SAVANNAH RIVER
ECOLOGY LABORATORY

ANNUAL TECHNICAL PROGRESS REPORT OF ECOLOGICAL RESEARCH FOR FY14

Final: Submitted: June 1, 2015

Supported under Cooperative Agreement
DE-FC09-07SR22506

between
The University of Georgia
and
The U.S. Department of Energy
for the period of
1 October 2013 – 30 September 2014

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Director

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SECTION I: Savannah River Ecology Laboratory – FY14 Overview of Achievements

The Savannah River Ecology Laboratory (SREL) is a research unit of The University of Georgia (UGA). SREL 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 2014 fiscal year was fulfilled with the publication of 46 journal articles and several book chapters by faculty, technical staff, students, and visiting scientists. One book was also authored by SREL faculty and staff. Additional journal articles and books have been submitted or are in press. Significantly, SREL outreach activities reached over 35,000 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 DOE Environmental Management (EM) and DOE National Nuclear Safety Administration (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 leaner, but robust SREL presence continues to operate on the SRS. Currently, SREL's total employment is approximately 96 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 Army Corps of Engineers, 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 FY14, DOE-SR funding was leveraged to acquire approximately $410,000.00 in new salary and infrastructure investments from the University of Georgia, in addition to the 20% cost share negotiated under the terms of UGA's Cooperative Agreement with DOE. DOE funding also has been used to leverage new cost shared faculty positions with UGA units on the main campus (beginning in FY14 and FY15), resulting 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, Savannah River Nuclear Solutions-Area Closure Projects (SRNS-ACP) , and Savannah River Remediation (SRR) 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.

During FY14, SREL has continued to optimize its research programs to address DOE and SRS concerns, maintain staff in critical research disciplines, and attract new personnel. SREL researchers are 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 furthering DOE's strategic investments in radioecology, Next Generation Cleanup Technologies and Renewable Energy.

Researchers at SREL received funding from 29 new and continuing external grants during FY14 and increased non-SRS external funding levels significantly in FY14. Sources of grant awards range from private foundations to federal and state agencies including 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. Several SREL faculty members (and emeritus faculty) have adjunct status at other colleges and universities. Faculty, staff, and students 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 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 FY14 and SREL faculty and staff mentored over a dozen undergraduate students and over 59 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 significantly from science professionals. During the past year, SREL presented over 194 talks, 27 tours, 20 exhibits, and 34 ***Ecologist for a Day*** Programs reaching a total of over 35,000 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 been a part of the SRS public tour program (≃ approximately two tours per month of 30-40 attendees). 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 continues to be a valuable asset to SREL and other entities on the SRS. SREL used the facility to host numerous meetings and environmental education programs for students, teachers, and other organizations this past year. The facility is also used by DOE, the USDA Forest Service, and other site tenants when available.

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 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. Of particular note in FY14 was SREL's performance of an Independent, Expert Technical Review of the SRS radiological monitoring program for DOE in response to CAB Recommendation 317.

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 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 helps 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 63 years.

The FY14 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 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 FY14, the Savannah River Ecology Laboratory received approximately 5 million dollars in funding from a variety of sources (Figure 2.1). These funds supported approximately 100 faculty, staff, and students conducting basic and applied environmental research for at least some portion of FY14 (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 35% 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 FY14. 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)

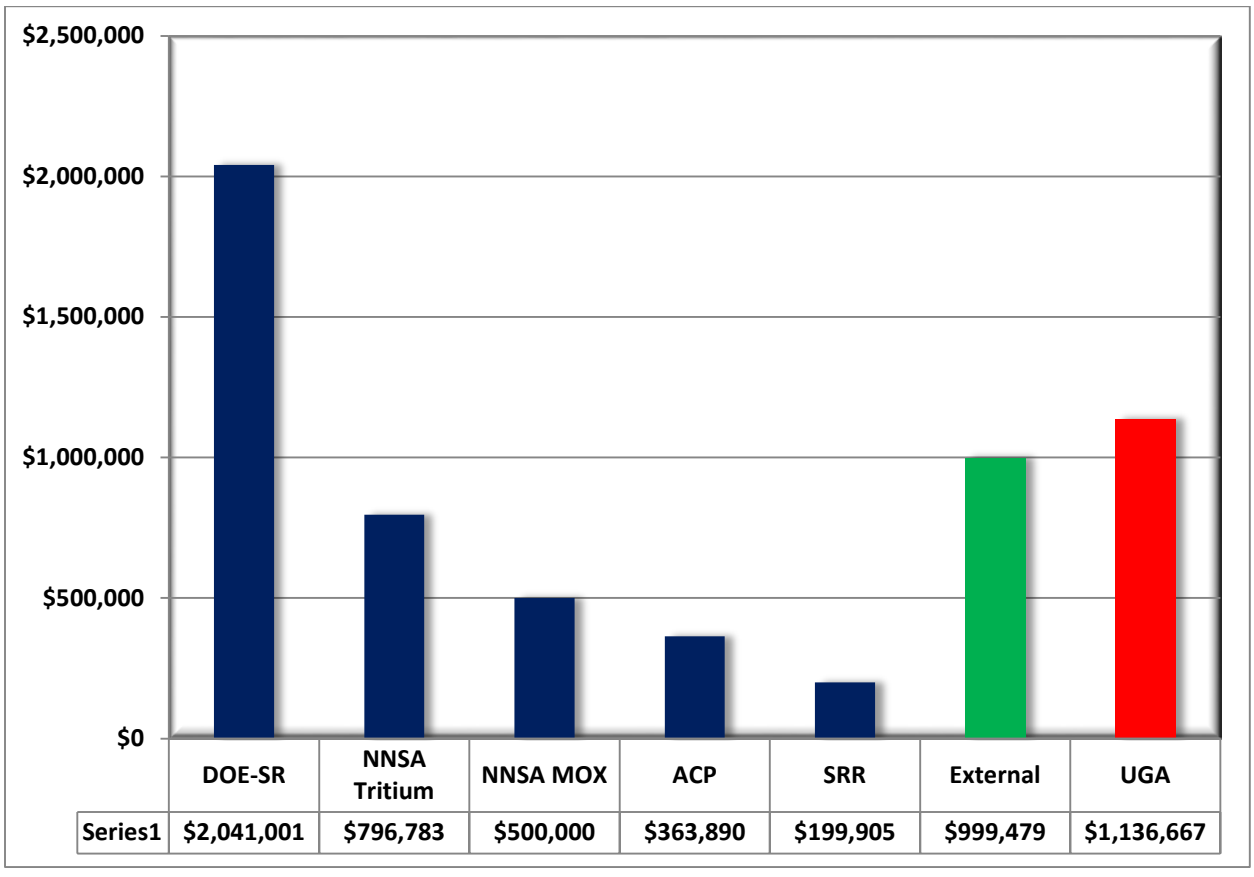

Table 2.1. SREL organizational structure for FY14. This table includes all research faculty, classified staff and Emeritus faculty in residence at the Savannah River Ecology Laboratory for any portion of the FY14 fiscal year.

SREL ORGANIZATIONAL CHART – FY14	
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 **Tenure Track Faculty** Dr. James Martin Dr. Dalia Abbas **Emeritus Faculty in Residence** Dr. D. Adriano Dr. I. Brisbin, Jr. Dr. J.W. Gibbons Dr. K. McLeod Dr. R. Sharitz **Post Docs** Dr. M. Byrne Dr. H. Chang Dr. S. Unger Dr. S. Weir Dr. A. Kremer Dr. D. Coyle **Research Professionals** R. Beasley L. Bryan S. Buettner D. Fletcher R. Kennamer L. Lee A. Lindell D. Scott P. Stankus **Research Technicians** B. Croft B. Harris S. Dean D. Soteropoulos A. Grosse S. Weathersbee Z. Smith S. Webster K. White J. O'Brynim N. Fletcher M. Attkinson R. Thomas M. Baker E. Beechuk N Bossenbroek C. Burton A. Coleman J. Daly F. Depkin D. Haskins K. Hinkson D. Keiter C. Leapart S. Mannix C. Murphy A. Mustion L. Oliver Z. Ross S. Taylor S. Yu	**Assistant Director Budget and Facilities** C. McBride **Safety and Environmental Manager** D. Mosser **Computer Service and GIS Lab Manager** W. Taylor **Outreach Program Staff** V. Sutton-Jackson 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** L. LopezdeVictoria M. Roberts C. Summer V. Taylor L. Zweifel M. Wead
	(As of 10/1/2014)

Table 2.2. Summary of professional activities and accomplishments by Savannah River Ecology Laboratory research faculty, research professionals, postdocs and students in FY14.

Publications and Reviews	Total
Peer Reviewed Journal Articles	46
Book and Book Chapters	5
Proceedings Articles	4
Primer or Other Scientific Notes	9
Non-Peer reviewed Articles	18
Articles In Press	36
Articles In Review	30
Peer Review of Manuscripts Conducted	40
External Funding (non-SRS)	**Total**
External Grants Submitted as PI or CoPI	38
External Grant Funding Submitted as PI or CoPI	$15,805,290
External Grants Funded as PI or CoPI[1]	46
External Grants Funded Dollars as PI or CoPI	$ 999,479
Graduate Education and Postdocs	**Total**
MS Graduate Students Chaired	23
MS Graduate Students Completed	1
PhD Graduate Students Chaired	3
PhD Graduate Students Completed	0
Graduate Student Committee Memberships	33
Graduate Students Hosted at SREL	20
Post Docs Supervised	5
Presentations	**Total**
Invited Presentations	36
Professional Oral Presentations	53
Professional Poster Presentations	43
Extension Presentations	26
Extension Publications	84
Other	**Total**
Awards or Honors	4
Professional Society Committee Memberships	19
Staff Teaching Courses for UGA	9
Technical Research Consultations	37

[1] – includes new grants and contracts, renewals and continuations associated with funding sources external to DOE. Total includes multi-year funding commitments received in FY14 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 FY14 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

Radiocesium in American Coots on Pond B: A Long-Term Perspective

Funding Entity
SRNS Area Closures Projects
Start Date and Funding Amount
October 1, 2013; $43,281
PI and co-PI's
Robert A. Kennamer, A. Lawrence Bryan Jr., and Dr. James C. Beasley – SREL
Objectives
Our overall objectives for this project were to examine current levels of radiocesium in waterfowl (American Coots [*Fulica americana*; hereafter coots] and Ring-necked Ducks [*Aythya collaris*]) on Pond B of the SRS and: (1) establish current/future risk for human consumption, (2) use new data with historic data to demonstrate a long-term natural attenuation of radiocesium in Pond B waterfowl, and (3) elucidate potential species differences in radiocesium accumulation.
Summary of Research Activities
During 12/7/2013 through 1/13/2014, 34 coots were trapped on L-Lake (an SRS reservoir with relatively low [at background] radiocesium levels in biota, including waterfowl), banded with USGS bird bands, wing-feather scissored (rendered flightless), transported to Pond B, and released. On 2/26/2014 and 3/5/2014, Pond B coots were collected by shotgun, yielding 16 banded, flightless coots with known residency times on the reservoir of 44 to 88 days. These resulting residence times were all in excess of the typical 25-30 days shown in earlier work for coots to establish equilibrium levels of radiocesium. Sixteen full-flighted, unmarked coots, also collected from Pond B in the winter of 2014, had whole-body radiocesium levels that did not differ significantly from the collection with known residency times, so both collections were pooled for comparison with historic data for Pond B coot radiocesium levels, and determination of an ecological half-life (T_{ecol}) for Pond B coots. These 32 collected coots accumulated whole-body radiocesium levels ranging from 0.393 – 1.850 Bq/g, with a median level of 0.898 Bq/g. No work with Ring-necked Ducks took place in FY14. This research will continue in FY15 and will include releases of both coots and Ring-necked ducks on Pond B.
Conclusions
1. Thirty of 32 coots collected from Pond B in the winter of 2014 had whole-body radiocesium levels in excess of the European Economic Community's (EEC) limit for radiocesium in fresh meat of 0.600 Bq/g (coot whole-body equivalent of 0.470 Bq/g).
2. T_{ecol} for Pond B coots was estimated as 17.45 years (95% CI=12.63 – 28.20 years). At that estimated rate of natural attenuation, it will be 2029 before the median whole-body radiocesium level in a

hypothetical collection of coots from Pond B will be below the EEC limit for radiocesium in fresh meat of 0.600 Bq/g (coot whole-body equivalent of 0.470 Bq/g).

3. A simple health-screening of Pond B coots, based on a body condition index, revealed no effects that related to radiocesium levels under the conditions/residency periods that were examined.

Major Impact(s) of Research

1. Long-term radiocesium body burden data are useful to produce estimates of contaminant natural attenuation and will be important for site remediation decision making.
2. Continued periodic waterfowl collections at contaminated SRS reservoirs will be useful to refine (reduce confidence intervals of) estimates of contaminant natural attenuation rates.
3. Future research with a goal of estimating residency time of unmarked, full-flighted birds using SRS-contaminated sites is desirable.

Other Project Personnel

Ricki Oldenkamp, MS Student – SREL
Chris Leaphart, Undergraduate Intern – SREL

External Collaborators

NA

Products (Publications, Presentations, Technical Reports)

Leaphart, C., R. A. Kennamer, and J. C. Beasley. Natural attenuation of radiocesium (Cs-137) in American coots (*Fulica americana*) wintering on Pond B reservoir located on the Savannah River Site, Aiken, SC. 2014 SREL Undergraduate Research Program Symposium. (Oral Presentation).

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

Funding Entity
SRNS Area Closure Project
Start Date and Funding Amount
November 2013; $39,500
PI and Co-PIs
Larry Bryan, Dr. Jim Beasley, Robert Kennamer and Dr. Gary Mills - SREL
Objectives
We are completing a 2+ year study documenting the levels of contaminants of concern, primarily radiocesium and metals/metalloids (including mercury), in tissues of wild pigs, waterfowl, squirrels and other "game" (e.g.; raccoons & beaver) from various regions of the SRS. Our goal is to generally assess if SRS-associated contaminants are reaching levels of concern in game species that could leave the SRS and potentially be consumed by the hunting public. We also will use manipulative experiments to quantify temporal patterns in uptake of metals/metalloids for waterfowl utilizing the D-area ash basins.
Summary of Research Activities
In the second year of the study, and after discussions with ACP, we limited our new collections (to waterfowl) and expanded our analyses of archived SRS hog samples. We also acquired samples of non-SRS hogs (south-central Georgia) for comparison. At present, all of the collected tissues have been analyzed for metals and the majority have been analyzed for mercury (mercury is analyzed on a different instrument). Radiocesium level determination for many of the tissue samples is on-going. Data on tissue concentrations of the various elements is being compiled and compared to existing databases on health risks. Manipulative experiments to quantify uptake rates of metals/metalloids in waterfowl are planned for spring 2015 in the D-area ash basins.
Conclusions
1. This research is on-going, to be completed in 2015.
2. Waterfowl muscle and liver samples continue to exhibit the highest concentrations of metals (As, Hg & Se) of the game species, especially those collected from the D-Area ash basins. Waterfowl samples from Pond B exhibited the highest radiocesium levels, with approximately 50% at or exceeding levels of concern for human consumption.
3. Raccoon muscle and liver samples have higher concentrations of selenium and selected other metals compared to other mammalian game species on SRS, possibly due to the number of samples being collected in D-Area.
4. Selenium and mercury concentrations in SRS pig samples are greater than the "control" (south central Georgia) samples.

Major Impact(s) of Research
1. The reported concentrations/levels of selected metals and radiocesium in game species collected on the SRS will be incorporated into on-site, IOU-specific ecological and human risk assessments generated by SRNS/SRNL. In a larger sense, these efforts will assist DOE in maintaining an environmental stewardship policy that minimizes the likelihood of public exposure to contaminants of concern.
2. This research will produce the most comprehensive information to date on uptake rates for metals/metalloids of concern in migratory waterfowl utilizing ash settling basins, data that will be used to assess risk to hunters and other wildlife potentially consuming contaminated waterfowl.

Other Project Personnel
Ricki Oldenkamp – MS Student – SREL
Chris Leaphart – temporary research technician – SREL
External Collaborators
None

Products

Hernandez, F, S. Wisely, and J.C. Beasley. (2014). Are raccoons good sentinels of heavy metal contamination? A wildlife health perspective. Florida Cooperative Fish and Wildlife Research Unit. Gainesville, FL. (Poster Presentation).

