0020 – Endangered and threatened wildlife and plants: Reclassification of Continental U.S. breeding population of Wood Stork from Endangered to Threatened. Federal Register Vol. 77/No. 247:75947-75966.

SREL Investigator
Dr. Stacey L. Lance
Date of Request
October 2012
Requesting Entity
Faculty member, California State University, Fullerton
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
October 2012
Requesting Entity
Faculty member, St. Olaf College
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
October 2012
Requesting Entity
Faculty member, Universidad Nacional Autónoma México
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
October 2012
Requesting Entity
Faculty member, Universidad de Valle
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
October 2012
Requesting Entity
Faculty member, University of Wisconsin, Lacrosse
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
November 2012
Requesting Entity
Faculty member, Colorado College
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
November 2012
Requesting Entity
Faculty member, University of New Mexico
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
November 2012
Requesting Entity
Faculty member, Pacific Biological Station
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
November 2012
Requesting Entity
Faculty member, Florida International University
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
December 2012
Requesting Entity
Faculty member, University of Athens, Greece
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
January 2013
Requesting Entity
Faculty member, Universidad Austral de Chile
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
February 2013
Requesting Entity
Faculty member, University of Azores, Portugal
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
March 2013
Requesting Entity
Faculty member, St. Lawrence University
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
April 2013
Requesting Entity
Faculty member, Harvard University
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
April 2013
Requesting Entity
Faculty member, University of Massachusetts, Boston
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
April 2013
Requesting Entity
Faculty member, San Diego State University
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
April 2013
Requesting Entity
Faculty member, University of British Columbia, Canada
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
May 2013
Requesting Entity
Faculty member, Tulane University
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
May 2013
Requesting Entity
Faculty member, University of Iowa
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
May 2013
Requesting Entity
Faculty member, Texas Tech University
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
June 2013
Requesting Entity
Faculty member, Kuwait Institute for Scientific Research
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
August 2013
Requesting Entity
Scientist, United States Fish and Wildlife Service
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
August 2013
Requesting Entity
Faculty member, University of Georgia
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
August 2013
Requesting Entity
Scientist, The Peregrine Fund
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
August, 2013
Requesting Entity
Scientist, Bionics Corporation, Korea
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
August 2013
Requesting Entity
Faculty member, Universidad Nacional Autónoma México
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. Stacey L. Lance
Date of Request
September 2013
Requesting Entity
Faculty member, Desert Botanical Garden
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Dr. H. Chang
Date of Request
August 2013
Requesting Entity
Dr. Peter H. Santschi's group at the Department of Marine Sciences, Texas A&M University
Nature of Request
Develop a conceptual model for plutonium behavior in soil.

SREL Investigator
Dr. Tracey Tuberville
Date of Request
FY2013
Requesting Entity
IUCN / World Bank
Nature of Request
Provide expertise on Kihansi Spray Toad Reintroduction Project, Tanzania

SREL Investigator
Dr. Tracey Tuberville
Date of Request
FY2013
Requesting Entity
SCDNR
Nature of Request
Serve as species expert on gopher tortoise population biology and reintroduction

SREL Investigator
Dr. Tracey Tuberville
Date of Request
FY2013
Requesting Entity
USFWS
Nature of Request
Serve as expert on Blandings turtle reintroduction project

SREL Investigator
Dr. Tracey Tuberville
Date of Request
FY2013
Requesting Entity
Southeastern Partners in Amphibian and Reptile Conservation
Nature of Request
Serve as co-leader of Reintroduction Working Group

SREL Investigator
Dr. Tracey Tuberville
Date of Request
May 2013
Requesting Entity
Gopher Tortoise Council, USFWS, Florida Fish & Wildlife Conservation Commission
Nature of Request
Assist with development of minimum viable population criteria for gopher tortoises

SREL Investigator
Dr. Tracey Tuberville
Date of Request
May 2013
Requesting Entity
Gopher Tortoise Council, USFWS, Florida Fish & Wildlife Conservation Commission
Nature of Request
Assist with development of minimum viable population criteria for gopher tortoises

SREL Investigator
Dr. Tracey Tuberville
Date of Request
May 2013
Requesting Entity
USFWS Desert Tortoise Recovery Office
Nature of Request
Participate in desert tortoise head-starting working group

SREL Investigator
Dr. K. Buhlmann
Date of Request
October 2012
Requesting Entity
Virginia Department of Game and Inland Fisheries, Williamsburg, VA
Nature of Request
Facilitate a discussion among state agencies responsible for various aspects of a reintroduction of a extirpated turtles species back to Virginia.