Hernandez, F, S. Wisely, and J.C. Beasley. (2014). Are raccoons good sentinels of heavy metal contamination? A wildlife health perspective. Ecohealth. Montreal, Canada. (Poster Presentation).

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; $290,000
PI and co-PI's (and Affiliations)
Dean E. Fletcher, Angela H. Lindell, Dr. Gary Mills, and Dr. J Vaun McArthur – SREL
Objectives
We proposed to establish how and to what extent aquatic organisms in Beaver Dam Creek on the SRS were at risk from contaminant bioaccumulation by documenting inter- and intra-specific variation of levels of a suite of metals and metalloids in species ranging from herbivorous invertebrates (< 2 cm in length) to large predatory fishes (> 1 m in length). We also completed an annotated bibliography of ecological work done in the D Area and Beaver Dam Creek system.
Summary of Research Activities
On the Savannah River Site, coal combustion waste (CCW) had been produced by the D Area Power Plant since the early 1950's and stored in basins that discharged into Beaver Dam Creek (BDC). Beaver Dam Creek is a highly modified system. The headwaters were channelized during the early infrastructure construction of the SRS between 1951 and 1956 to transport effluents from the D Area Power plant and associated ash and coal pile runoff basins to the Savannah River. Flow patterns in the upper three km of BDC were established with field reconnaissance and GIS resources. Field collections were made at two sites in Beaver Dam Creek headwaters that differed in hydrologic regimes. Stable isotope analyses ($\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.

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 were entering and moving through the food web in species and element specific patterns.
2. Some contaminants accumulated to 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 JV. McArthur. 2014. Variation in trace element accumulation in predatory fishes from a stream contaminated by coal combusiont waste. *Archives of Environmental Contamination and Toxicology* 66:341-360.

Fletcher, D.E., A.H. Lindell, G.K. Stillings, G.L. Mills, S.A. Blas, and JV. McArthur. 2014. Spatial and taxonomic variation in trace element bioaccumulation in two herbivores from a coal combustion waste contaminated stream. *Ecotoxicology and Environmental Safety* 101:196-204.

Fletcher, D.E., A.H. Lindell, G.K. Stillings, G.L. Mills, S.A. Blas, and JV. McArthur. Trophic variation in coastal plain stream predatory fishes. *Southeastern Naturalist* (In Press).

Fletcher, D.E., A.H. Lindell, G.K. Stillings, and JV. 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 JV. 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 JV. McArthur. Contaminant bioaccumulation and trophic characterization of top-level predatory fishes. Annual Meeting of the American Fisheries Society, Seattle, WA, September 2011 (Poster).

Lindell, A.H., G.L. Mills, G.K. Stillings, JV. 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, JV. 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. 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).

McArthur, JV., G.L. Mills, A.H. Lindell, and D.E. Fletcher. Taxonomic and spatial variation in trace element bioaccumulation and stable isotope analysis in odonate nymphs in a stream receiving coal combustion waste. Joint Aquatic Sciences Meeting, Portland, OR, May 2014. (Oral Presentation).

Fletcher, D.E., A.H. Lindell, G.L. Mills, and JV. McArthur. Differential accumulation of coal combustion contaminants in stream organisms: effects of trophic level and body size. Annual Meeting of the Society of Environmental Toxicology and Chemistry, Vancouver, BC, November 2014. (Poster).

Chemical and Physical Properties of Saltstone as impacted by Curing Environment

Funding Entity
Savannah River Remediation
Start Date and Funding Amount
December 2013; $125,842
PI and co-PI's
Dr. John C. Seaman and Dr. H.S. Chang - SREL
Objectives
The project objectives for FY 2014 were to: (1) experimentally determine the distribution coefficients (i.e., K_d) for iodine (I) partitioning in the presence of sediments and cementitious materials relevant to the Saltstone Disposal Facility (SDF); (2) process saltstone monoliths (utilizing SRR prescribed grout formulations) spiked with radioactive contaminants and/or non-radioactive analogs for subsequent measurements of density, porosity, contaminant leaching, inherent reduction capacity, and hydraulic conductivity; and (3) determine the feasibility of, and develop the methodology for, characterizing the dynamic leaching behavior of cured saltstone monoliths spiked with radioactive contaminants and/or non-radioactive analogs.
Summary of Research Activities
A series of batch experiments were conducted to evaluate iodide (I^-) partitioning to an SRS subsoil typical of materials underlying the Saltstone Disposal Facility (SDF) and a concrete test sample representative of the vault construction materials. Iodide partitioning was evaluated under four different background solution chemistries chosen to mimic various stages of saltstone/cement aging throughout the lifetime of the closed facility, from initial cementitious material formation and curing through weathering and eventual far-field leaching in the underlying soil environment.

Simulated saltstone spiked with stable iodine-127 (^{127}I) and rhenium (Re) to serve as nonradioactive analogs for iodine-129 (^{129}I) and technetium-99 (^{99}Tc) was produced utilizing Savannah River Remediation LLC (SRR) prescribed grout formulations. The relative concentrations of I and Re in the saltwaste simulant were consistent with the average concentrations of ^{129}I and ^{99}Tc in the Tank 50 feed waste at the SDF. After curing for a specified duration, the monoliths were evaluated in terms of inherent reduction capacity, contaminant mass transfer rates, and saturated hydraulic conductivity (SHC). Contaminant mass transfer for the I and Re spiked monoliths was evaluated using EPA Method 1315, Mass Transfer Rates of Constituents in Monolithic or Compacted Granular Materials Using a Semi-Dynamic Tank Leaching Procedure. The SHC of select monolith sections cured for 30 and 90 days was evaluated using a flexible-wall permeameter according to ASTM D5084.

A dynamic leaching method based on ASTM D5084 for determining SHC was evaluated as a means of determining the mass transfer rates of contaminants present in grout used in the disposal of low-activity salt waste. Sections of 2-in. diameter, cured saltstone monoliths spiked with I^- and ReO_4^- were used to evaluate the leaching method. Initial hydraulic conditions were estimated using Darcy's law with an assumed saturated hydraulic conductivity for the saltstone of $\approx 5 \times 10^{-9}$ cm s^{-1}, and a target leaching rate of ≈ 5 mL d^{-1}. Based on these criteria, the initial confining pressure and hydraulic head were set at 25 and 20 psi, respectively. Effluent samples were collected periodically for I and Re analysis.
Conclusions
1. Soil distribution coefficients for I^- at the high pH values tested (i.e., > 11) were generally quite low, < 1 mL g^{-1}, as evidenced by high I^- recoveries, making it difficult to distinguish sorption from experimental variation.
2. Based on EPA Method 1315, the cumulative release history for both Re and I conformed to a diffusion controlled mechanism. For Re, the lack of response to extraction atmosphere may reflect the difficulty in achieving reduction, with similar amounts of Re(VII) available for release regardless of the atmospheric conditions.

3. The SHC for all saltstone monoliths were ≈ 10^{-9} cm s^{-1}. The SHC for saltstone monoliths cured for 90 days was less than the 30 day values, suggesting a reduction in SHC with long-term curing, but additional analyses are required to confirm any trends.
4. For the dynamic leaching method, high levels of Re (250-800 µg L^{-1}) were initially observed in the monolith leachates, which decreased to a rather stable level with continued leaching. After stabilizing, the relative level of Re found in the effluent was dependent on the leaching flow rate, a factor that is inversely related to the leaching solutions residence time within the saltstone monolith.
5. Based on dynamic leaching results, the proposed method was modified to address the logistical obstacles for testing ^{99}Tc-spiked saltstone, such as the low flow rates that limited effluent sample yield at reasonable hydraulic gradients.

Major Impact(s) of Research

1. SREL provided site-specific partitioning estimates for I partitioning, demonstrating the low K_d values found at high pH.
2. The insensitivity of Re leaching to redox conditions suggests Re is a poor analog for Tc behavior in reductive saltstone materials.
3. Testing the novel dynamic leaching method suggested several modifications that are important in applying the method to rad-spiked saltstone materials, including the use of large diameter monolith sections to reduce the hydraulic gradient required to get significant leaching.

Other Project Personnel

Shea Buettner, Research Professional – SREL

External Collaborators

Dr. D. Kaplan and Dr. D. Li – SRNL

Products (Publications, Presentations, Technical Reports)

Seaman, J.C., and H.S. Chang. 2014. Dynamic Leaching Characterization of Saltstone. SREL Doc. R-14-0007, ver. 1.0. Submitted to SRR September 29, 2014.

Seaman, J.C., H.S. Chang, and S.W. Buettner. 2014. Chemical and Physical Properties of Saltstone as Impacted by Curing Duration. SREL Doc. R-14-0006, ver. 1.0. Submitted to SRR September 21, 2014.

Seaman, J.C., and H.S. Chang. 2014. Impact of Cementitious Material Leachate on Iodine Partitioning. SREL Doc. R-14-0005, ver. 1.0. Submitted to SRR September 6, 2014.

Tritium Distribution at the Tritiated Water Management Facility - Southwest Plume Interim Measures

Funding Entity

SRNS Area Closures Projects

Start Date and Funding Amount

November, 2013; $122,572

PI and co-PI's

Dr. John C. Seaman - SREL

Objective

Evaluate the efficacy of ongoing remediation efforts at the SRS Mixed Waste Phytoremediation Management Facility to address the tritium and 1, 4 dioxane plume originating from the Old rad Waste Burial Ground.

Summary of Research Activities

In FY 2014, SREL worked collaboratively with the SRS-US Forest Service, SRNS-ACP and DOE to complete the following activities: (1) 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) develop and refine a soil extraction method for evaluating the persistence of 1, 4 dioxane in soils at the MWMF.

Conclusions

1. Water balance calculations based on soil cores from the original irrigation plots indicated very limited tritium leaching, similar to results from 2010 through 2012 due to the ongoing drought.
2. The estimated tritium evapo-transpiration efficiency for individual irrigation plots ranged from ≈ 36.6 to 95.6%, with lower efficiencies associated with the high recovery of soil tritium in the eastern expansion plots (plots 31 and 40). Even so, the average efficiency was approximately 90.8 ± 4.4% for all 10 plots, slightly higher than observed for 2011 and 2012.
3. Efficiency results derived from the Cornell 1D model were consistent with the soil-based calculations, ranging from 84.7 to 88.5% between plots, with a yearly average of 86.5 ± 1.2% for all 10 plots.
4. The soil tritium extraction method based on the sublimation (i.e., freeze drying) proved to be an effective means of extracting 1, 4 dioxane from soils for subsequent VOC analysis.

Other Project Personnel

Shea Buettner, Research Professional - SREL

External Collaborators

NA

Products (Publications, Presentations, Technical Reports)

S.W. Beuttner, J.H. Singer and J.C. Seaman. 2014. Estimating Evapo-Transpiration Losses for Tritium at the MWMF: 2013 End of Year Summary Report. Final report submitted to SRNS-ACP March 18, 2013.

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; $100,000
PI and co-PI's
Dr. Tracey D. Tuberville, David Scott, Dr. Stacey Lance - SREL
Objectives
Our objectives are to: 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; 2) survey / interview local hunters and fishermen in communities surrounding SRS with regard to harvesting and consumption of aquatic turtles and alligators; and 3) evaluate alternative fitness-related endpoints using standard veterinary diagnostic tools & health parameters 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 and aquatic turtles inhabiting contaminated and uncontaminated aquatic habitats on the SRS, focusing this fiscal year primarily on aquatic turtles. In addition, we completed a selenium dietary exposure experiment with alligators and initiated a similar study with yellow-bellied sliders, the most ubiquitous turtle species on the SRS. We also analyzed tissue samples from our initial alligator experiment investigating dietary exposure to coal combustion waste (CCW)-contaminated prey. We conducted screening for *Ranavirus* in aquatic turtles on the SRS using archived blood samples from 288 individuals of 8 species collected from 2008-2014. We developed a protocol to successfully extract corticosterone from alligator scutes and alligator and turtle nails for quantifying long-term stress. We continued monthly population counts of alligators in Par Pond and L-Lake reservoirs. Finally, in collaboration with Dr. Beasley, we developed questionnaire-based surveys to administer to people who hunt or fish in South Carolina and Georgia. The goal of the questionnaires (which were administered in FY15 at two wildlife and hunting festivals) is to characterize hunting and game consumption patterns for game species, including turtles and alligators.
Conclusions
1. Juvenile alligators subjected to chronic dietary exposure to CCW-contaminated prey for two years accumulated significant levels of Se in kidney, liver, scutes and muscle.
2. Juvenile alligators subjected to acute dietary exposure to Se can accumulate up to 100 ppm concentrations of Se in their kidney and liver over relatively short exposure periods (7 weeks). These concentrations are sufficient to induce lethargy, neurological impairment, and even mortality in at least some individuals.
3. Although a mud turtle (*Kinosternon subrubrum*) from Risher Road sloughs captured Spring 2014 was documented to have severe Ranaviral infection and to have later died, subsequent screening for Ranavirus in multiple aquatic turtles across the SRS has failed to reveal any other actively infected individuals. Based on current evidence, Ranavirus does not appear to be a significant threat to aquatic turtle populations on the SRS at this time. However, the screening test only detects actively infected individuals, which may exhibit extreme lethargy and rapid mortality – both of which severely limit detectability of disease.
4. Corticosterone can be successfully extracted from both alligator scutes and alligator and turtle nails, suggesting they should be useful measures of long-term chronic stress in long-lived reptiles.
5. Alligator populations at L-Lake and Par Pond appear stable.

Major Impact(s) of Research

1. Comparative data regarding bioaccumulation of Se in alligators under two different dietary exposure scenarios – acute exposure (such as that following an accidental or intentional release of CCW waste) and chronic low-dose exposure (such as that likely to occur at historically-contaminated sites undergoing natural attenuation).
2. Baseline data regarding prevalance of Ranavirus in populations of aquatic turtles across the SRS.
3. Incorporation of new biological endpoints for evaluating sublethal effects of contaminants on alligators and freshwater turtles.

Other Project Personnel

Bess Harris, Temporary Research Technician – SREL
Matt Hamilton, MS Student - UGA
David Haskins, MS Student - UGA
Amanda Jones, summer undergraduate intern – USC-Aiken

External Collaborators

John Finger, PhD student - UGA
Dr. Terry Norton, wildlife veterinarian – Georgia Sea Turtle Center
Dr. Travis Glenn, Faculty - UGA

Products

Hamilton, M.T., J.W. Finger, A. Grosse, R. Horan, R. Kennamer, I.L. Brisbin, and T.D. Tuberville. American alligator (*Alligator mississippiensis*) population trends on radiologically-contaminated reservoirs located on the Savannah River Site. Joint Meetings of Ichthyologists and Herpetologists, Chattanooga, TN. July 2014. (oral)

Hamilton, M.T., J.W. Finger, Jr., and T.D. Tuberville. Effects of contaminants on American alligators (*Alligator mississippiensis*) at the individual and population level: thesis prospectus. Society for Integrative and Comparative Biology, Austin, TX. Jan 2014. (poster)

Hamilton, M.T., J.W. Finger, Jr., and T.D. Tuberville. Effects of contaminants on American alligators (*Alligator mississippiensis*) at the individual and population level: thesis prospectus. Southeastern Partners in Amphibian and Reptile Conservation, Lake Cumberland State Resort Park, KY. February 2014. (poster)

Hamilton, M.T., J.W. Finger, Jr., B.S. Metts, R.M. Elsey, T.C. Glenn, and T.D. Tuberville. The effects of dietary exposure to coal fly ash contaminated prey on the immune system of the American alligator (*Alligator mississippiensis*). IUCN Crocodilian Specialist Group, McNeese State University, Lake Charles, LA. May 2014. (poster)

Finger, J.W., Jr., M.T. Hamilton, B.S. Metts, R.M. Elsey, T. Glenn, and T.D. Tuberville. The effects of coal fly ash contaminants on the immune system of the American alligator (*Alligator mississippiensis*). Interdisciplinary Toxicology Retreat, UGA, Athens, GA. April 2014. (poster)

Examination of Mercury/Methylmercury in Aquatic Biota Associated with Fourmile Branch

Funding Entity
SRNS Area Closure Project
Start Date and Funding Amount
November 2013; $42,765
PI and Co-PIs
Larry Bryan, Dr. Gary Mills, Angela Lindell - SREL
Objectives
We have completed the first of a five-year project examining mercury bioavailability within selected portions of the Fourmile Branch drainage, including the Savannah River Swamp System (SRSS), on the Savannah River Site. These selected areas (H- and F-Area seeplines and adjacent stream littoral zone and the river swamp) had previously-documented elevated levels of mercury (seeplines: 1990; SRSS: 2002). Our objectives in the initial year were to collect general samples (sediment, biofilms and biota) from all areas and document current total mercury in existing biota. In subsequent years we will focus on each area (H-Area, F-Area and SRSS) and examine the environmental conditions resulting in mercury bioavailability and uptake.
Summary of Research Activities
In year 1 we collected sediment, biofilm, and fish samples, as well as crayfish and amphibians (when present), for mercury analysis within 4-5 sites within each study area (H-Area, F-Area and SRSS) associated with Fourmile Branch. All sampling occurred in late summer as we tried to match the seasonal timing of the monitoring that historically documented the elevated mercury levels.
Conclusions
1. F and H Area sediment samples had relatively low mercury levels (< 0.2 ppm Hg) whereas SRSS sediment samples varied considerably by site, ranging from 0.015-1.34 ppm Hg.
2. Biofilm samples followed a general trend (SRSS > F & H Areas) similar to that of the sediments.
3. Mercury concentrations in fish/invertebrates (n~225) generally followed perceived trophic levels, with the highest concentrations found in the more predatory redfin pickerel (max = 3.25 ppm Hg). One exception to this trophic trend was the mosquitofish, a presumed low trophic level species, where several individuals exhibited mercury concentrations above 1 ppm.

Major Impact(s) of Research
This was the preliminary survey of mercury in biota of sites that had demonstrated “high” mercury levels in historical studies. The data collected in year 1 documented current mercury levels in biota, but perhaps more importantly demonstrated the variation in these samples within these selected areas which will aid us in our more detailed studies of specific sites in upcoming years.
Other Project Personnel
Nick Bossenbroek – research technician - SREL
External Collaborators
None
Products
No publications, presentations, or reports have yet been prepared.

Bacterial Metagenomics of the Rodent Microbiome Under Conditions of Long-Term, Chronic Exposure to Contaminants on the SRS

Funding Entity
DOE-EM Support to SREL
Start Date and Funding Amount
October 2013; $24,000
PI and Co-PIs
Olin Rhodes - SREL
Objectives
1. To evaluate changes in the gut microbiome of rodents related to long-term, chronic exposure to radionuclides and heavy metals.

Summary of Research Activities
In year 1 we collected soil samples and rodents within each of 3 study areas on the SRS (reference site, radionuclide contaminated site and heavy metal contaminated site). Soil and tissue samples were archived for metal and radionuclide analyses. Rodent gut samples were frozen and moved to UGA where they are undergoing bacterial metagenomic analyses for targeted genes of interest to evaluate differential adaptation and physiological responses to long term chronic exposure to contaminants. These analyses are ongoing.

Conclusions
1. This research is in the initial stages of development and analysis.

Major Impact(s) of Research
1. This research will provide insights into the adaptation and evolution of the microbiome of mammals in response to long-term, chronic exposure to radionuclides and heavy metals

Other Project Personnel
Jesse Thomas – Ph.D. Student – UGA
Dr. James Beasley – Assistant Professor – SREL
Erin Abernethy – M.S. Student – UGA
Kelsey Turner – MS Student - UGA

External Collaborators
Dr. Travis Glenn – Professor - UGA

Products
No publications, presentations, or reports have yet been prepared.

Effects of Chemical Contaminants on Coleopteran Carrion Assemblages

Funding Entity
DOE-EM Support to SREL
Start Date and Funding Amount
October 1, 2013; 86,000
PI and Co-PIs
Dr. James C. Beasley and Dr. Olin E. Rhodes, Jr.
Objectives
The objective of this study is to evaluate the influence of metal and radionuclide contaminants on the richness, diversity, and composition of coleopteran scavenging beetles and to determine levels of radionuclides and metals within adult beetles inhabiting contaminated sites on the SRS.
Summary of Research Activities
For this research 40 caged rabbit carcasses were placed along transects at 0, 100, 200, and 300m from the water's edge at both the D-area ash basin and a control site in summer 2014. Insect traps were placed at each carcass and all beetles colonizing carcasses were collected. Beetles captured in summer 2014 are currently being characterized to species. Additional trials will be conducted in 2015 at Pond A, the D-area Ash Basins, and two control sites.
Conclusions
This study has just begun, there are no conclusions at this time.
Major Impact(s) of Research
1. This research is amongst the first studies to quantify responses of invertebrate carrion communities to chemical contamination in the U.S. and will allow us to determine whether population-level effects exist to invertebrates inhabiting landscapes contaminated with radionuclides or metals.
2. This research will contribute greatly to our understanding of the fate and transport of contaminants within ecosystems, as well as the body burden levels of contaminants in invertebrate carrion communities.

Other Project Personnel
Kelsey Turner, M.S. Student – UGA
Erin Abernathy, M.S. Student – UGA
Ansley Silva, M.S. Student – UGA
David Coyle, Postdoctoral Research Associate – UGA
Kamal Gandhi, Associate Professor – UGA
External Collaborators
Jeffery Tomberlin, Associate Professor, Texas A&M
Products
Silva, A., D. Coyle, E. Abernethy, K. Turner, J. Beasley, and K. Gandhi. 2014. Effects of contamination on invertebrate Scavenging communities. Southern Forest Insect Work Conference, Charleston, SC

Potential Production of Oilseed-based Biofuels on the SRS

Funding Entity
DOE-EM Support to SREL
Start Date and Funding Amount
October 2013; $40,000
PI and Co-PIs
Olin Rhodes - SREL
Objectives
1. To evaluate the potential for production of biofuels from oilseed crops in right-of-ways on the Savannah River Site.

Summary of Research Activities
In year 1 evaluated potential study areas on the SRS and selected 12 potential 2ha sites based on soil type, existing native vegetation, slope and ease of access. Extensive soil testing was performed on each potential study area to determine the existing soil characteristics and potential need for soil additives. After selection of 9 study sites for experimental use, each site was submitted for site use permitting and was surveyed for archeological concerns as well as screened using ground penetrating radar to evaluate the location and depth of existing underground wires associated with overhead electrical transmission lines. Crop types (cotton, soybean and peanuts) and herbicide selections were made for each site and initial arrangements were made for discing to be performed by the USFS at each site in early FY15. In addition, arrangements were made with collaborators at the National Wildlife Research Center in Fort Collins, CO to have data collected on each study area for evaluation of economic impacts of crop damage to each crop type in FY15.

Conclusions
1. This research is in the initial stages of development and analysis.

Major Impact(s) of Research
1. This research will provide insights into the potential for cultivation of oilseed crops for production of diesel biofuels for use on the SRS as well as into the potential challenges that may need to be overcome to achieve this objective.

Other Project Personnel
Linda Lee – Research Professional – SREL
Jim Beasley – Assistant Professor – SREL
External Collaborators
Dr. Dewey Lee – Professor – UGA
Stephanie Schwiff – Research Scientist – USDA
Products
No publications, presentations, or reports have yet been prepared.

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

SREL's public outreach and communication programs focus on habitats and environments on the SRS and the ecological research that is conducted by SREL, with the purpose of increasing public understanding of scientific issues ~~that~~ affecting the site and bringing general ecological awareness to the general public.

SREL Outreach Activities in FY13

Historically, the program's mission has 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 for environmental stewardship. The program highlights SREL's ecological research on the SRS through oral presentations, exhibits, tours, and various electronic media. Outreach programs facilitate and encourage participation by students, regional teachers, resident and visiting faculty and training programs. SREL actively communicates information to the media via UGA Public Affairs and local and regional media outlets. 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 and present an on-site tour program that focuses on the environments of the SRS and the ecological projects of SREL —conveying SREL's role as an independent evaluator.

D. Give presentations to the public, including schools, civic groups, and other organizations that focus on environments of the SRS region and on SREL's 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~~ broadcast programs that focus on environmental issues, SREL's ecological research, and ecological projects on the SRS.

H. Develop and distribute brochures and publications that are informative the public and on-site tenants of SREL's ecological research, and the environments on the SRS.

I. Develop and establish displays of SREL research projects in appropriate areas of the SREL facilities.

J. Publish an internal newsletter (*The GrapeVine*) as a means of enhancing internal communications—promoting individual as well as organizational achievement.

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

L. Establish a photograph~~ic~~ collection that tells SREL's story, is informative of 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 ecological research.

N. Maintain an area of the website for education on wildlife native to the SRS to include identification of regional species and information on wildlife safety.

O. Develop and present 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 SRS monthly safety meetings to deliver PowerPoint presentations and introduce 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 section on the SREL 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 been a participant in SRS's outreach to the general public via the SRNS Public Tours program, with SREL providing a 45-60 minute presentation bimonthly year-round (24 scheduled and more than 20 additional lab tours and impromptu presentations). These 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 conclude with a question and answer period for 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 allows 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 off-site UGA Conference Center. The conference center also hosts civic group presentations and ecological tours. All school programs incorporate science standards and curricula for particular school districts. ~~In many~~ Most of these programs provide an opportunity for participants 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 local and regional community at the UGA Conference Center, which allows individuals of all ages to interact with live animals and plant species, to meet site researchers, and to learn more about SRS efforts, including our

research and education components. 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 Outreach section of the SREL website receives numerous hits, as it has links to the popular ***Ecologist for a Day*** program, Outreach fact sheets and educational products, the ***Ecoviews*** weekly newspaper column. It also invites questions about wildlife native to the SRS that are answered by the Outreach personnel. This website is frequented by teachers from all over the country, who use the materials in their classrooms. SREL distributes thousands 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 FY14

IT Infrastructure

Over the past year the Savannah River Ecology Laboratory continued to improve our IT capabilities by making several upgrades and additions to our network. They include the following improvements in FY14:

1. **Worked with DOE Cyber Security to gain approval to have the UGA Secure PAWS wireless network installed in 737-A.** The approval was granted, although the network is still in the development phase.

2. **Setup new Database server**. This will allow us to effectively store and access our long-term data sets.

3. **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 this was upgraded to the latest Cat 6 wiring. A fiber optic trunk line was also added to this.

4. **Installed Symantec Endpoint antivirus software on our servers**. This provides us with a more robust antivirus protection than our old software.

5. **Upgraded our backup software to Backup Exec 2014**. This enabled us to upgrade the backup server operating system to Windows 2012

6. **Used Zenworks to deploy GIS to all desktop network computers**. Now all of our users have ready access to GIS

7. **Use Zenworks for Patch Management of all network computers**. This not only keeps Microsoft products up to date, but all software installed on the computer. It also gives the administrator the ability to choose what software is updated.

8. **Used Zenworks to deploy an Active Shooter Training module to all network computers**. By doing this all of our users had easy access to the important training.

We are also in the process of developing a long-range plan for replacing some of our smaller, dated, servers and older operating programs. Our goal is to continually improve our system to effectively protect our valuable data and provide our staff with the IT resources needed to accomplish their objectives.

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 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.

During FY14, SREL successfully negotiated a cost-sharing agreement to fund two information managers already based at UGA to transition SREL's legacy data into a modern, full-featured system compatible with NSF standards for data archiving. The end product will resemble that in use at the NSF funded Sapelo Island Long Term Ecological Research Site, but it will be customized for SREL's needs. Work began in the latter part of FY14. As mentioned in the IT Infrastructure section, SREL purchased and set up a dedicated server for the new data archive and populated it with data and metadata from the legacy archive. Information management personnel have begun processing the legacy materials. They have also created databases of personnel, publications, species, study sites, and other general information, populated from SREL material or from outside sources where appropriate (e.g. ITIS). Processing of the data and metadata from the legacy system will continue in FY15. Web code development is also expected to take place in FY15.

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 FY14

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 what was formerly known as the Savannah River Plant 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.

- Implementation of the Flamingo Bay prescription began in FY14 with a prescribed burn in January. As the first conditioning burn on a fairly productive site, it was conducted as a head fire over soaked duff to prevent mortality from root damage. The burn carried well and consumed only the top of the litter layer, as planned, leaving roots protected.

- In late FY14 the Set-Aside Task Group agreed that the prospect of a cooperative burn at Craig's Pond was slim, and that the DOE side of the bay should be burned as soon as possible, preferably in the growing season. The burn will include the surrounding Set-Aside uplands as well as the DOE-owned portion of Sarracenia Bay.

- The ice storm in February 2014 inflicted spotty but significant damage to the young pine plantations in the Mona Bay and Woodward Bay Set-Aside. The area will be burned in FY15 and decisions about timber may be reassessed.

- In late FY14 SREL became aware of a possible aerial broadcast of herbicide on ROWs, and negotiated to have ROW sections in or adjacent to Set-Asides excluded if such an application were to occur.

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 approximately 3,000 years. This site has yielded important insights into both bay formation processes and patterns of human activity in the early Holocene.

- 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.

- Studies of aquatic snake populations continue at Ellenton Bay and Risher Pond. Long-term monitoring of 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 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.

- Flamingo Bay, Dry Bay, Mona Bay, and Thunder Bay were all used as field sites for a graduate researcher investigating vertebrate scavenging communities around Carolina bays. Specifically the researcher was interested vertebrate scavengers of reptile and amphibian carcasses.

- Steel Creek Bay served as a reference site for a graduate researcher comparing invertebrate scavenging communities around contaminated and uncontaminated wetlands.

- Steel Creek Bay served as a reference site for a graduate researcher comparing gut flora in deer mice living around contaminated and uncontaminated wetlands.

- 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 36 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 approximately 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. These programs give 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 the 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 sampling site for a graduate researcher at Fordham University studying reproductive ecology of Triodanis perfoliata, a species that produces both open-pollinated flowers and cleistogamous flowers specialized for self-pollination.

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 FY14 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
January 2014; $286,355
PI and co-PI's
Dr. Olin E. Rhodes, Jr. – 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 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

Vicky Sutton-Jackson, Public Relations Coordinator – SREL
Sean Poppy, Outreach Coordinator – SREL
Angela Tucker, Animal Caretaker – SREL
Judy Green-McLeod, Research Professional – SREL
Carol Eldridge, Research Professional – SREL

External Collaborators

Dr. Kimberly Andrews – Georgia Sea Turtle Center

Products

1. Conducted 27 scheduled SREL or SRS Public Tours and tours for onsite personnel; estimated number of attendees – 986
2. Provided 4 Wildlife safety talks for SRS employees; estimated number of attendees – 235.
3. Presented 140 classroom education programs for elementary and secondary students; estimated number of attendees – 14,550.
4. Provided 32 environmental outreach presentations to college, civic, and professional groups; estimated attendees – 1,827.
5. Provided 20 SREL Exhibits at local and regional events; estimated number of attendees – 14,248. [Includes 4 career exhibits at schools (estimated 991 attendees); 4 science night exhibits at schools (estimated 1,078 attendees)].
6. Conducted 34 ***Ecologist for a Day*** Programs (school field trips to SREL's Conference Center); estimated number of attendees – 872.
7. Conducted 1 ***Touch an Animal Day*** (August 23, 2014, at UGA Conference Center- estimated number of attendees – 469.
8. Provided 18 presentations at regional library summer reading programs – estimated 2,220 attendees

*Total Outreach events: 276; Total estimated attendance: 35,407

H-02 Constructed Wetland Studies: Amphibians

Funding Entity
NNSA Tritium Facility
Start Date and Funding Amount
October 1, 2013; $381,829.00
PI and co-PI's
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 2013 to September 2014. We used aquatic trapping 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 from different source populations examining multiple stressors, including Cu and predator presence, which we continued into a terrestrial study to test for the possible post-metamorphosis latent effects of Cu accumulated as tadpoles. We completed an initial survey of SRS wetlands for two amphibian diseases, chytridiomycosis and ranavirus, across contaminated and reference wetlands and initiated a new study investigating the impact of wetland hydroperiod on disease prevalence. We also began creating a population model to examine the relative importance of climate change and copper contamination on viability of southern toad and southern leopard frog populations. Rainbow Bay and other isolated wetlands serve as comparison sites for the H-02 amphibian studies. We completed the 36th 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 leopard frogs reared *in situ* in the H-02 wetlands did not contract either amphibian disease and had overall high survivorship.
2. Incidence of the fungus that causes chytridiomycosis, *Batrachochytrium dendrobatidis*, decreased from 22% to 0% in the H-02 wetlands, indicating the potential for temporal cycling of disease prevalence.
3. In our mesocosm study we found significant effects of parental source population on time to- and size at-metamorphosis with offspring of D-Area (fly ash contaminated) adults performing less well than offspring from reference animals. They also had significantly worse physiological performance up to one month post-metamorphosis. There were also significant interactions of source population and copper exposure on performance.
4. 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 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.