SREL Investigator
Dr. K. Buhlmann
Date of Request
January 2013
Requesting Entity
U.S. Forest Service-SR
Nature of Request
Assist USFS-SR with prescribed burning of the Dry Bay Set-Aside on SRS

SREL Investigator
Dr. K. Buhlmann
Date of Request
March 2013
Requesting Entity
IUCN Amphibian Specialist Group/World Bank
Bronx Zoo
Toledo Zoo
Global Wildlife Conservation
University of Dar es Salaam
Nature of Request
Designed and assisted with reintroduction of Kihansi Spray Toads in Tanzania.

SREL Investigator
Dr. K. Buhlmann
Date of Request
March 2013
Requesting Entity
U.S. Department of Defense, U.S. Navy
Nature of Request
Evaluate and comment on the potential for certain federally-listed species to occur on select DOD Navy installations, including Bases in Virginia and Florida.

SREL Investigator
Dr. K. Buhlmann
Date of Request
FY13; ongoing
Requesting Entity
South Carolina Department of Natural Resources
Nature of Request
Serve as biological expert on gopher tortoise population biology and reintroduction techniques.

SREL Investigator
Dr. K. Buhlmann
Date of Request
FY13; ongoing
Requesting Entity
National Park Service, Gulf Coast Monitoring Network
Nature of Request
Help design and conduct population monitoring of Texas tortoises at Palo Alto National Battlefield in order to inform management of the park.

SREL Investigator
Dr. K. Buhlmann
Date of Request
FY13; ongoing
Requesting Entity
US Fish and Wildlife Service
Nature of Request
Serve as biological expert on population viability and reintroduction of Blanding's turtles for Great Meadows Wildlife Refuge Complex, MA.

SREL Investigator
Dr. K. Buhlmann
Date of Request
May 2013
Requesting Entity
U.S. Fish and Wildlife Service, Desert Tortoise Recovery Office, Barstow, California
Nature of Request
Participate in meeting requested by USFWS of research parties involved in headstarting of desert tortoises to help USFWS understand progress and evaluate permit revisions

SREL Investigator
Dr. K. Buhlmann
Date of Request
FY13, multiple
Requesting Entity
U.S. Fish and Wildlife Service, Wildlife Inspectors, Dallas-Fort Worth, San Francisco, Los Angeles Freshwater Fish Commission
Nature of Request
Assistance with identification of seized, illegally imported reptile and amphibian species, primarily from Asian countries.

SREL Investigator
Dr. K. Buhlmann
Date of Request
May 2013
Requesting Entity
Turtle Conservation Fund
Nature of Request
Review, evaluate, and rank 34 proposals for potential funding support by this non-profit conservation group.

SREL Investigator
Dr. K. Buhlmann
Date of Request
February 2013, continuing
Requesting Entity
Southeast Partners in Amphibian and Reptile Conservation
Nature of Request
Continue to co-chair Reintroduction Task Force and conduct workshop/discussion at annual SEPARC meetings (with Dr. Tracey Tuberville).

SREL Investigator
Dr. K. Buhlmann
Date of Request
April 2013
Requesting Entity
Jeykll Island Authority and Georgia Sea Turtle Center
Nature of Request
Asked to assist with design of a diamondback terrapin conservation program to reduce road mortalities on the Jeykll Island Causeway and to help implement a program to provide nesting habitat for terrapins that deters terrapin road mortality.

SREL Investigator
Dr. K. Buhlmann
Date of Request
January 2013
Requesting Entity
U.S. Department of Defense, U.S. Navy
Nature of Request
Convene natural resource management parties (USFWS, Florida Wildlife Commission, Natural Resource Mgmt, Navy's Whiting Field) to assess habitat management options and strategies for maintaining rare amphibian species on certain military lands and help meet the goals of the military mission as well as the INRMP (Integrated Natural Resource Management Plan).

TASK 9. SREL scientists will work closely with SRS personnel to assist DOE and other SRS contractors in making wise and informed decisions concerning land and facilities management. SREL will continue to publish its scientific findings in peer-reviewed scientific journals to aid the public and to assist DOE in making policy decisions by providing a basis of independent, verifiable science

Please see SECTION VIII of this report for a list of SREL publications in FY13. Below we provide examples of specific activities that SREL personnel have conducted in FY13 to assist DOE and other SRS site tenants with ongoing missions and to leverage federal funding provided to SREL to attract non-federal funding to conduct research activities on the SRS.