2. Our focus on among-species and among-life stage 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.
3. 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.
4. Our mesocosm studies demonstrate the importance of looking a) at multiple stressors, b) beyond the larval period, and c) at multiple source populations. We found significant latent effects that lead to completely different conclusions than the larval study alone.
5. Our disease studies are ongoing, but are demonstrating the complexity of variables involved with disease incidence and prevalence in amphibians. The nature of the wetland—metal-contaminated vs. clean, permanent vs. ephemeral, and constructed treatment wetland vs. natural,— impacts disease prevalence and variables are confounded with each other. Experimental studies are needed to disentangle these variables.
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 on isolated wetlands and provide insights to land managers who may need to design protective measures for rare species.

Other Project Personnel

Wes Flynn, PhD student – UGA
Caitlin Rumrill, MS student – UGA
Megan Winzeler, MS student – UGA
Austin Coleman, research technician – SREL

External Collaborators

NA

Products

Nunziata, S.O., Scott, D.E., and S.L. Lance. Temporal genetic and demographic monitoring of pond breeding amphibians in three contrasting population systems. *Conservation Genetics (Accepted with revision)*.

Winzeler, M., Hamilton, M., Tuberville, T., and S. Lance. First isolation of ranavirus from an eastern mud turtle (*Kinosternon subrubrum*) with associated morbidity and mortality in South Carolina. *Diseases of Aquatic Organisms* (*In press*).

Flynn, R.W., Scott, D.E., Kuhne, W., Soteropoulos, D., and S.L. Lance. Lethal and sublethal measures of chronic copper toxicity in the Eastern Narrowmouth Toad, *Gastrophryne carolinensis*. *Environmental Toxicology and Chemistry (In press)*.

Soteropoulos, D.L., Lance, S.L., Flynn, R.W., and D.E. Scott. 2014 Effects of copper exposure on hatching success and early larval survival in marbled salamanders, *Ambystoma opacum*. *Environmental Toxicology and Chemistry* 33:1631-1637.

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

Lance, S.L., Erickson, M.R., Flynn, R.W., 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.**,** Winzeler, M.E., Beasley, R., Nunziata, S.O., Scott, D.E., and S.L. Lance. 2014. Prevalence of *Batrachochytrium dendrobatidis*, in contaminated and uncontaminated wetlands on the Savannah River Site, SC. Society of Integrative and Comparative Biology, Austin, TX.

Flynn, R.W. and S.L. Lance. 2014. Copper tolerance in the southern toad, *Anaxyrus terrestris*: a quantitative genetic approach. Society of Integrative and Comparative Biology, Austin, TX.

Winzeler, M.E., Love, C.N., Scott, D.E., Beasley, R., Nunziata, S.O., and S.L. Lance. 2014. Prevalence of Two Amphibian Diseases at Contaminated Wetlands on the Savannah River Site, SC. Joint Meetings of Ichthyologists and Herpetologists. Chattanooga, TN.

Rumrill, C.T., Flynn, R.W., Scott, D.E., and S.L. Lance. 2014. Latent effects of multiple stressors on southern toads, *Anaxyrus terrestris*. Society for Integrative and Comparative Biology, Austin, TX.

Love, C.N.**,** Winzeler, M.E., Beasley, R., Nunziata, S.O., Scott, D.E., and S.L. Lance. 2014. Prevalence of ranavirus in contaminated and uncontaminated wetlands on the Savannah River Site, SC. Society of Integrative and Comparative Biology, Austin, TX.

Microbial antibiotic resistance characterization of the MOX stream (U8)

Funding Entity
NNSA MOX
Start Date and Funding Amount
March 2011;NFP
PI and co-PI's
J Vaun McArthur - SREL
Objectives
1. Determine whether the MOX stream 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 3000 isolates from eleven locations on eight streams including the MOX stream and Upper Three Runs Creek. From these samples we have isolated and screened over 3000 *E. coli* for resistance profiles. From these analyses we have found that the bacteria from the MOX stream and from U4 (F-area) were resistant to nearly twice as many antibiotics as the other streams sampled. Both U4 and the MOX stream have been heavily impacted by site operations. In the headwaters of the MOX stream 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. 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 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
Courtney Burkholder, Undergraduate Student – USCA
External Collaborators
R. Cary Tuckfield, Ecostatys, LLC, Aiken, SC
Products
McArthur, J V., D. Fletcher, R. C. Tuckfield and C. Baker-Austin. Survey of multi-antibiotic resistant *Escherichia coli* from streams in the Upper Three Runs drainage on the Savannah River Site. *In review* FEMS Microbiology Ecology/

McArthur, J V. and C. Burkholder. 2014. Comparing levels of antibiotic resistance, heavy metal contamination and bacterial community diversity in stream sediment samples from the Savannah River Site. 2014 SREL Undergraduate symposium.

Restoration of the MOX stream (U8): Initial efforts

Funding Entity
NNSA - MOX
Start Date and Funding Amount
January 2014; $213,645
PI and co-PI's
Dr. J Vaun McArthur and Dean Fletcher – SREL
Objectives
Our overall goal is to provide a comprehensive assessment of the Upper Three Runs Tributary (U8) that originates beside the MOX construction site. Hydrologic, geomorphic, and biologic features of the stream are being assessed as well as contaminants accumulating in stream sediments and biota. Through a collaborative effort, restoration and post-treatment monitoring plans will be developed.
Summary of Research Activities
Integration of our work on tributary U8 into additional SRS stream studies is expanding the geographic scope of our work as well as incorporating additional critical expertise into our collaborative effort. The NNSA-MOX funded study, while providing a nucleus for the U8 work to be built around, will benefit by contaminant analyses being placed into a broader spatial perspective by making comparisons to other stressed SRS streams (e.g. Crouch Branch funded by NNSA-Tritium and McQueen Branch funded by SRR). Use of the same study taxa along with identical laboratory and field protocols is allowing seamless comparison of data among these efforts. Overall, our contaminant assessments include five streams in the Upper Three Runs basin. Geomorphic and hydrologic analyses have also been conducted in collaboration with the University of Kentucky and funded by the USDA Forest Service-SR in a project aimed at setting up a mitigation bank for SRS headwater streams. U8 is on a short list of streams being evaluated for restoration potential.

A large proportion of contaminants in lotic systems can be stored in sediments, particularly those in depositional zones where finer sediments and organic matter tend to settle out. We are analyzing multiple composite sediment samples from both sandy runs and depositional zones in each of the 5 study streams. Analyzing contaminant accumulation in macroinvertebrates is enhancing our assessments of contamination by verifying which contaminants detected in the sediments are bioavailable and actually entering the stream community. Macroinvertebrates are known to accumulate a variety of contaminants and represent trophic links between primary production and higher trophic level vertebrates. We selected three groups of aquatic macroinvertebrates as biomonitors for the current study: dragonfly nymphs, crane fly larvae and crayfish. Composite samples are being analyzed for each media category. Concentrations of 18 trace elements (Be, Mg, Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Sr, Cd, Ba, Pb, and U) are being determined by inductively coupled plasma mass spectrometry. Total mercury concentrations are being determined with a DMA-80 direct mercury analyzer. Additionally, Cs-137 is being analyzed using an auto-gamma counter. All contaminant analyses are being conducted at SREL. As indicators of carbon diet source and trophic position in all study taxa, stable isotope analyses of C and N are being performed. In early FY 15 we will complete chemical analyses of 108 sediment, 412 dragonfly, 365 crayfish, and 105 crane fly samples. A total of 990 composites will be completed in FY15. Additional sediment composites will be collected in FY15 to assess temporal variability associated to wet years. Analysis of geomorphic and hydrologic variables will be completed in FY15. Dragonfly community richness was reduced in U8 compared to references streams with sensitive genera missing. Life history differences between genera and disturbance status have also been observed.
Conclusions
1. Initial results are indicating tributary U8 to be severely degraded with impaired hydrology, geomorphology, and biological communities. Statistical analyses of physical and biotic parameters are in progress as are contaminant analyses.
2. Contaminant analyses will be completed in FY15.

Major Impact(s) of Research

1. We will assess potential impacts of MOX construction and other activities in the U8 drainage. Condition of physical habitat will be assessed as will the biotic communities.
2. Extensive contaminant analyses will establish whether contaminants are stored in stream sediments and whether bioavailable contaminants are entering the aquatic food web.
3. Through a collaborative effort with multiple onsite and offsite collaborators, we will propose a restoration plan including post-treatment monitoring for tributary U8.

Other Project Personnel

Paul Stankus, Research Professional – SREL
Angela Lindell, Research Professional – SREL
John Seaman, Senior Scientist – SREL

External Collaborators

Christopher Barton – University of Kentucky
Richard Biemiller – University of Kentucky
James Fudge – SRNL
John Blake – USDA Forest Service

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 2013; $302,190
PI and co-PI's
Dr. Gary Mills and Dean Fletcher - SREL
Objectives
Broadly, the goal of this research is to support, assess and improve operations of the NNSA constructed wetlands to maintain treatment efficiency and ensure long-term sustainability. Our primary objectives are to: (1) assess the efficiency of metal attenuation and determine the biogeochemical processes controlling metal removal; (2) characterize specific substrates that sequester metals within the sediments and assess their geochemical stability;(3) determine the bioavailability of metals that escape sequestration and enter regulated stream waters; (4) evaluate disturbance conditions, including storm events, that facilitate metal remobilization and export from the system; and (5) examine the potential transfer of metals to terrestrial food webs via bioaccumulation by aquatic macroinvertebrates that are subsequently preyed upon or emerge from the wetland as adult flying insects.
Summary of Research Activities
In FY-14, we continued monthly monitoring of metal concentrations and water quality parameters in surface waters as well as our seasonal collection of sediment cores. 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). Influent Cu concentrations ranged from 14.0 to 34.5 ppb and were within historical values but less variable. Effluent Cu concentration ranged from 7.2 to 14.6 ppb (mean = 12.0 ppb). Influent and effluent concentration for Zn ranged from 9.36 to 35.6 ppb and 3.16 to 19.5 ppb, respectively. These results are consistent with data from previous years. Analysis of sediment cores collected during summer and winter seasons show that Cu and Zn continue to increase in the upper 5 cm of the wetland sediments with little accumulation in the deeper (15-30 cm), sulfide-laden layer. Although sulfide minerals are not visually apparent in the surface sediments, reactive sulfides can accumulate to geochemically relevant concentrations by diffusion from the deeper sulfide mineral layer. Consequently, we initiated a survey of reactive sulfide concentrations, measured as acid volatile sulfides, in the surface sediments (0-5 cm). This is a well-established approach for assessing mobility and bioavailability in reducing and suboxic sediments.

We continued studies evaluating methods for determining the bioavailable forms of metals in SRS wetland and stream waters focusing on diffusive gradient thin films (DGT), a passive, diffusion-based, *in-situ* sampling device designed to mimic a biological membrane. DGT potentially provide a rapid method for determining metal bioavailability that can assist regulators in setting appropriate standards that account for mitigating water quality characteristic that reduce toxicity. Using DGT exposure coupled with aquatic organism bioassays, we assessed the use of DGT as a tool for estimating Cu bioavailability. The metal species accumulated by DGT, free Cu ions and labile Cu complexes, are generally considered to be the bioavailable metal species. Fathead minnow (*Pimephales promelas*) and a freshwater mussel (*Lampsilis cariosa*) soft tissue Cu concentrations were compared with DGT accumulated Cu after 2, 4, and 6 days of exposure to a Cu concentration series in static, water-only assays. DGT accumulated Cu was found to include free Cu ions, labile inorganic Cu complexes, and labile dissolved organic matter Cu complexes when compared to the Cu speciation output from the EPA-Biotic Ligand Model (BLM). Regressions of DGT and fathead minnow accumulated Cu at 4 and 6 days of exposure demonstrated linear relationships; however, DGT over-predicted Cu accumulation in mussels at concentrations greater than 10 ppb. BLM-predicted inorganic Cu had similar relationships to fathead minnow and yellow lampmussel as DGT at all deployment durations.

Analyzing contaminant accumulation in macroinvertebrates is enhancing our assessments by verifying levels of contaminants entering wetland communities. Macroinvertebrates are known to accumulate a variety of contaminants and represent trophic links between primary production and higher trophic level vertebrates. We selected dragonflies as biomonitors because the aquatic nymphs are commonly preyed upon, diverse habitats are utilized in genus-specific manners, and flying adults may further export contaminants from the wetlands. The present study is evaluating contaminant accumulation in nymphs from six sites distributed throughout the H-02 wetland system and from two reference sites. Composite samples were formed for six genera based on site and size class. FY-14 efforts focused on *Anax sp*. that clings to vegetation in mid-water. Elements variably accumulated in *Anax* with some elements differing among sites within the H-02 wetland system. Accumulation often did not follow the same contamination gradient as in water concentrations throughout the system. Consistent with our prediction that genera more closely associated with bottom sediments will accumulate higher concentrations, highest Cu, Mn, and Al concentrations accumulated in *Anax* from shallow water habitats. Shallow water forces *Anax* closer to contaminated bottom sediments. We anticipate genus and element specific patterns of metal accumulation as we analyze additional dragonfly genera. These analyses will further illustrate the value of the H-02 Wetland System as a model system to evaluate factors influencing contaminant accumulation in aquatic organisms. Recognizing that a continuum of water flow runs from the H-02 influent pipes to UTR, we are also analyzing macroinvertebrates from Crouch Branch downstream of the wetlands. Dragonfly nymphs, crane fly larvae, and crayfish are being analyzed from a downstream reach of Crouch Branch, and crayfish from a pool immediately below Road 4.

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.
2. DGT provide a good estimate of metal bioavailability and accumulation for fathead minnow at the exposure concentrations, but are not adequate for assessing metal accumulation for yellow lampmussel, a freshwater bivalve.
3. Complex factors including habitat use and availability can influence contaminant accumulation in aquatic organisms.

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. Our research evaluates the potential transport of contaminants from constructed wetlands to terrestrial environments and supports DOE commitment to good ecological stewardship.
3. 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, Graduate Student – UGA
Savannah Harris, Graduate Student – UGA
Rebecca Philipps, Graduate Student – UGA

External Collaborators

NA

Products

Philipps, R.R., S.L. Lance, D.E. Scott, and G.L. Mills. 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, November 2013, Nashville, TN. (Poster Presentation).

Philipps, R.R., S.L. Lance and G.L. Mills. Evaluation of diffusive gradients in thin films for predicting bioaccumulation of copper in aquatic organisms. Warnell School of Natural Resources Graduate Student Symposium, February 2014, Athens, GA. (Poster Presentation).

Tritium Distribution and Cycling on the Savannah River Site

Funding Entity
NNSA - Tritium
Start Date and Funding Amount
November, 2014; $90,764
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 initially constructed an OBT combustion/extraction line capable of handling large biological samples. Most commercially available extraction lines are designed for small quantities of radiolabeled (^{3}H and ^{14}C) compounds. Initial testing of our combustion system provided poor sample mass recoveries due to incomplete sample oxidation. Therefore, SREL purchased a Carbolite MTT 12/38/850 combustion furnace system in FY 2014 with a chemical oxidation system. The relative efficiency of the commercial system is under evaluation using traceable ^{3}H-labeled organic compounds.

While the extraction methodology is under development, we have continued to collect and archive 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 and vegetation samples has been completed. In collaboration with Dr. J. Beasley, we have collected a limited number of receptor species (e.g., rodents) from various SRS "control' locations, with an additional round of sample collection scheduled for summer 2015.
Conclusions
Conclusions to date are based on conventional tritium extractions methods.
4. 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.
5. 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. As a low-energy beta emitter, ingestion is the primary source of environmental dose. Therefore, 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
Dr. James Beasley – SREL
Robert Thomas, Graduate Student – UGA
Matt Baker, Graduate Student – UGA

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

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 FY14, 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 regional 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 180 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. Temporally SRS stream disturbances span from 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. 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 (20 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.