Department of Energy – SR

- SREL Director provided a presentation to the SRS Citizens Advisory Board on the radioecology strategic initiative at SRS
- SREL personnel participated in site visits with DOE and SRNL personnel to evaluate potential biofuel production technologies
- SREL leveraged DOE funding against UGA funding to conduct research on the development of pilot projects in proteomics/metabolomics at the SREL low dose facility to examine consequences of low dose exposures to aquatic species on the SRS
- SREL leveraged DOE funding and SRS site assets to obtain > 1 million dollars in new external funding during the FY13 fiscal year
- SREL personnel hosted multiple DOE personnel to tour SREL's analytical capabilities that might be used in support of SRS missions
- SREL personnel provided input to DOE on potential strategies for education and outreach concerning radiation risks to local communities in GA

Department of Energy – NNSA

- SREL personnel met with Roxanne Jump of NNSA Tritium to discuss ongoing and future research in support of tritium production on the SRS
- SREL personnel leveraged funding from NNSA to conduct research on biogeochemical cycling and efficiency of metal treatment of the HO2 wetland associated with the regulatory requirements of tritium production on the SRS
- SREL personnel leveraged funding from NNSA to conduct ecotoxicological research on amphibians utilizing the HO2 metal treatment wetlands to elucidate the biological effects of copper and other metals associated with tritium production on the SRS
- SREL personnel met with Scott Cannon and Sam Wisdom of NNSA to discuss SREL activities and research in support of MOX
- SREL personnel leveraged funding from the NNSA to conduct research focused on the impacts of MOX construction on the viability of upper three runs creek
- SREL outreach personnel conducted extensive community outreach and education programs for NNSA and SRS

Savannah River Remediation

- SREL personnel participated in a tour of the SRS liquid waste programs by Terry Spears to identify analytical capabilities that might be used in support of SRS missions
- SREL provided baseline reference data for evaluation of biological impacts of potential contaminants associated with the Salt Waste Processing Facility
- SREL personnel established a new contract with SRR to perform work scope related to derivation of Kd values for cementitious materials

Savannah River Nuclear Solutions

- SREL personnel leveraged funding from ACP to conduct radioecology research programs on radionuclides in long-lived reptiles, radionuclides in game species, and tritium mitigation activities at the Mixed Waste Facilities on SRS
- SREL personnel met with ACP senior management team to discuss environmental concerns related to cesium remediation in lower three runs creek and remediation of D Area wetlands

Savannah River National Laboratory

- SREL personnel held a workshop on the potential for development of Green Remediation research on the SRS with SRNL, SREL, and UGA participants
- SREL personnel participated in SRNL-hosted visits by the Japanese Ministry of the Environment, The Japanese National Institute of Environmental Sciences, Japan NKK, the Japanese Atomic Energy Agency, and local governmental officials from the Fukushima Prefecture of Japan
- SREL personnel gave tours of the SREL Low Dose Facility to multiple visitors to the SRS to support the development of joint research missions with SRNL for work in Japan
- SREL led the development of a multidisciplinary proposal for remediation work in Japan involving a researchers from SREL, UGA, USFS-SR, and SRNL

US Forest Service

- SREL personnel met with Dr. John Blake of the USFS and researchers from UGA to discuss potential collaborations on biofuel production on the SRS

TASK 10. SREL will provide stipend support to college undergraduates, graduate students, and visiting faculty to conduct research on the Savannah River Site in association with ongoing environmental research studies. The objective of the program will be to provide participants, including minority students and Historically Black Colleges and Universities, with an opportunity to pursue ecological research and training under the direction and supervision of SREL scientific staff members

The objectives of the SREL Education Program are to (1) recruit and develop additional professionals to the environmental sciences and (2) enhance environmental awareness and research opportunities among undergraduate and graduate students with emphasis on conducting ecological research important to the DOE and Savannah River Site mission. We have made special efforts in the recruitment from under-represented minority groups and our faculty members have worked with both students and faculty from Historically Black Colleges and Universities (HBCU) throughout the Southeast.

SREL has a long history of graduate and undergraduate education, training over 400 graduate and over 600 undergraduate researchers since 1967. Undergraduate students from more than 275 different colleges and universities have coauthored more than 170 peer reviewed research publications and more than 200 of these students have gone on to pursue careers in science. SREL offers students state-of-the-science laboratory facilities, a wide variety of natural and impacted habitats for field research, a diversity of faculty expertise, and more than sixty years of experience in ecological research. Since 1967, an average of six students per year have completed graduate studies at SREL, resulting in a total of more than 335 dissertations and theses. Since 1985, our graduate students have won over 200 awards from regional, national, and international competitions at numerous professional societies and foundations. In recent years, SREL has undergone significant changes in administrative infrastructure and transitioned to self-supporting funding model. Throughout this transition period, SREL has maintained its commitment to student research and education as an integral component of its mission. In fact, many of the current graduate students initiated their program of study in the past fiscal year.

In FY13, SREL faculty and staff mentored and supervised 18 undergraduate students (Table 1) from several universities. These students were supported from several funding sources including DOE supported projects and other extramural grants and projects. In addition, SREL faculty provided research support for >40 graduate students (Table 2) from universities across the country in 2013. In many cases, this included formal involvement by serving as major advisors/co-major advisors and committee members for M.S. and Ph.D. candidates and in a few cases students received stipend support. However, support for students also included various activities in less formal relationships such as assistance at and access to field sites, use of field equipment, temporary lab space, as well as analytical and GIS resources for their studies.