In FY14, data processing, analysis and manuscript writing continued with data from our 20 Level III analysis locations. Stream geomorphology is being characterized by calculated variables such as bank full area, wetted width and perimeter, width depth ratio, hydraulic radius, entrenchment ratio, and bottom firmness. Channel stability is being established by quantifying changes in these characters over time. Base flow water quality parameters incorporated into our analyses include major anion and cation concentrations, specific conductance, pH, and TOC. Total suspended solids was measured from samples collected by ISCO automated water samplers equipped with flow actuators designed to trigger the unit during flood events. The Richards-Baker Flashiness Index is characterizing stream discharge flashiness. Habitat was further characterized by quantifying habitat features such as canopy and silt coverage, abundance of macrophytes, undercut banks, root mats, as well as substrate composition and leaf decomposition rates. Our analyses are providing a comprehensive assessment of the physical state and stability of the stream. We are further analyzing the relationship of these physical parameters with metrics characterizing stream macroinvertebrate communities. Metrics include measures of taxa richness, relative abundance, and density of functional feeding groups and key taxa. Integration of our assessments with contaminant analyses funded by SRR, NNSA-MOX and NNSA-Tritium is establishing whether contaminants are a concern in a subset of our sites. Using information accumulated from the three levels of assessments, we began prioritizing tributary drainages that may be suitable for a stream restoration mitigation bank. This list will be completed in FY15.

Conclusions

1. Preliminary analyses are identifying streams receiving excessive stormwater runoff to be the most disturbed systems of our study streams.
2. Even though streams have often stabilized from pre-SRS legacy impacts, some risks appear to persist.

Major Impact(s) of Research

1. We will verify effects of legacy and current disturbances on stream chemistry, hydrology, geomorphology, and biology on select SRS streams.
2. Through a collaborative effort with multiple onsite and offsite collaborators, we will propose restoration plans including post-treatment monitoring for a series of tributary basins.
3. A framework upon which a headwater stream mitigation bank can be built is being developed.

Other Project Personnel

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

External Collaborators

Christopher Barton – University of Kentucky
Richard Biemiller – University of Kentucky
John Blake – USDA Forest Service-SR
James Fudge – SRNL
Michael Paller – SRNL

Products (Publications, Presentations, Technical Reports)

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, 219 pp.

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, WA, 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-SR, 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-SR, 9 pp.

Fletcher, D.E., R. Biemiller, M.H. Paller, C.D. Barton. 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-SR, 3 pp.

Fletcher, D.E., R. Biemiller, and C.D. Barton. 2014. 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-SR, 3 pp.

Biemiller, D.E. Fletcher, and C.D. Barton. Evaluating the influence of disturbance on macroinvertebrate colonization of leaf packs in Upper Coastal Plain headwater streams. Conference on Ecological and Ecosystem Restoration, New Orleans, LA, July 2014. (Poster).

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 2014; $164,331

SREL Collaborators

Dr. O.E. Rhodes, Dr. Jim 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 (e.g., vultures, gulls, waterfowl, blackbirds) from unwanted and/or dangerous locations and to determine whether sound treatments with the LRAD affect avian behavior. Sound treatments will occur either at existing sites where these targeted species naturally 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 of birds with a history of aviation collisions: vultures, waterfowl, blackbirds and gulls.

Vultures –We wing-tagged an additional 200 vultures in summer 2014, resulting in approximately 300 total marked individuals to include in our bait site defense analyses. We conducted 26 trials of the LRAD at created bait sites comparing numbers of vultures before and after sound treatments. The LRAD was effective at dispersing attending vultures. GSM transmitters deployed in years 1 and 2 are resulting in 100-300 locations of individual birds per day and have provided > 1,000,000 total positions as of September 2014. Analyses are proceeding on determining typical flight and movement patterns at extremely fine temporal scales, as well as home ranges and resource selection patterns; data that can be used to estimate risks of bird strikes with aircraft.

Waterfowl – During the winter of 2013-2014, we marked > 200 ring-necked ducks on L-Lake, including deployment of 150 nasal saddles and 50 VHF transmitters. We conducted trials (LRAD treatments) on these marked and other unmarked waterfowl on a baited site on L-Lake as well as the lower end of the lake. Assessment of the efficiency of the LRAD at dispersing (1) radio-tagged waterfowl, (2) marked waterfowl, or (3) all waterfowl from either the bait site or the lower lake suggested that the LRAD was not effective at dispersing waterfowl under these conditions. Trials will continue in FY15.

Blackbirds – We conducted three trials on blackbirds at winter roosts with varying results. This was due in part to the transitory nature of these birds at this time of year. Additional trials will be conducted in FY15.

Gulls – We will test the LRAD on gulls at winter locations (L-Lake and/or landfill) in FY15.

Conclusions

1. This project, as well as the resulting analyses, is on-going.
2. Through the reported trials to date, the LRAD appears effective at dispersing certain species (vultures) but not others (blackbirds & waterfowl).

Major Impact(s) of Research

1. The on-going research will provide information to assist in the determination of the ability of this device (LRAD) to disperse nuisance birds from unwanted locations.
2. From this research we will be able to quantify fine-scale movement patterns of black and turkey vultures for use in elucidating bird strike risks with aircraft.

Other Project Personnel

Dr. Mike Byrne – Postdoctoral Research Associate – SREL

Zak Smith – Temporary Research Technician - SREL

External Collaborators

Dr. Travis DeVault – USDA Wildlife Services

Dr. Bradley Blackwell – USDA Wildlife Services

Products

Holland, A.E., M.C. Byrnes, A.L. Bryan, T.L. DeVault, O.E. Rhodes, and J.C. Beasley. Fine-scale assessment of seasonal home ranges for resident black and turkey vultures in the southeastern US. American Ornithologist Union, Estes Park, CO, 9/25/2014, oral presentation.

Holland, A.E., M.C. Byrnes, A.L. Bryan, T.L. DeVault, O.E. Rhodes, and J.C. Beasley. Efficacy of solar-powered *Groupe Special Mobile/Global Positioning System* (GSM/GPS) transmitters in a range of weather conditions. Symposium of Animal Movements and the Environment, Raleigh, NC, 5/6/2014, poster presentation.

Bryan, L, A. Holland, J. Beasley and G. Rhodes. Examining vulture movements and behaviors with GSM/GPS transmitters. *Tracker News* 15:5. [Microwave Telemetry, Inc., Spring 2014].

Effect of Bait Type and Persistence Time on Scent Station Visitation Rates by Carnivores

Funding Entity
SREL
Start Date and Funding Amount
September 1, 2013; NFP
SREL Collaborators
Dr. James C. Beasley
Objectives
The objectives of this study are to 1) evaluate visitation rates of common carnivores in the southeastern U.S. to scent stations baited with fatty acid tablets against a suite of alternative carnivore-based attractants, and 2) evaluate latency to detection of each lure for individual carnivore species as well as the influence of sampling period length on visitation rates and population estimates.
Summary of Research Activities
During fall 2013 we conducted 178 scent station trials across the SRS. Trials were balanced among 5 lure types: fatty acid, synthetic fermented egg, fish oil, beaver castor, and skunk essence. Trials were conducted for 2 weeks and we monitored visitation using Reconyx infrared remote cameras. All camera images from the 2013 trials have been analyzed and additional trials have been planned for fall 2014.
Conclusions
From those experiments conducted to date, coyote, bobcat, and striped skunk all exhibited significant differences in visitation frequencies among bait types. From these preliminary results it appears fish oil and skunk essence, not the commonly used fatty acid tablets are most effective for attracting carnivores to scent stations. Overall synthetic fermented egg had the lowest average latency to detection followed closely by fish oil and skunk essence. These results, although preliminary, suggest fatty acid tablets, which are the most commonly used carnivore attractant for scent station research, may be less efficient than other common lures in attracting carnivores.
Major Impact(s) of Research
1. Scent stations are one of the most common methods used to survey carnivore abundance and thus this research will provide important guidance to refine and improve methodology to survey a suite of carnivore species.
2. This research will determine the optimal lures and survey duration periods necessary to maximize efficiency of carnivore scent station surveys.

Other Project Personnel
Sarah Webster, M.S. Student – SREL
Zach Smith, Research Technician – SREL
James Leaphart, Research Technician – SREL
External Collaborators
NA
Products
Webster, S., and J.C. Beasley. 2014. Evaluation of scent lures for carnivore scent station surveys. Warnell Graduate Student Symposium. Athens, GA. (Poster 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
1. Preliminary results indicate several genes involved in pigmentation biological processes are down-regulated in the skin of northern populations of this species in comparison with southern populations.

Major Impact(s) of Research
1. This research represents the most comprehensive phylogenetic study of Virginia opossums to date and will produce novel information on the phylogeny and evolution of traits in opossum populations across the species' range.

Other Project Personnel
Sarah Webster, M.S. Student – UGA
External Collaborators
Sergio Nigenda – UCLA
Products
Nigenda, S., R. Harrigan, H. Ruiz-Pina, J.C. Beasley, D. Valenzuela, and R. Wayne. 2014. Phenotypic variation and differential gene expression in opossum populations inhabiting different environments. Evolution. Raleigh, NC. (Oral Presentation)

Development of Genetic-Based Mark-Recapture Tools for Feral Swine

Funding Entity
USDA – Wildlife Services – National Wildlife Research Center
Start Date and Funding Amount
May 1, 2014; $35,000.00
SREL Collaborators
Dr. Olin E. Rhodes, Jr. and Dr. James C. Beasley
Objectives
The objectives of this study are to quantify detection rates for wild pig scat and evaluate the effects of survey protocol, scat characteristics, and environmental parameters on scat detection. In addition, through this research we will develop a suite of microsatellite markers that are optimized for fecal sampling in wild pigs.
Summary of Research Activities
During July-August 2014 we surveyed 58km of transects established in upland pine and bottomland hardwood habitat on the SRS for pig scat to quantify differences in scat detection rates among habitat types. In addition, at each detected scat we conducted a suite of radial searches (5-20m) as well as an adaptive cluster sampling approach to assess the influence of survey methodology on scat detection rates. We additionally conducted surveys to quantify the influence of scat size, the number of pellets present, weather, and percentage ground cover on scat detection among observers. During summer-fall 2014 we collected fecal samples and ear tissue from culled pigs to conduct laboratory studies in order to characterize a suite of microsatellite markers that are optimized for wild pig scat. All samples have been collected for this research and currently are being analyzed in the laboratory.
Conclusions
This study has just begun; there are no conclusions at this time.
Major Impact(s) of Research
1. This research will provide a robust assessment of the factors influencing wild pig scat detection and the efficacy of a suite of potential scat survey protocols. These data will be used to establish a framework to advise future population estimation studies and management of wild pigs across their range.
2. From this research we will produce a suite of microsatellite markers for wild pigs that are optimized for fecal sampling. Delineation of these markers will be essential for future non-invasive mark-recapture research in wild pigs.

Other Project Personnel
David Keiter, M.S. Student – UGA
Shem Unger, Postdoctoral Research Associate – SREL
External Collaborators
Dr. Frederick Cunningham ─ USDA
Toni Piaggio ─ USDA
Kim Pepin – USDA
Products
No publications, reports, or presentations have been prepared to date.

Sub-lethal health effects of chronic exposure to contaminants in raccoons and wild 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 wild 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 wild 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. A manuscript detailing these findings is nearly complete.
Conclusions
1. Raccoons sampled from the D-area ash basins had significantly higher burdens of copper, arsenic, and selenium in their liver tissue than individuals sampled from reference locations.
2. Although raccoons with higher copper concentrations had more diverse and higher endoparasite burdens, no other adverse health effects were observed in raccoons exposed to higher levels of contaminants.

Major Impact(s) of Research
1. Raccoons are good sentinels of metal and metalloid pollution.
2. Metal/metalloid levels observed in raccoons sampled in the vicinity of the D-area ash basin are below the threshold believed needed to cause adverse effects in mammals and no adverse effects were observed in comparison with individuals sampled from a nearby uncontaminated site.

Other Project Personnel
Sarah Webster, M.S. Student – UGA
Ricki Oldenkamp, M.S. Student – UGA
External Collaborators
Dr. Samantha Wisely – University of Florida
Felipe Hernandez – University of Florida
Products
Hernandez, F, S. Wisely, and J.C. Beasley. (2014). Are raccoons good sentinels of heavy metal contamination? A wildlife health perspective. Florida Cooperative Fish and Wildlife Research Unit. Gainesville, FL. (Poster Presentation).
Hernandez, F, S. Wisely, and J.C. Beasley. (2014). Are raccoons good sentinels of heavy metal contamination? A wildlife health perspective. Ecohealth. Montreal, Canada. (Poster Presentation).

Dose Titration and Duration of Rhodamine B as a Biomarker in Feral Swine

Funding Entity
USDA – Wildlife Services – National Wildlife Research Center
Start Date and Funding Amount
May 1, 2014; $14,934.00
SREL Collaborators
Dr. James C. Beasley and Dr. Olin E. Rhodes, Jr.
Objectives
The objectives of this study are to evaluate the minimum effective dose of Rhodamine B to reliably mark guard hair and vibrissae of wild pigs and determine the duration of marks in these tissues subsequent to Rhodamine B exposure.
Summary of Research Activities
Wild pigs were live-trapped throughout the SRS during spring of 2014 to quantify uptake of Rhodamine B (RB) in vibrissae and guard hairs as a function of dose. Fifteen wild 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, 15, or 5 mg/kg. Vibrissae and guard hairs were collected prior to the administration of RB as control samples. Pigs were maintained in captivity for 12 weeks and guard hair and vibrissae samples were collected every 2 weeks. All samples collected will be evaluated for the presence of RB using fluorescence microscopy and the number of samples exhibiting marking consistent with Rhodamine B exposure will be quantified for each individual and for each sample type (guard hair vs. vibrissae).
Conclusions
This study has just begun; there are no conclusions at this time.
Major Impact(s) of Research
1. This research will provide the first data to date on the effective RB dose required to sufficiently mark wild pigs. These data will be highly informative for any future control of wild pigs through use of pharmaceutical baits.
2. From this research we will produce RB degradation models that will allow us to predict the probability of detecting RB marks in exposed individuals as a function of time since exposure.

Other Project Personnel
Sarah Webster, M.S. Student – UGA
James Leaphart, Research Technician – SREL
External Collaborators
Dr. Frederick Cunningham – USDA
Products
Webster, S.C., F.L. Cunningham, O.E. Rhodes, Jr., and J.C. Beasley. Evaluation of Rhodamie B as a biomarker for assessing bait acceptance in wild pigs. Starkville, MS. (Poster Presentation).
Beasley, J.C., S.C. Webster, O.E. Rhodes, Jr. and F.L. Cunningham. 2015. Evaluation of Rhodamine B as a biomarker for assessing bait acceptance in wild pigs. ***Wildlife Society Bulletin*** 39: 188-192.

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; $11,660.00
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 wild pigs by quantifying presence in both guard hair and vibrissae of male and female wild pigs of various age classes at one and two weeks post-exposure.
Summary of Research Activities
Wild pigs were live-trapped throughout the SRS during fall 2013 to quantify uptake of Rhodamine B (RB) in vibrissae and guard hairs. Thirty wild 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 wild pigs, as well as evaluate the potential impacts of pig baits on non-target species.
2. Rhodamine B exposure can be detected as little as 1 week (or potentially less) following exposure, suggesting field sampling of pigs can begin almost immediately following bait distributions.

Other Project Personnel
Sarah Webster, M.S. Student – UGA
Zachary Smith, Research Technician – SREL
Lincoln Oliver, Research Technician – SREL
External Collaborators
Dr. Frederick Cunningham – USDA
Products
Beasley, J.C., S.C. Webster, O.E. Rhodes, Jr. and F.L. Cunningham. 2015. Evaluation of Rhodamine B as a biomarker for assessing bait acceptance in wild pigs. ***Wildlife Society Bulletin*** 39: 188-192.
Webster, S.C., F.L. Cunningham, O.E. Rhodes, Jr., and J.C. Beasley. Evaluation of Rhodamie B as a biomarker for assessing bait acceptance in wild pigs. Starkville, MS. (Poster Presentation).

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; $21,665.00
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 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
1. Scavenger community composition differs substantially as a function of carcass size and season, with increased diversity during the winter owing to longer carcass persistence.
2. The proportion of carcasses scavenged by vertebrates increases as a function of carcass size.

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, M.S. Student – UGA
Erin Abernathy, M.S. Student – UGA
Zachary Smith, Research Technician – SREL
Lincoln Oliver, Research Technician – SREL
External Collaborators
Dr. Mike Conner – Joseph Jones Ecological Research Center
Products
Turner, K, E. Abernethy, O.E. Rhodes, Jr., and J.C. Beasley. The Effects of Carcass size, Habitat Type, and Season on Scavenging Communities in the Coastal Plain of the Southeast. Warnell School of Forestry and Natural Resources Symposium, Athens, GA, February 2014 (Oral presentation).