During the FY13 fiscal year, an emphasis has been placed on finding creative ways to cost share graduate students by leveraging UGA funding with federal funding acquired through SREL's cooperative agreement with the Department of Energy. In addition, new emphases have been placed on enhancing participation of SREL Research Faculty in both graduate and undergraduate instruction. To these ends, SREL accomplished the following in FY13.

- SREL leveraged SRS site assets to acquire external resources to conduct UGA Maymester courses in wildlife ecology and genetics beginning in May 2013

- SREL leveraged UGA funding against project specific funding from DOE and other sources to cost share 15 new graduate students – selected from over 100 applications received by SREL Research Faculty - all of whom have projects which will contribute to the knowledge base and needs of the SRS

- SREL leveraged DOE dollars to obtain 4 months of salary support for each of 2 research faculty to provide instructional support to UGA departments as a means to maintain critical environmental expertise on the SRS

- SREL provided funding to establish 5 undergraduate internships in radioecology as part of collaborative education and research efforts in radioecology with faculty at USC-Aiken and the University of Georgia Warnell School of Forest and Natural Resources

- SREL personnel submitted a National Science Foundation Proposal to develop a *Research Experience For Undergraduates* internship program for undergraduates in radioecology

- SREL taught 2 of its 4 new Maymester courses in radioecology in FY13, and thus has established one of the only active radioecology training programs in the US. Details on this effort are below:

Funded by the Nuclear Regulatory Commission, the GA/SC Regional Environmental Radiation Protection Curriculum (ERP) established a university partnership between UGA, USC and USC-Aiken to offer a diverse curriculum focusing on nuclear safety and environmental protection. The ERP curriculum consists of four new classes that are offered by the participating institutions.

Two of the four classes were offered for the Maymester 2013 session, Introduction to Radioecology (3 hrs) and Radiation Protection and Safety Training (3 hrs), with enrollments of seven and eight students, respectively. In addition to the standard class lectures, students from both classes participated in several field trips on DOE's Savannah River Site (SRS), including trips to the SRS Mixed Oxide (MOX) Fuel Facility currently under construction, the SRS Radcon Training Facility, and UGA-SREL's Low Dose Irradiation Facility.

Six of the students also participated in UGA-SREL's summer Research Experience for Undergraduates (REU) program, completing research projects related to radioecology and the fate of radionuclides in the environment. Of those six students, one has already started graduate school at The University of Georgia, and two have been accepted to graduate programs for 2014.

The two remaining classes, Radiation Genotoxicology (3 hrs) and Environmental Geochemistry of Radionuclides (3 hrs), are scheduled for Maymester 2014. In addition, the Introduction to Radioecology will be offered again because of significant interest from students that were unable to accommodate the Maymester 2013 schedule.

Table 10.1. SREL Undergraduate Student Program Participants, FY 13

Undergraduate	University	Faculty Advisor
Caldwell McFadden	South Carolina State University	Beasley
Lindsey Callier	South Carolina State University	Beasley
Zak Smith	University of New Hampshire	Beasley
Sarah Webster	Virginia Tech	Beasley
Kelsey Turner	University of Georgia	Beasley
Amanda Holland	Oregon State University	Beasley
Alyssa Frediani	University of Vermont	Buhlmann
Lindsey Callier	South Carolina State University	Kennamer
Kimberly Price	Georgia Regents University	Lance
Jesse Baxley	University of South Carolina-Aiken	Lance
Citiyah Burton	University of South Carolina-Aiken	Mills
Nathaniel Fletcher	College of Charleston	Mills
Shelby Weathersbee	University of South Carolina - Aiken	Mills
Matt Baker	University of South Carolina - Aiken	Seaman
Robert Thomas	University of Georgia	Seaman
Matt Atkinson	University of Georgia	Tuberville
Paul Thomas	University of South Carolina-Aiken	Tuberville
Brandy Bossle	University of South Carolina-Aiken	Unger