Turner, K., E. Abernethy, O.E. Rhodes, Jr., and J.C. Beasley. 2014. Effects of carcass size and habitat type on the composition and efficiency of vertebrate scavenging communities. The 21st Annual National Meeting of the Wildlife Society. Pittsburgh, PA.

Turner, K., M. Conner, and J.C. Beasley. 2014. The effect of species exclusions on scavenging community dynamics. Georgia Chapter of the Wildlife Society Annual Meeting. Tifton, GA.

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

Funding Entity
U.S. Army Center for Health Promotion and Preventative Medicine
Start Date and Funding Amount
September 1, 2013; $9,000
SREL Collaborators
Dr. James C. Beasley
Objectives
The objective of this research is to determine whether small mammals residing in habitats contaminated with radionuclides, 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 trapping for this research was conducted during March-May 2014. Sampled sites included Pond B, Tim's Branch, Upper 3 Runs, and the D-area ash basins on the SRS. All captured individuals were necropsied and various organs and tissues were collected to conduct body burden assessments of contaminants and determine if elevated exposures have contributed to altered reproductive parameters (e.g., sperm counts, sperm morphology, ovarian follicle counts).
Conclusions
This research has just begun, thus there are no conclusions at this time.
Major Impact(s) of Research
1. 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
Lawrence Tannenbaum – U.S. Army Center for Health Promotion and Preventative Medicine
Products
No publications, presentations, or reports have been prepared yet.

Spatio-temporal Shifts in Coyote Spatial Ecology and Home Range Overlap in Response to Supplemental Food Provisioning

Funding Entity
SREL
Start Date and Funding Amount
September 1, 2014; NFP
SREL Collaborators
Dr. James C. Beasley
Objectives
The objective of this study is quantify the effects of resource availability on coyote movement behavior, home range overlap, and social interactions through manipulation of carrion food resources. Despite the importance of carrion to carnivores, few studies have evaluated how these resources influence their movement behavior or intraspecific interactions. Moreover, I am not of aware of any studies that have assessed the influence of resource availability and predictability on coyote spatial ecology. Collectively, these questions have important implications to disease transmission dynamics, food web ecology, and management of carrion and other food resources.
Summary of Research Activities
During winter/spring 2014/15 we will attach GPS transmitters to free-ranging coyotes on the SRS. Additional coyotes will be fitted with GPS transmitters on nearby properties outside SRS boundaries to serve as controls. Movement behavior of all individuals will be monitored during spring 2015 and beginning 1 June 2015 we will establish multiple sites baited with wild pig carcasses within the general home range boundaries of collared coyotes on the SRS. Carcasses will be maintained at sites for several months and we will subsequently quantify shifts in coyote spatial ecology in response to carcass placement. Off-site coyotes will serve as controls without manipulation of food resources.
Conclusions
This project has just begun, there are no conclusions at this time.
Major Impact(s) of Research
1. This research will have important implications to the management of carrion resources as well as the impact of carrion on potential shifts in disease transmission dynamics in wild carnivores.
2. Despite the large number of wild pigs culled throughout the U.S. during efforts to manage this invasive species, disposition of carcasses following culling operations currently do not take potential impacts to food-web dynamics or disease transmission dynamics into consideration. This research will elucidate potential ecological impacts of wild pig carrion on the spatial ecology of apex carnivores in southeastern ecosystems.

Other Project Personnel
Sarah Webster, M.S. Student – UGA
Michael Byrne, Postdoctoral Research Associate – SREL
Ernest Borchert, Research Technician – SREL
External Collaborators
Dr. John Kilgo – USFS-SR
Products
No publications, presentations, or reports have been prepared yet.

Survival and Cause-Specific Mortality of Juvenile Feral Swine

Funding Entity
USDA – Wildlife Services – National Wildlife Research Center
Start Date and Funding Amount
September 30, 2014; $25,300.00
SREL Collaborators
Dr. James C. Beasley
Objectives
The objectives of this study are to quantify survival and cause-specific mortality of juvenile wild pigs. Survival will be evaluated as a function of a suite of demographic and environmental attributes (e.g., age of sow, weight of piglet, litter size).
Summary of Research Activities
This research has just begun. We have established a collaboration with Dr. John Kilgo at USFS and begun discussing a research plan that we will begin carrying out in winter 2015. Pilot data for this research were collected in spring 2014 on 20 piglets that were monitored by USFS personnel.
Conclusions
This study has just begun; there are no conclusions at this time.
Major Impact(s) of Research
1. This research will provide the first data to date on the survival of juvenile wild pigs, data that are essential to the development of robust population growth models.
2. This research will evaluate multiple transmitters for monitoring piglet survival and provide future researchers with recommendations for a model from which future studies can be based.
3. Determine cause-specific mortality of juvenile wild pigs as well as the influence of key demographic parameters (e.g., age of sow, weight of piglet, etc.) on survival rates of pigs.

Other Project Personnel
David Keiter, M.S. Student – UGA
External Collaborators
Dr. John Kilgo – USFS-SR
Mark Vukovich – USFS-SR
Dr. Frederick Cunningham – USDA
Products
No publications, reports, or presentations have been prepared to date.

Post-translocation Movement Behavior of Feral Swine

Funding Entity
USDA – Wildlife Services – Veterinary Services
Start Date and Funding Amount
September 5, 2014; $45,870.00
SREL Collaborators
Dr. James C. Beasley
Objectives
The objective of this study is to quantify the movement behavior of wild pigs pre- and post-translocation to elucidate the movement behavior of translocated individuals, as well as shifts in movement behavior in response to translocation.
Summary of Research Activities
This study has just begun. I have met with USDA researchers and developed a research plan that will be carried out beginning January, 2015. All transmitters have been purchased and I have begun searching for personnel that will assist with this research.
Conclusions
This study has just begun; there are no conclusions at this time.
Major Impact(s) of Research
1. This research will produce the first data to date on the spatial ecology of wild pigs subsequent to translocation.
2. This research will provide important insights to guide future management of invasive wild pigs and will produce critical data to better develop disease transmission models for wild pigs.

Other Project Personnel
None
External Collaborators
Dr. Ryan Miller – USDA
Dan Grear – USDA
Products
No publications, reports, or presentations have been prepared to date.

Effects of resource distribution on coyote population sizes on the SRS

Funding Entity
USFS
Start Date and Funding Amount
July 1, 2013; $10,000
SREL Collaborators
Dr. Stacey L. Lance
Objectives
The overall objective in this project is to determine if the protocol of having contract killers hired to control/reduce wild hog populations leave the carcasses where shot is impacting coyote abundance. We will estimate coyote abundances across the SRS using genetic mark-recapture techniques and collecting scat along transects for one year. Then all hog carcasses will be left on only one half of the SRS for the next year and we will repeat the transect and genetic studies to determine if the alteration of the food resource has impacted coyote density patterns.
Summary of Research Activities
Mark Vukovich of the USFS conduced the first scat surveys in July 2013. These will be repeated in October 2013, January 2015, and April of 2015. In June of 2015 the experimental phase will begin and surveys will be repeated for at least on year.
Conclusions
Data are still being collected, thus there are no conclusions at this time.
Major Impact(s) of Research
Too early to determine.
Other Project Personnel
Rochelle Beasley, Research Professional - SREL
External Collaborators
Dr. John Kilgo – USFS-SR
Mark Vukovich – USFS-SR
Products
No publications, presentations, or reports have yet been prepared.

Collaborations and Externally Funded Research Non - SRS

Savannah Harbor Expansion Project: Cadmium in Birds

Funding Entity
U.S. Army Corps of Engineers
Start Date and Funding Amount
November 11, 2013; $96,905
SREL Collaborators:
Dr. Olin E. Rhodes, Jr. and A. Lawrence Bryan, Jr.
Objectives
To monitor the potential uptake of cadmium and other metals in dredge materials by birds, including resident and migratory species, associated with the dredge containment impoundments being employed as part of the Savannah Harbor Expansion Project. A natural layer of cadmium is present in the harbor sediments and will likely be dredged (and enter the impoundments) in the second or third year of the project. Current samples are considered "control" or pre-contaminant samples to assess potential uptake.
Summary of Research Activities
We initiated collections of avian blood and/or tissue samples from sentinel avian species listed by the U.S. Army Corps of Engineers (USACE) in April of 2014 and completed our spring/summer sampling in August 2014. Blood and tissue samples were archived pending collection of Year 1 Winter (December 2014 – February 2015) samples.
Conclusions
No conclusions pertaining to cadmium/metals uptake at this time. The project is on-going, to be completed in approximately 5 years.
Major Impact(s) of Research
None at this time, given the completion of only the first season of the control year.
Other Project Personnel
Frank C. Depkin, Research Technician – SREL
External Collaborators
Dr. Susan Wilde – UGA
Brigette Haram – UGA
Products
Project is on-going, so none at this time other than brief quarterly progress reports to USACE.

Kings Bay Rare, Threatened and Endangered Wildlife Surveys: Wood Storks and Wading Birds

Funding Entity
DoD-Navy/USACE
Start Date and Funding Amount
June 18, 2014; $35,745
SREL Collaborators:
A. Lawrence Bryan Jr. and Dr. Olin E. Rhodes Jr.
Objectives
To monitor the use of aquatic habitats on the Kings Bay Submarine Base for use by wood storks and other wading birds, including the use of the base as a breeding site.
Summary of Research Activities
We initiated monitoring of selected base aquatic habitats in July of 2014 after establishing road survey routes adjacent to these habitats. We also initiated periodic visits to the primary breeding site (colony) on base, although timing of the funding arrival did not allow us to monitor for the entire breeding season. Monitoring roadside habitats has continued monthly through the post-breeding season.
Conclusions
No conclusions at this time. The project is on-going, to be completed in September of 2015.
Major Impact(s) of Research
1. Wood storks, a "threatened" species under ESA, used multiple aquatic habitats and nested in small numbers on the base in 2014.
2. Many other wading bird species, several considered state-listed species of concern, also utilize base aquatic habitats and nest on the facility.

Other Project Personnel
Frank C. Depkin – SREL
External Collaborators
NA
Products
No publications, presentations, or reports have yet been prepared.

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; $60,781
SREL Collaborators
Dr. James C. Beasley and Dr. Stacey L. Lance
Objectives
The overall objectives of this project are to measure the spatial and temporal variation in radiation dose that individual wolves experience throughout the Chernobyl Exclusion Zone (CEZ), quantify the relationship between dose and sub-lethal effects, and quantify the distribution and density of carnivores throughout areas of the CEZ varying widely in radionuclide contamination.
Summary of Research Activities
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. Following this workshop we were given the green light by the Ministry for Emergency Situations to move forward with submitting proposals to work in Belarus, a huge step forward as no western scientists have been permitted to conduct wildlife research on the Belarusian side of the CEZ. Since this workshop, we have submitted multiple proposals to various organizations and foundations and have received funding from the National Geographic Society and IRSN. We are currently in the final stages of planning our first trip to the CEZ to deploy GPS-dosimetry collars and conduct carnivore surveys, which will begin October, 2014.
Conclusions
This research has just begun, thus there are no major conclusions at this time. However we have validated the GPS/dosimetry technology in the laboratory and in the field on three wild pigs at the SRS and have produced a manuscript detailing these experiments. We will begin field work in the CEZ in October 2014.
Major Impact(s) of Research
1. First time use of coupled GPS-dosimetry to directly measure radiation dose rates for free-ranging animals in the CEZ.
2. Use our telemetry/dosimetry data to directly examine the relationship between sub-lethal effects (e.g., disease, immunosuppression, stress) and exposure.
3. Quantify the distribution and density of select carnivores throughout the CEZ.

Other Project Personnel
Sarah Webster, M.S. Student – UGA
Cara Love, Ph.D. Student – UGA
Mike Byrne, Postdoctoral Research Associate – SREL
External Collaborators
Dr. Thomas Hinton – IRSN
Dr. Yuri Bondar – Polesye State Radioecological Reserve
Dr. Dima Shamovich – Researcher and Wildlife Tour Guide, Belarus
Products
Hinton, T.G., M. Byrne, P. Fort, P. Martin, R. Schuman, S. Webster, and J.C. Beasley. *In Press.* Quantifying the spatial and temporal variation in dose from external exposure to radiation: A new tool for use on free-ranging wildlife. ***Journal of Environmental Radioactivity***

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, 2013; $108,038
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 (technical staff, graduate students, undergraduates, postdocs, etc.)
Carol Eldridge, Research Professional – SREL
External Collaborators (and Affiliations)
D. Allen Saxon, Jr. – Augusta-Utilities Department
Tim Weegar – Augusta Regional Airport
Products (Publications, Presentations, Technical Reports)
Kennamer, R. A., I. L. Brisbin, Jr., C. S. Eldridge, and D. A. Saxon, Jr. 2014. Wastewater treatment wetlands: potential hazardous wildlife attractants for airports. Pages 119-131 in *Proceedings of the 15th Wildlife Damage Management Conference*. J. B. Armstrong, G. R. Gallagher, eds. Clemson University, SC.

Kennamer, R. A., I. L. Brisbin, Jr., and C. S. Eldridge. 2014. Abundance, Distribution, and Movement Patterns of Avifauna in the Vicinity of Bush Field Airport: 2013–2014 Report. Final report submitted to Augusta Utilities Department, 149pp.

Kennamer, R. A. Measure to control cattle egret use of Augusta regional Airport. Wildlife Hazard Group Meeting, Augusta Regional Airport, GA. May 2014. (Oral Presentation).

Kennamer, R. A. Blackbird activity at AGS and constructed wetlands during fall-2013/winter-2014. Wildlife Hazard Group Meeting, Augusta Regional Airport, GA. May 2014. (Oral Presentation).

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 FY14
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. The FY14 project specifically investigated incubation temperature as a constraint on the evolution of clutch size and a cost of brood parasitism in birds.
Summary of Research Activities
This research project has been a multi-year investigation. In the last year, we completed manipulations of clutch size in wood duck nests and subsequent, follow-on examinations of trade-offs between female self-maintenance and nest incubation temperature. In these manipulations, we outfitted nests with multiple artificial eggs equipped with temperature data-loggers to monitor micro-locational variations in temperature within nests as it relates to overall clutch size, and to see if females adjust their incubation behaviors in response to the enlarged clutches, which tend to reduce nest temperatures and prolong the incubation period.
Conclusions
1. Data are currently being analyzed and have produced only preliminary results on the FY14 project at this point.

Major Impacts of Research
1. Novel approach to bird nest manipulations through alteration of nest temperatures by enlarging clutch sizes and examining within-clutch temperatures experienced by developing embryos.
2. Forces incubating parents to make decisions potentially affecting current versus future reproduction.
3. Illustrates the potential importance of incubation costs as related to intra-specific nest parasitism.

Other Project Personnel
Maureen McClintock, MS Student – Auburn University
John Hallagan, Research Technician – Virginia Tech
Sydney Hope, MS student – Virginia Tech
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* 131:672-680.

DuRant, S. E., A. W. Carter, R. J. Denver, G. R. Hepp, and W. A. Hopkins. 2014. Are thyroid hormones mediators of incubation temperature-induced phenotypes in birds? *Biological Letters* 10: 20130950.

Role of terrestrially derived carbon in the food webs of rocky intertidal marine organisms

Funding Entity

National Science Foundation – Biological Oceanography; University of Oregon Marine Institute, Brigham Young University and SREL

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

NSF – no funding yet; UOMI – $5000; BYU – $2000; SREL – $800

SREL Collaborators

J Vaun McArthur

Objectives

Determine the role of terrestrially derived carbon in the food web of rocky intertidal marine organisms

Summary of Research Activities

We completed two preliminary experiments – one in the spring and the other in the fall. We estimated the k-values for each organic source and treatment combination using both accumulated Julian days and degree-days. As the results of the degree-day analyses did not provide any additional clarity we present only the Julian day analyses. The three treatments were designed to determine the effects of biological + physical processes (open packs), biological + reduced physical processes (coarse mesh packs), and biological processes (fine mesh packs). Variability in the amount remaining was very high in all treatments. Some of this variation was attributed to some packs being buried in the rocky intertidal and Sunset Stream. Packs that were buried had higher amounts of biomass remaining than unburied packs at the same site. Burial is a natural process. Although the variance was high we did obtain several statistically relevant differences presented below. Based on these results we are preparing another proposal that will be submitted to NSF during 2015.

Conclusions

This research has just begun. However, it is clear that for several rocky intertidal organisms terrestrial litter makes up >30% of their diet. These results have never been shown before..