Table 10.2. SREL Graduate Student Program Participants, FY 13

Student	Degree	University	SREL Faculty	Role
Amanda Holland	M.S.	University of Georgia	Beasley	Advisor
Kelsey Turner	M.S.	University of Georgia	Beasley	Advisor
Erin Abernathy	M.S.	University of Georgia	Beasley	Committee
Felipe Hernandez	Ph.D.	University of Florida	Beasley	Committee
Charles Evans	M.S.	University of Georgia	Beasley	Committee
Mark Peaden	M.S.	University of California-Davis	Buhlman	Committee
Jared Green	M.S.	University of Georgia	Buhlman	Committee
Nassor Mohammed	M.Sc.	University of Sares Salaam	Buhlman	Committee
Melia Nafus	Ph.D.	University of CA.-Davis	Buhlman	Committee
Dan Quinn	M.S.	University of Georgia	Buhlman	Committee
Brett Moule	Ph.D.	Clemson University	Buhlman	Committee
Wesley Flynn	Ph.D.	University of Georgia	Lance	Advisor
Caitlin Rumrill	M.S.	University of Georgia	Lance	Advisor
Cara Love	Ph.D.	University of Georgia	Lance	Advisor
Megan Winzeler	M.S.	University of Georgia	Lance	Advisor
Allison Williams	Ph.D.	University of Georgia	Lance	Committee
Eric Goolsbey	Ph.D.	University of Georgia	Lance	Committee
Jason O'Bryhim	Ph.D.	George Mason University	Lance	Committee
Schyler Nunziata	Ph.D.	University of Kentucky	Lance	Committee
Rebecca Philips	M.S.	University of Georgia	Lance	Committee
Lauren Cameron	M.S.	University of Georgia	Mills	Co-Advisor
Rebecca Philips	M.S.	University of Georgia	Mills	Co-Advisor
Savannah Harris	M.S.	University of Georgia	Mills	Co-Advisor
Gabrielle Robinson	M.S.	University of Georgia	Mills	Committee
Michael Blackowicz	M.S.	Eastern Illinois University	Mills	Committee
Erin Abernathy	M.S.	University of Georgia	Rhodes	Advisor
Cecilia Hennessey	Ph.D.	Purdue University	Rhodes	Advisor
Jesse Thomas	Ph.D.	University of Georgia	Rhodes	Co-Advisor
Wes Flynn	Ph.D.	University of Georgia	Rhodes	Committee
Jusun Hwang	Ph.D.	University of Georgia	Rhodes	Committee
Shem Unger	Ph.D.	Purdue University	Rhodes	Committee

Student	Degree	University	SREL Faculty	Role
Matt Beard	Ph.D.	Purdue University	Rhodes	Committee
Liyun Zhang	Ph.D.	University of Georgia	Seaman	Advisor
Savannah Harris	M.S.	University of Georgia	Seaman	Committee
Luke Snyder	Ph.D.	University of Georgia	Sharitz	Committee
Marcus Zokan	Ph.D.	University of Georgia	Sharitz	Committee
Bryan Nuse	Ph.D.	University of Georgia	Sharitz	Committee
Jacqueline White	Ph.D.	University of North Carolina	Sharitz	Committee
Bess Harris	Ph.D.	University of Georgia	Tuberville	Advisor
Jared Green	M.S.	University of Georgia	Tuberville	Advisor
Matt Hamilton	M.S.	University of Georgia	Tuberville	Advisor
Dan Quinn	M.S.	University of Georgia	Tuberville	Advisor
Melia Nafus	Ph.D.	University of CA.-Davis	Tuberville	Committee
Jess Goynyer McGuire	Ph.D.	University of Georgia	Tuberville	Committee
John Finger	Ph.D.	University of Georgia	Tuberville	Committee
Nassor Mohammed	M.S.	University of Sares Salaam	Tuberville	Committee

TASK 11. The participant will operate and maintain the SREL facilities on the SRS to efficiently and successfully perform the research, education and outreach programs described in this project description (Appendix A of the Cooperative Agreement)

Facilities Maintenance

The Savannah River Ecology Laboratory is the custodian of ten DOE owned buildings with the largest of these being our 45,000 square foot main laboratory and office complex. We also operate a 4,000 square foot radioecology laboratory located near Par Pond, four animal holding facilities, a greenhouse complex, two office buildings, and an assortment of utility buildings (maintenance shops, receiving building, and storage sheds).

As a partner here on the Savannah River Site, we strive to maintain our facilities in such a way that they comply with all of the DOE guidelines for property use and safety standards. We have also worked to develop facilities that are not only aesthetically pleasing, enjoyable, and safe to work in, but facilities that lend themselves toward providing our researchers with the best possible environment to conduct their research. To that end, we have set aside significant parts of our overhead budget and dedicated many man-hours to the maintaining and renovation of our facilities.

Over the last year we have completed a number of significant renovations to our facilities resulting in an investment of over $75,000 towards the continual improvement of the facilities under our care. Some of these significant projects include:

- The renovation of our Aquatic Animal Holding facility. The cornerstone of this process involved the installation of a new 20 ton HVAC unit for this facility. We also painted the exterior and interior of the facility and carried out a general cleaning and reorganization of this area.

- The renovation of our computer lab. This effort included the removal of excess equipment, replacing the existing computer furniture, repainting the 1,500 foot area, and installing new wiring and switches for better computer connectivity to our sever room.

- The replacement of the hallway carpeting in the SREL office wing. This project included the removal and then installation of over 325 sq. yards of premium grade commercial carpet.

- The painting of all interior hallways in both the office and laboratory wings of our main 45,000 square foot facility.

- The total renovation of over 10 SREL office spaces. This process involved the re-carpeting, painting, replacing ceiling tiles, and making any other necessary repairs to these spaces.