Major Impact(s) of Research

1. Novel data on rocky intertidal community bioenergetics
2. Experimental evaluation of the role of terrestrial vs. marine algae and sea grass in the food webs of rocky intertidal organisms

Other Project Personnel

None

External Collaborators

Craig Young – University of Oregon Marine ~~s~~Station
Russell Rader – Brigham Young University
Douglas Fairbanks – Brigham Young University

Products

No publications, presentations, or reports have yet been prepared.

Testing bioclimatic thresholds of reptiles predicted by maximum entropy theory

Funding Entity
US Department of the Army – ERDC-CERL
Start Date and Funding Amount
April 2014; $90,734.00
SREL Collaborators
Tracey Tuberville and Kimberly Andrews
Objectives
The overall goal of this research is identify physiological thresholds to predict which reptile species are more vulnerable to potential climate change, with emphasis evaporative water loss and metabolic rates under different temperatures.
Summary of Research Activities
Physiological characteristics play an important role in shaping activity patterns, habitat use, and ultimately, species distribution—particularly for ectothermic vertebrates. For example, evaporative water loss has been shown to be correlated with degree of terrestriality in lizards and snakes, with species with higher evaporative water loss rates presumably constrained in their ability to survive drought and travel overland between aquatic habitats. Individual metabolic rate is another physiological characteristic that can have important consequences at higher levels of organization. In reptiles, approximately 85% of an individual's energy budget is allocated to maintenance. Standard metabolic rates increase with increasing temperatures in reptiles; therefore, assuming equal rates of energy acquisition, a higher proportion of an individual's energy budget is required for basic maintenance at higher temperatures than lower temperatures, with less energy available for growth and reproduction. Thus, both evaporative water loss and standard metabolic rate are physiological attributes influenced by bioclimatic conditions and in turn, are likely to shape species distribution patterns via their ability to occupy or persist at locations near their bioclimatic thresholds.
We conducted evaporative water loss trials for four species of turtles and eight species of snakes to evaluate their relative vulnerability to drought-related desiccation. In addition, we conducted metabolic experiments under three different temperatures for two species of turtles and seven species of snakes. Efforts to collect additional individuals and additional species are ongoing, thus we present only preliminary conclusions below.
Conclusions
1. Aquatic turtles lost 4-10% of their initial body mass due to EWL over 24hr periods, with EWL rates varying among species. In addition, within species, EWL rates decreased with increasing size.
2. Species that exhibited higher EWL rates also tended to experience higher metabolic costs with increasing temperature.

Major Impact(s) of Research
1. Mechanistic explanation for differential ecological responses of reptile species to drought and increased environmental temperatures
2. Experimental validation of species-specific temperature thresholds identified by our CERL collaborators in their maximum entropy analysis.

Other Project Personnel
Bess Harris, Temporary Research Technician – SREL
Samantha Dean, Temporary Research Technician – SREL
David Haskins, M.S. Student – UGA
Chris Murphy, Undergraduate Student – UGA
External Collaborators
Dr. Jinelle Sperry – ERDC-CERL and University of Illinois
Dr. James Westervelt – ERDC-CERL

Products

Murphy, C. 2014. Determining evaporative water loss rates of four species of aquatic turtle from the Coastal Plain of the southeastern US. Senior thesis, University of Georgia.

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 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
We completed a climate change vulnerability assessment of all 117 reptile and amphibian species occurring in the Sandhills ecoregion of the southeastern United States, using NatureServe. We then developed spatially explicit ecological models to identify environmental thresholds to species persistence for two species predicted to be vulnerable to climate change but having different hydroperiod requirements.
Conclusions
Of the 117 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.
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. Identifies 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. Although precipitation and other climate variables are out of management control, other management manipulations can be implemented to mitigate climate threats.

Other Project Personnel
Bess Harris, Temporary Research Technician – SREL
External Collaborators
Dr. Nathan Nibbelink – UGA
Dr. James Westervelt – ERDC-CERL
Dr. Tim Hayden – ERDC-CERL
Dr. Jinelle Sperry – ERDC-CERL
Products
Tuberville, T.D., K.M. Andrews, J.H. Sperry, and A.M. Grosse. *In review*. Use of the NatureServe Climate Change Vulnerability Index as an assessment tool for reptiles and amphibians: lessons learned.

Andrews, K.M., and T.D. Tuberville. Using climate change vulnerability assessments of amphibians and reptiles as a species prioritization tool for determining population thresholds in response to climate change in the sandhills ecoregion, USA. The 9th Southern Forestry and Natural Resource Management GIS Conference, Athens, GA, December 2013.

Ecology 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

May 2011; NFP

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 life stage.

Summary of Research Activities

We investigated the ecology of juvenile gopher tortoises using a variety of techniques, including radiotelemetry, mark-recapture, and automated temperature dataloggers affixed to tortoises.

Conclusions

Temperature loggers 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. 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, M.S. Student, Warnell School of Forestry and Natural Resources, UGA

External Collaborators

Dr. Nathan Nibbelink – UGA

Dr. Terry Norton – St. Catherines Island / Georgia Sea Turtle Center

Products (Publications, Presentations, Technical Reports)

Harris, B.B. 2014. Ecology of juvenile gopher tortoises (*Gopherus polyphemus*) on a Georgia barrier island. M.S. Thesis, University of Georgia.

Harris, B.B., T.M. Norton, N.P. Nibbelink, and T.D. Tuberville. *In press*. Overwintering ecology of juvenile gopher tortoises (*Gopherus polyphemus*). Herpetological Conservation and Biology.

Harris, B.B., T.M. Norton, N.P. Nibbelink, and T.D. Tuberville. Naturally recruited juvenile gopher tortoise growth rates on St. Catherines Island, Georgia. Gopher Tortoise Council, Ponte Vedra Beach, FL, October 2013.

Harris, B.B., T.M. Norton, N.P. Nibbelink, and T.D. Tuberville. Overwintering ecology of juvenile gopher tortoises at St. Catherines Island, Georgia. Southeastern Partners in Amphibian and Reptile Conservation, Lake Cumberland State Resort Park, KY. February 2014. (Also presented at Turtle Survival Alliance meetings, Orlando, August 2014).

Evaluation of head-starting as a recovery tool for the Mojave desert tortoise

Funding Entity

National Park Service, California Energy Commission

Start Date and Funding Amount

Nov 2010; $450,000 (NPS), $313,000 (CEC)

SREL Collaborators

Dr. Tracey Tuberville, 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

Our research activities included monitoring of hatchling and juvenile gopher tortoises in outdoor rearing pens, and radio-tracking of juveniles released into the wild.

Conclusions

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.

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

Jacob Daly, M.S. Student - UGA

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., B.D. Todd, K.A. Buhlmann, and T.D. Tuberville. *In press*. Consequences of maternal effects on offspring size, growth, and survival in the desert tortoise. Journal of Zoology.

Tuberville, T.D., B.D. Todd, K.A. Buhlmann, M. Nafus, M. Peaden, and V. Johnson. 2014. Desert tortoise research, Mojave National Preserve, California: 2013 activities and results. A report to U.S. Fish and Wildlife Service and California Department of Fish and Game. 24 pp.

Buhlmann, K.A., T.D. Tuberville, M.G. Nafus, M. Peaden, V. Johnson, and B.D. Todd. Movements and survivorship of hatching and head-started desert tortoises. Turtle Survival Alliance Meetings, Orlando, FL. August 2014.

Effects of road fencing on desert tortoises

Funding Entity
Bureau of Land Management
Start Date and Funding Amount
July 2013; $230,000
SREL Collaborators
Dr. Tracey Tuberville, 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
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
Peaden, J.M., T.D. Tuberville, K.A. Buhlmann, M.G. Nafus, and B.D. Todd. *In review*. Delimiting road-effect zones for threatened species: implications for mitigation fencing.

Todd, B.D., J.M. Peaden, M.G. Nafus, K.A. Buhlmann, and T.D. Tuberville. Quantifying road effect zones for desert tortoises (*Gopherus agassizii*) to estimate benefits of mitigation and habitat protection. Joint Meetings of Ichthyologists and Herpetologists, Chattanooga, TN. July 2014.

Peaden, J.M., B.D. Todd, M.G. Nafus, K.A. Buhlmann, and T.D. Tuberville. Quantifying road effect zones for desert tortoises (*Gopherus agassizii*) to estimate benefits of mitigation and habitat protection. Turtle Survival Alliance Meetings, Orlando, FL. August 2014.

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
October 2013; $63,075
SREL Collaborators
Dr. Tracey Tuberville and Larry Bryan
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 data to document population trends.
3. When requested by Navy, provide an 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 our third survey (since 2008) of gopher tortoises on Kings Bay Naval Submarine Base, Georgia. In addition, we completed a 12-month assessment of threats to gopher tortoise populations on Whiting Field Naval Air Station (NAS) and associated Holley Outlying Field (OLF) using remote wildlife cameras at 20 active gopher tortoise burrows. As part of the remote camera monitoring, we also characterized the non-tortoise species that used tortoise burrows.

Conclusions
Populations on all surveyed properties are unlikely to be viable in the long-term without significant intervention, including increasing habitat management efforts and potentially even translocations or augmentations. Over 50 species of vertebrates were associated with gopher tortoise burrows, including several previously undocumented species.

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
Nicole White, Temporary research technician – SREL

External Collaborators
Robby Smith – Department of Navy
Ron Cherry – Department of Navy
Dr. Susan Wilde – UGA

Products
Tuberville, T.D., N. White, L. Bryan, S. Wilde. 2014. Gopher tortoise survey of the Kings Bay Naval Submarine Base, Georgia, Cooperative Agreeement #F09AC00232. A report to Department of Navy. 31 pp.

White, K.N., and T.D. Tuberville. Changing perceptions: using of gopher tortoise (*Gopherus polyphemus*) burrows by commensal and associated species. Southeastern Partners in Amphibian and Reptile Conservation, Lake Cumberland State Resort Park, KY. February 2014.

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

Funding Entity
USFWS, Disney Worldwide Conservation Fund
Start Date and FundingAmount
September 2013; $49,900 (Disney), $20,000 (USFWS)
SREL Collaborators
Dr. Kurt Buhlmann and Dr. Tracey Tuberville
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 on 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, M.S. Student - UGA
External Collaborators
Dr. Stephanie Koch– USFWS
Brian Bastarache – Bristol County Agricultural High School
Brian Butler –Oxbow Associates
Dr. Richard Chandler – UGA
Products
Buhlmann, K.A., S. Koch, B. Butler, T.D. Tuberville, V. Palmero, and B. Bastarache. *In press.* Reintroduction and head-starting: Tools for Blanding's turtle (*Emydoidea blandingii)* conservation. Herpetological Conservation and Biology (Special Issue on Turtle Head-starting).

Head-starting to augment gopher tortoise populations on protected areas in Georgia

Funding Entity
Georgia Department of Natural Resources
Start Date and Funding Amount
October 2013; $93,335
SREL Collaborators
Dr. Tracey Tuberville, Dr. Kurt Buhlmann,
Objectives
Evaluate the effectiveness of head-starting as a means of establishing viable populations of gopher tortoises on protected lands in Georgia.
Summary of Research Activities
We protected and hatched nests from three donor sites in Georgia. We continue to monitor released head-started juveniles from the 2013 cohort that have been released into the field. We are currently rearing the 2014 cohort under three experimental diet treatments. The 2014 cohort will be released in May 2015, after which they will be monitored via radio-telemetry and mark-recapture.
Conclusions
Our first year was a pilot study with a small sample size. The full scale project is currently underway and cannot be evaluated until after release of the 2014 cohort.
Major Impact(s) of Research
This work is among the first to evaluate post-release site fidelity and survival of released head-started gopher tortoises. Our results will help determine whether head-starting can be used as a potential recovery tool for the species.
Other Project Personnel
Dan Quinn, M.S. Student - UGA
External Collaborators
John Jensen – Georgia Department of Natural Resources
Dr. Terry Norton – Georgia Sea Turtle Center, Jekyll Island
Products
Quinn, D., K.A. Buhlmann, T.M. Norton, J.B. Jensen, V. Greco, and T.D. Tuberville. Use of head-started gopher tortoises (*Gopherus polyphemus*) to augment populations in managed areas: prospectus. Southeastern Partners in Amphibian and Reptile Conservation, Lake Cumberland State Resort Park, KY. February 2014.

Quinn, D., K.A. Buhlmann, T.M. Norton, J.B. Jensen, V. Greco, and T.D. Tuberville. Evaluating the effectiveness of head-starting as a potential conservation tool for gopher tortoises on managed areas: prospectus. Turtle Survival Alliance Meetings, Orlando, FL. August 2014.

Social isolation and social disruption in a long-lived colonial reptile occurring at high densities: habitat-mediated effects

Funding Entity

Riverbanks Zoo Conservation Fund, Disney Worldwide Conservation Fund, Archbold Biological Station, Cornell University

Start Date and Funding Amount

March 2014; $4,800 (Riverbanks Zoo)

SREL Collaborators

Dr. Tracey Tuberville

Objectives

Our overall objective is to characterize the social dynamics of the gopher tortoise, a long-lived colonial reptile, under high density scenarios associated with declining habitat conditions.

Summary of Research Activities

We have conducted continuous monitoring of social interactions at gopher tortoise burrows using remote wildlife cameras. We have also collected DNA samples from all resident adults in the populations, genotyped them at 24 microsatellite loci, and calculated pairwise relatedness. This year we will continue camera monitoring and genotype offspring from nests collected at the study site, genotype them at at least 10 microsatellite markers, and conduct parentage analysis.

Conclusions

This project is ongoing and we are still in the process of reviewing camera monitoring data to record social interactions in the database. Thus, no conclusions are available at this time.

Major Impact(s) of Research

1. Greater understanding of social behavior derived from this study will inform translocation protocols and support our long-term goal to investigate habitat factors influencing social structure.
2. Provide data for comparison with previously conducted social interaction monitoring in populations at low densities.

Other Project Personnel

Nicole White, M.S. Student - UGA

External Collaborators

Dr. Betsie Rothermel – Archbold Biological Station

Dr. Kelly Zamudio – Cornell University

Products

No publications, presentations, or reports have yet been prepared.

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

March 2012, $ 53,500

SREL Collaborators

Dr. Kurt Buhlmann

Objectives

1. Determine if head-starting hatchling wood turtles (9 mos) post-hatching subsequently increases their survivorship after release.
2. Determine site fidelity, activity ranges, and eventually home range of head-started wood turtles.
3. Compare survivorship and growth of head-started and direct-released wood turtles.

Summary of Research Activities

The Great Swamp National Wildlife Refuge contains a remnant population of state threatened wood turtles (*Glyptemys insculpta*). Surveys and monitoring via radio-telemetry of adult female wood turtles has been on-going for several years. Females nest on artificially constructed nesting areas, where the nests are subsequently protected from predators until hatching. Half of each female's hatchlings are directly-released after marking and measuring, while half of the hatchlings are retained for head-starting in collaboration with a natural resource-focused high school in Massachusetts. Head-started turtles are measured weekly by the students and are returned to the Great Swamp NWR the following Spring. Head-started turtles are radio-tracked for their first growing season to monitor survival and habitat use.

Conclusions

1. Head-started wood turtles have significantly greater survivorship than direct-released hatchlings.
2. Head-started hatchlings are the size of wild 3-4 year old juveniles when they are released (at 9 mos of age).
3. Head-started wood turtles make the greatest movements during their first month post-release, but then occupy ranges with repeatable patterns of movement. Activity ranges of turtles tracked into their second year show even stronger fidelity to their selected range.

Major Impact(s) of Research

1. Turtle life histories include normally high first-year hatchling mortality. Turtles also have delayed sexual maturity, and wood turtles specifically require 14-18 years to mature. Head-starting increases the number of hatchlings surviving the period of normally greatest mortality, thus putting more juveniles on a trajectory towards maturity. For situations where the original cause of population decline has been remediated, head-starting may be an effective conservation tool to boost juvenile recruitment, thus increasing the likelihood of population recovery of endangered species.

Other Project Personnel

Bess Harris, MS Student - UGA

External Collaborators

Colin Osborn – Great Swamp National Wildlife Refuge
Dorothy Fescke – Great Swamp National Wildlife Refuge
Emily Scully – Great Swamp National Wildlife Refuge
Alyssa Frediani – Great Swamp National Wildlife Refuge
Brian Bastarache – Bristol County Agricultural High School
Brian Zarate – New Jersey Department of Environmental Protection

Products

Publications:

Buhlmann, K.A. and C.P. Osborn. 2011. Use of an Artificial Nest Mound by Wood Turtles (*Glyptemys insculpta*): A Tool of Turtle Conservation. Northeastern Naturalist 18(3): 315-334.