- The continued repair and maintenance of our aged climate control systems. We invested over $10,000 over the past year in updating and repairing this critical infrastructure.

- The renovation of our lobby/entrance area. This process involved the replacement of all of the architectural glass at the entrance of our building as well as updates to the paint and décor of our lobby.

- Renovations to some of our restroom facilities. This process included the total re-tiling of some of the floors as well as the replacement of damaged and failing wall coverings.

- The renovation of our Rhizotron facility. This facility is a partially below ground outdoor laboratory that allows for various plant and soil studies to be conducted. The Rhizotron had been in a mothballed

state, and we brought it back to operational status. To accomplish this, a number of structural repairs were made, and then the facility was cleaned and repainted.

- The bringing online of our radio-ecology Low-Dose facility. Members of our research and maintenance staff worked in conjunction with SRS Radiation Services to bring this outdoor radiation effects laboratory back to a functioning state.

We also continued our emphasis on cleaning and proper organization this year, as this is one of our key institutional standards. To achieve this goal, we have excessed outdated or nonfunctional equipment, cleaned our laboratories of clutter and unneeded supplies, and directed efforts to maintain appropriate housekeeping in all areas. We will continue to work diligently in the coming year to continue to improve our facilities in terms of proper organization and housecleaning.

We continued our efforts to improve our landscaping and grounds through this year. While much has been achieved this past year, we will still remain institutionally committed to aggressively pursuing our goal of developing facilities that comply with DOE guidelines as well as reflect positively on our staff and research efforts.

Environmental Health and Safety (EH&S) Program

The Savannah River Ecology Laboratory (SREL) continues to operate successfully under safety and environmental requirements and standards established by The University of Georgia and the SREL Safety Manual. 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. The SREL EH&S Manager interfaces with other SRS Contractor Environmental Health and Safety Programs and Professionals through participation in site level management Committees (ISM Integration Council and the SRS Senior Environmental Managers Council).

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 **30** (twenty) lessons learned and other site safety notices in FY 2013 to targeted groups at SREL. Additionally, in excess of **60** (sixty) SRS operational safety and environmental related announcements and notices were communicated to all SREL personnel.

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 **1 (one)** work related recordable injury/illness during FY2013 involving an eye injury (corneal abrasion) sustained by an SREL sponsored field worker. The injury resulted in a single restricted workday for the worker.

The SREL EH&S Program continues to place an emphasis on safety and environmental training of SREL personnel. All new SREL personnel receive an initial, 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 general SREL safety training and job

specific safety training provided for by their SREL supervisor. Approximately **26 (twenty-six)** SREL personnel received this required training during FY2013. Additionally, SREL personnel received EH&S related training during FY2013 in the following functional areas as their job tasks required:

- 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
- Georgia Right-To-Know Law (GRTK- HAZCOM equivalent) chemical specific training for UGA/SREL employees who utilize hazardous chemicals in the work place.
- Resource Conservation Recovery Act (RCRA) training for employees involved in the management, handling, or manipulation of hazardous or universal wastes.

SREL waste minimization and chemical disposal issues continue to be refined to promote sound environmental practices and support SRS environmental initiatives. Waste minimization techniques such as source reduction continue to be incorporated into experimental protocols, reducing the generation of chemicals wastes while supporting the SRS's pollution prevention efforts. SREL generated approximately **2,954 (two-thousand nine-hundred and fifty-four)** pounds of hazardous wastes in FY2013. Approximately **80(eighty)** percent of the hazardous wastes generated was from disposal of excess laboratory chemicals through a LabPack disposal event arranged with SRNS. The balance of hazardous wastes generated was from ongoing research operations. 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 **51 (fifty-one)** separate chemical purchase orders made by SREL personnel.

SREL received no Notices of Violation in FY2013 as the result of external or internal reviews, inspections, or assessments. All safety related Corrective Action Plan (CAP) commitment items for SREL which originated in FY2012 were adequately addressed and closed out during FY2013. During FY2013, SREL's assigned DOE Facility Representative (FR) conducted **4(four)** walk-down inspections of SREL operated SRS facilities in which minor safety issues were identified and promptly corrected. In addition SREL's DOE FR observed or reviewed **4(four)** planned or ongoing research projects for safety compliance and adequate work planning and controls with no major findings.

Additionally, 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.

Equipment Acquisition and Maintenance

Each year SREL reviews its capital equipment resources to ensure we maintain the analytical instrumentation as well as the laboratory and field equipment needed to meet the goals and objectives of our research programs. Regular review of our equipment infrastructure is important for maintaining and improving our research productivity, completing the tasks and objectives of our grants and contracts, and acquiring new equipment that employs technological advances needed to maintain the high quality of SREL's research programs. Based on input from the SREL research staff and prioritization by the Capital Equipment Committee the following equipment was approved for purchase by the SREL Director. The lists include a mix of new instruments as well as equipment upgrades and/or repairs that allowed us to best achieve our priority equipment needs within our budget constraints. The total expenditure for FY13 was $121,662.

Description	Total Cost	Category	Programs Supported
MARS 6 Microwave – Digestion System	$18,026	Expands acid digestion sample throughput	Ecotoxicology; Environmental Chemistry
Telonix Data Logger (2)	$8,200	Provides automated logging of wildlife movements	Wildlife Ecology
Liquid Argon Supply Tank	$10,300	Secures Argon supply for ICP MS Systems	Analytical Chemistry
Ultrasound	$6,920	Replacement for outdated x-ray system	Wildlife Ecology; Ecotoxicology;
Netblaster Avian Capture Device	$4,995	Provides safe alternative for wildlife capture	Wildlife Ecology; Ecotoxicology;
Ultracold Freezer	$16,291	Provides additional cold storage capacity	Ecotoxicology; Disease Ecology; Population Genetics; Conservation Genetics
Negative Chemical Ionization Module for Gas Chromatograph-Mass Spectrophotometer	$11,435	Upgrades existing analytical capabilities for chlorinated organic compounds	Ecotoxicology; Environmental Chemistry
ABI 3101 XL DNA Sequencer	$45,500	Increases capacity for molecular genetic analyses	Wildlife Ecology; Ecotoxicology; Conservation Genetics

TASK 12. UGARF will be responsible for management and engineering services for the planning, design, and construction of approved projects as may be required to repair, modify or upgrade existing facilities or construct new facilities, not to include line item projects, necessary to support the UGARF scope of work, as approved by the Contracting Officer and appropriate DOE program personnel. Funding for major repairs and new construction will be provided by DOE

No new construction was undertaken in FY13. See Task 11 (above) for summary of facilities upgrades.

SECTION III. Cost Status Report

Provided to DOE-SR budget office monthly and final FY13 report was submitted on time.

SECTION IV. Schedule Status Report

No significant changes in the schedule of deliverables or achievement of milestones were experienced by SREL in FY13.

SECTION V. Changes in Approach or Goals

In FY13 SREL implemented a number of administrative changes designed to improve accountability, facilitate the conduct of business, and focus resources and procedures within those areas deemed most critical to carrying out the mission of the laboratory. These changes include:

- Developed new protocols, documentation and accountability processes for badging, onboarding, project safety and visitor site access
- Developed new protocols, documentation and accountability processes for grant submission,
- Developed new policies and procedures for faculty roles and responsibilities, unit definition of privileges, promotion guidelines and annual faculty and classified staff reviews
- Implemented new data collection tools and formats for DOE and UGA reporting, monthly and quarterly progress updates for DOE site manager and assistant managers and monthly meetings with current faculty as well as with research professionals, post docs, and emeritus faculty
- Created and assigned new standing laboratory committee for Animal Care
- Implemented a new set of guidelines and procedures for evaluating graduate students
- Developed boat pool for SREL researchers needing to conduct operations in aquatic environments
- Restructured vehicle pool cost structure to provide better access and diversity of vehicles for staff use
- Restructured Annual Report to DOE to better reflect Cooperative Agreement Tasks and reporting requirements
- Restructured meetings of faculty and research staff to provide monthly updates on lab activities, facilities improvements, research activities and external funding and administrative practices

In addition, the Director of SREL has challenged the Research Scientists and Staff at the laboratory to increase the proportion of total funding received by the laboratory from sources external to the SRS in an effort to both diversify funding streams for the laboratory and effectively leverage federal dollars to attract external funding to the SRS. In FY13, external funding (non-SRS or UGA dollars) totaled 20% of the laboratories budget, up from 9% in FY12 (Section I; Section II-Task 8). It is the intent of laboratory management to increase this proportion to >25% in FY14.

SECTION VI. Actual or Anticipated Problems, Delays and Remedial Actions

Due to restrictions on budgetary reprograming authority and delays associated with the FY13 continuing resolution for budgetary authority, the majority of funding from DOE-SR for FY13 was received through the cooperative agreement in August of 2013. The late arrival of funding resulted in carryover of approximately 2/3 of the FY13 allocated funds into FY14. However, it is anticipated that SREL will carry over less than 30% of FY14 funding into FY15.

Savannah River Nuclear Solutions has withdrawn their support for SREL participation in public tours on the SRS. As a result, the SREL director chose to redirect DOE-SR funding to cover the deficit and continue to provide SREL support for the SRNS program. In the latest Facilities Service Agreement with SRNS, SREL has indicated that it will continue to try and provide support for public tours as long as it (SREL) has the funding to support these activities.

Language in the new cooperative agreement (2011-2016) between the University of Georgia Research Foundation and the Department of Energy specifies SREL's right to charge DOE for the use of the University of Georgia Conference Center. This provision was added to the cooperative agreement due to the fact that no funding had been provided to SREL by DOE-SR in the previous several years, thus making the cost of maintaining the conference center as well as the main laboratory facilities the responsibility of SREL management. However, the permit for the use of the DOE land upon which the UGA conference center was built specifies that DOE has free use of the facility. Thus a discrepancy between the cooperative agreement and the permit needed to be addressed. In FY13, funding was once again provided to SREL by DOE-SR and the director of SREL resolved this issue by agreeing to allow free use of the facility by DOE personnel, subject to scheduling conflicts, and has initiated an effort to change the language in the cooperative agreement to accommodate this action and resolve any discrepancies in authorities. This action is slated to occur in FY14.

SECTION VII. Absence or Changes in Key, non-temporary Personnel or Team Arrangement.

Administrative
No Activity
Research Scientists
No Activity
Postdoctoral Researchers
Hired – Dr. Shem Unger (Postdoctoral Research Associate)
Research Professionals
Separated – Dr. Brian Metts (Research Professional II)
Separated – Dr. Elizabeth Burgess (Research Professional II)
Retired – David Kling (Research Professional I)
Research Technicians
Separated – Skyler Nunziata (Research Technician III)
Separated – Chris Hagen (Research Technician III)
Separated – Cara Love (Research Technician III)
Hired – Shae Buettner (Research Professional II)
Hired – Kimberly White (Research Technician III)
Support Staff
Separated – Val McFarland (Event Support Services Associate)
Separated – William Finney (IT Manager)
Retired – Malcom Squires (Maintenance Foreman)
Hired – Paul Carroll (Maintenance Foreman)
Hired – Whit Taylor (IT Manager)
Rehired Annuitant – David Kling (Research Professional I)
Rehired Annuitant – Malcom Squires (Maintenance Foreman)

SECTION VIII. Products or technology transfer accomplished: Publications, websites, collaborations, technologies, inventions/patents, other products

SREL faculty and staff added 22 new publications to the SREL reprint list in 2013

3244 Congdon, J. D., J. W. Gibbons, R. J. Brooks, N. Rollinson and R. N. Tsaliagos (2013). "Indeterminate growth in long-lived freshwater turtles as a component of individual fitness." *Evolutionary Ecology* 27(2): 445-459.

3245 Metts, B. S., K. A. Buhlmann, T. D. Tuberville, D. E. Scott and W. A. Hopkins (2013). "Maternal Transfer of Contaminants and Reduced Reproductive Success of Southern Toads (*Bufo [Anaxyrus] terrestris*) Exposed to Coal Combustion Waste." *Environmental Science and Technology* (47): 2846-2853.

3246 Hepp, G. R. and R. A. Kennamer (2012). "Warm Is Better: Incubation Temperature Influences Apparent Survival and Recruitment of Wood Ducks (*Aix sponsa*)." *PLos ONE* 7(10): e47777.

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SECTION IX. Special Accomplishments by Laboratory Personnel

Dr. Kurt Buhlmann and Dr. Tracey Tuberville participated on the Kihansi Spray Toad Reintroduction Team, in Tanzania

Dr. Kurt Buhlmann and Dr. Tracey Tuberville's work on the Kihansi Spray Toad reintroduction was highlighted in the Wildlife Professional (Spring 2013) and UGA Research Magazine (Spring 2013)

Dr. Kurt Buhlmann served as an Executive Board Member of the Turtle Conservation Fund

Dr. Kurt Buhlmann served as the Co-Chair of the Partners in Amphibian and Reptile Conservation Reintroduction Working Group

Dr. Tracey Tuberville joined the Interdisciplinary Toxicology Program at UGA

Dr. Jim Beasley became a Certified Wildlife Biologist of The Wildlife Society

Drs. John Seaman and Stacey Lance served on the EPA Star Graduate Fellowship Review Panel, in Washington DC

Dr. John Seaman was the Chair of the Planning Committee for the12th International Conference for the Biogeochemistry of Trace Elements (ICOBTE12) held in Athens, GA with more than 360 attendees representing over 50 countries

Dr. John Seaman was nominated to serve as the Soil Chemistry Division Representative to the Soil Science Society of America Executive Committee

Drs. John Seaman and Gene Rhodes hosted a NHK (Japan Public Television) film crew for documentary focusing on SREL and SRNL research contributions that are relevant to Fukushima cleanup

Dr. Rebecca Sharitz served as an Executive Board Member for South Carolina Audubon

Dr. Whit Gibbons was elected to the North Carolina Herpetological Society Hall of Fame

David Scott provided photographic support for the 2013 SRS Emergency Preparedness Calendar and the SRS 2012 Annual Site Environmental Report

Research conducted by SREL faculty was highlighted in numerous media outlets including Science magazine, Time Magazine, Scientific American, Augusta Chronicle, National Geographic, Aiken Standard, and others