Annual Endangered Species Permit Report to New Jersey Department of Environmental Protection, submitted December 2014

Presentations:

Wood Turtle Headstarting Project Update. Presented to the Friends of the Great Swamp National Wildlife Refuge. Endangered Species Day Program, Great Swamp NWR, Basking Ridge, NJ, 22 May 2014

Movements, Survival, and Site Fidelity of Juvenile Desert Tortoises. Presented at Turtle Survival Alliance (TSA) Conference, Orlando, FL, 9 August 2014

Headstarting of Balnding's Turtles and Wood Turtles on National Wildlife Refuges. Presented at Northeast Partners in Amphibian and Reptile Conservation (NEPARC), Stokes State Forest, Branchville, NJ, 15 August 2014

Wood Turtle Headstarting Project Update. Presented to the Friends of the Great Swamp, Summer Board meeting, Great Swamp NWR, Basking Ridge, NJ, 8 September 2014

Obtaining Baseline Population Demography and Nesting Information for Two Species of Map Turtles On the East Pearl and Mike's Rivers, U.S. Navy's Stennis Western Maneuver Area, Mississippi and Louisiana 2014-2015

Funding Entity
U.S. Navy, DOD
Start Date and Funding Amount
August 2014, $ 45,000
SREL Collaborators
Dr. Kurt Buhlmann
Objectives
1. Determine relative population size and demography (adult females, males, juveniles) of Federally threatened Ringed Map Turtles (*Graptemys oculifera*) inhabiting East Pearl and Mike's Rivers.
2. Assess levels of reproduction along stretches of the East Pearl River within Stennis WMA.
3. Assess the level of potential population recruitment from successful nesting within the Stennis WMA.
4. Provide recommendations for habitat restoration and/or enhancement that will assist the U.S. Navy in its responsibility to maintain populations of threatened species.

Summary of Research Activities
The Stennis Western Maneuver Area (WMA) is located on the East Pearl and Mikes Rivers, on the Mississippi/Louisiana border. The property is operated by NASA and the U.S. Navy trains boat-operating missions on site. Although the operation of large boats on the rivers may have disturbance impacts to threatened turtles, the target areas established by the Navy along the riparian floodplain provide opportunities for turtle nesting. Wildlife camera arrays have been established at select target areas and natural sandbars to monitor turtle nesting activity, as well as nest predation.
Conclusions
1. No conclusions are currently available.

Major Impact(s) of Research
The U.S. Navy requires riverine areas to train personnel. There may be opportunities to mutually benefit federally-listed threatened species through creation of open-canopy nesting habitats in otherwise closed riparian forests along the East Pearl and Mikes Rivers. Open canopy areas are needed by the U.S. Navy as target-training areas, and open habitats are required for turtle nesting. We are seeking collaborative ways to help recover a threatened turtle species, while helping the U.S. Navy meet its military mission needs.
Other Project Personnel
None
External Collaborators
Marion Fanalay – US Navy
Robby Smith – U.S. Navy
Will Selman – Louisiana Department of Fish and Wildlife
Keri Landry – Louisiana Department of Fish and Wildlife
Grover Brown – Southern Mississippi University
Products
Buhlmann, K.A. 2014. Assessment of Ringed Map Turtle (*Graptemys oculifera*) and Pearl Map Turtle (*Graptemys pearlensis*) Abundance and Habitat on the U.S. Navy's Stennis Western Maneuver Area (WMA) East Pearl and Mike's Rivers, Mississippi: With Recommendations for Habitat Enhancement. Report submitted to NAVFAC Southeast, Stennis Western Maneuver Area, Mississippi. 21 February 2014. 34 pp.

Long-term Management and Persistence of Flatwoods Salamanders (Ambystoma bishopi) at the U.S. Navy's OLF Holley Airfield

Funding Entity
U.S. Navy, DOD
Start Date and Funding Amount
July 2014, $ 45,000
SREL Collaborators
Dr. Kurt Buhlmann
Objectives
1. Monitor known and historic flatwoods salamander breeding sites on OLF Holley for continued use. Seek to document arrival of adult salamanders during the usual breeding migration
2. Identify environmental factors that contribute to use of breeding ponds by adult salamanders in any given year. In prior years of survey, not all the known breeding sites successfully recruit larval salamanders into the adult population.
3. Identify nesting habitat and locations of flatwoods salamanders within the breeding wetlands at Holley OLF. Determine the terrestrial distribution of the adult flatwoods salamander population on OLF Holley. There is a need to understand which terrestrial habitats are they using and in which ones are they most abundant.
4. Provide recommendations for habitat restoration and/or enhancement that will assist the U.S. Navy in its responsibility to maintain populations of threatened species.

Summary of Research Activities
We have assisted with design and implementation of invasive plant removal from two wetland basins used by flatwoods salamanders (*Ambystoma bishopi*) and have participated in the implementation of prescribed burns, both winter and growing season.
Conclusions
No conclusions are currently available, but seasonal rainfall affects the probability of breeding events by these salamanders. The majority of field work will commence in 2015.
Major Impact(s) of Research
We are seeking collaborative ways to help maintain the endangered salamander, while helping the U.S. Navy meet its military mission needs.
Other Project Personnel
None
External Collaborators
Ron Cherry – US Navy
Robby Smith – U.S. Navy
Kylie Stackis – US Navy
Products
No publications, presentations, or reports have yet been prepared.

Bonnethead sharks as an indicator of estuary health in coastal Georgia

Funding Entity
NFP
Start Date and Funding Amount
January 15, 2013; NFP
SREL Collaborators
Stacey L. Lance and 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. In addition we have analyzed mercury in silky sharks as a comparison.
Conclusions
1. Mercury levels in bonnethead muscle often exceed EPA recommended guidelines for human consumption.
2. Non-lethal biopsy punches can be used to effectively predict mercury levels in shark organs including liver.

Major Impact(s) of Research
The increase in consumption of shark meat by the general public may pose a health threat to humans and the high levels of mercury in the organs of sharks may pose a threat to shark populations. We are still analyzing stable isotope data from the bonnetheads but preliminary data in conjunction with stomach content analyses suggest that blue crabs are a primary staple in their diet. This suggests that crabs may also have high mercury levels and should be analyzed to determine if consumption guidelines are warranted.
Other Project Personnel
Jason O'Bryhim, Ph.D. Student – George Mason University
Kimberly Price, Undergraduate Student – Georgia Regents University
Citiyah Burton, Undergraduate Student – USC-Aiken
Sierra Mannix, Undergraduate Student – Georgia Regents University
Charles Best, Undergraduate Student – Georgia Regents University
External Collaborators
Dr. Chris Somers –University of Regina
David Shiffman – University of Miami
Products
O'Bryhim JR, Adams D, Spaet J, Mills G, Lance SL (2014) Relationship of mercury concentrations across twenty-three tissue types for three species of shark. Annual meeting of the American Elasmobranch Society. Chattanooga, TN.

Price K, O'Bryhim JR, Saul B, Lance SL (2014) The diet composition of the bonnethead shark (*Sphyrna tiburo*) around St. Catherine's Island, Georgia. Annual meeting of the American Elasmobranch Society. Chattanooga, TN.

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; $6,000

SREL Collaborators

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 four collection trips to Costa Rica. We have collected approximately 400 samples from the central markets of San Jose and Heredia, and approximately 300 samples from artisanal fisheries. We have now extracted DNA and sequenced most samples to identify them to species. We have also completed the social surveys and are analyzing those data.

Conclusions

1. The vast majority of filets labeled as "shark" and sold in the central markets are silky sharks, a threatened species.
2. The majority of sharks being caught by artisanal fishermen are juvenile scalloped hammerheads, and endangered species.

Major Impact(s) of Research

We are still analyzing the data but it is clear that the sharks being caught in the coastal waters of Costa Rica represent juvenile scalloped hammerheads. This species is not a target of the fishermen but rather is a product of bycatch. The fishing grounds appear to represent nursing grounds for this endangered species. After we analyze the social surveys of these fishermen we will work with them to discuss ways to minimize bycatch. The market data clearly indicate that off shore commercial fishermen are primarily catching silky sharks, a species experiencing dramatic population declines globally. One pescadaria in the market also was selling only scalloped hammerheads indicating that each pescadaria may be working with different commercial groups.

Other Project Personnel

Jason O'Bryhim, Ph.D. 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. Spaet, J.R. Hyde, K.L. Jones, D.H. Adams, and S.L. Lance. In press. Development of microsatellite markers for globally distributed populations of the threatened Silky Shark, *Carcharhinus falciformis. Conservation Genetics Resources.*

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

Funding Entity
SC-DNR
Start Date and Funding Amount
April 15, 2012; $10,000
SREL Collaborators
Stacey L. Lance
Objectives
The overall objective of this project is to determine if contaminant loads influence reproductive success in American alligators.
Summary of Research Activities
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 SCDNR. To date they have sampled eggs from >30 clutches from 2011-2014. 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. We have now developed a new set of 10 loci that have more variation and have increased our statistical power to detect parentage. We are in the process of rescreening individuals across these new loci. 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
Data are still being collected, thus there are no conclusions at this time.
Major Impact(s) of Research
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.
2. Sublethal endpoints of contaminant exposure are difficult to measure, but critical for understanding the environmental implications.
3. Our approach will allow us to look at reproductive success in males and females as a function of contaminant loads.

Other Project Personnel
Jason O'Bryhim, Ph.D. Student – George Mason University
External Collaborators
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
Lance, S.L. and B. Parrott. Population Genetics of Yawkey Alligators. Alligator Workshop, Medical University of South Carolina, Charleston, SC, January 2014 (*oral presentation*).

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; $46,820
SREL Collaborators
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 one 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 1,200 samples from Florida and John Jensen and Lora Smith have collected approximately 300 from Georgia. Stacey Lance hired Kristin Hinkson from Eastern Kentucky University to work on the genotyping during the summer of 2014. All samples from Florida have been genotyped and the data have been sent to Kevin Enge and now Tom DeVitt is in charge of all analysis, thus we have no conclusions at this time. The samples from Lora Smith failed to yield sufficient DNA for PCR. In spring of 2014 there was almost no gopher frog breeding in GA or SC and John Jensen will collect more samples in spring of 2015.
Conclusions
The data from Florida are currently being analyzed.
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 yet been prepared.

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; 19,000
SREL Collaborators
Stacey L. Lance
Objectives
The overall objective of 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 (SNPs) 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 have genotyped approximately 500 lake whitefish across 10 loci. One issue we ran into was rapid degradation of DNA in sampled whitefish. The use of SNPs is relatively new and there was major concern that they would not work on degraded DNA. We undertook a study to examine the effect of DNA degradation on SNP analyses by aging fish 0, 12, 48 and 96 hours before extracting DNA.
Conclusions
We analyzed the SNP degradation data and concluded that libraries generated up to after 48 hours of degradation were robust enough for SNP analyses but after 96 hours almost all successful sequences were of bacteria.
Major Impact(s) of Research
Until the population genetics data are fully acquired and analyzed we will not know the major impacts. The DNA degradation work has been published and is already generating interest as it was a major issue for molecular ecologists.
Other Project Personnel
Jason O'Bryhim, Ph.D. 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
Graham, C.F., Glenn, T.C., McArthur A.G., Boreham, D.R., Kieran, T., Lance, S.L., Manzon, R.G., Martino, J.A., Pierson, T., Rogers, S.M., Wilson, J.Y., and C.M. Somers. In Press Online. Impacts of degraded DNA on restriction enzyme associated DNA sequencing (RADSeq). *Molecular Ecology Resources*.

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. 2015. 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*. (In Press**).**

Abernethy, E., K. Turner, W. Pitt, T. DeVault, J. Beasley, O. Rhodes. 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? Vertebrate Pest Conference, Kona, HI. March 2014 (Oral Presentation).

Abernethy, E., K. Turner, W. Pitt, T. DeVault, J. Beasley, O. Rhodes. Contributions of invasive species to ecosystem instability on the Big Island of Hawai'i: Excuse me, but what will eat me when I die? Odum School of Ecology Graduate Student Symposium, Athens, GA. January 2014 (Oral Presentation).

Abernethy, E., K. Turner, W. Pitt, T. DeVault, J. Beasley, O. Rhodes. Impacts of invasive species on ecosystem energy flow on the Big Island of Hawai'i: Excuse me, but what will eat me when I die? Savannah River Ecology Laboratory Graduate Student Seminar Series, Jackson, SC. June 2014 (Oral Presentation).

Indirect transfer of acetaminophen /rodenticides to non-target organisms through scavenging during BTS and rodent control

Funding Entity
US Department of Defense - Navy
Start Date and Funding Amount
September 1, 2014; $439,705.00
SREL Collaborators
Dr. Olin Rhodes, Jr. and Dr. James Beasley
Objectives
The overall goal of this research is to elucidate the transfer of toxicants through the food chain as scavenging occurs on carcasses resulting from eradication programs for Brown Tree Snakes and Rodents on the island of Guam.
Summary of Research Activities
While there is a growing literature on the indirect effects of toxicants on other organisms via direct consumption of toxicant baits, there is virtually nothing known about the fate and transfer of rodenticides via energy flow pathways associated with scavenging of poisoned rodents (e.g., rats – *Rattus spp.* and *Mus. spp.*) and/or Brown Tree Snakes (BTS; *Boiga irregularis*). Data published by our research group and others over the past decade have clearly demonstrated that scavenging of vertebrate carcasses is significantly more common than has previously been thought and that the use of carcasses by both other vertebrate and invertebrate species represents both a major energy flow pathway in food webs and a relatively understudied pathway for transfer of contaminants and toxicants among trophic levels. The widespread use of rodenticides for management and conservation objectives by federal organizations may face challenges to operational feasibility if the transfer rates and fates of these toxicants are not quantified for use in risk assessment models. In addition, operational utilization of acetaminophen for control of BTS could be compromised if transfer rates and fates of this toxicant are not accounted for in risk assessment models used to estimate indirect effects of BTS control programs on Guam.
Conclusions
1) None yet as this research has just been initiated
Major Impact(s) of Research
1) Novel data on scavenging community structure for an island ecosystem
2) Data for parameterization of transfer factors for toxicants through trophic pathways
Other Project Personnel
Dr. Josh Smith, Postdoc – SREL
Kelsey Turner, MS Student - SREL
External Collaborators
Dr. Will Pitt – USDA Wildlife Services
Dr. Travis DeVault – USDA Wildlife Services
Products
No publications, presentations, or reports have yet been prepared.

Risk Assessment Models for Avian Species in Hawai'i

Funding Entity
US Fish and Wildlife Service
Start Date and Funding Amount
August 1, 2014; $43,341.00
SREL Collaborators
Dr. Olin Rhodes, Jr.
Objectives
The overall goal of this research is to utilize published data to develop and parameterize risk assessment models for transfer of rodenticides to threatened and endangered avifauna on the island of Hawai'i.
Summary of Research Activities
Rodents are very successful invaders and adaptable colonizers of island ecosystems worldwide and have severely impacted the native floral and faunal resources of the Hawaiian Islands. Broadscale control of introduced mammals is considered a necessary and standard practice in other countries such as New Zealand to protect small populations of critically rare birds, native plants, and invertebrates. To effectively manage rodents over large areas, the use of rodenticides is often necessary, whether by aerial or hand-broadcast, or bait station application. Two rodenticide products, both containing diphacinone, are currently approved for use to manage rodent populations in natural areas in Hawaii. Most insular rodent eradication projects have used brodifacoum, a second generation anticoagulant, because of its higher toxicity against rodents. Although brodifacoum (EPA Reg. No. 56228-36) is registered in the United States (Section 3) for conservation purposes, its use in Hawaiian natural areas is currently not allowed. Increased awareness of direct and secondary non-target poisoning of brodifacoum use in terrestrial ecosystem recovery programs has restricted its use in many areas in favor of first generation chemicals such as diphacinone which are considered less-toxic to birds. However, recent research suggests that sublethal effects from diphacinone may be observed in some birds of prey. A third rodenticide, chlorophacinone, is being considered for use in Hawaii in natural areas to protect native species.

Before any of these rodenticides are applied on a broad scale, it is critical that the potential effects on native birds be investigated. Of greatest concern are species that are federally listed as endangered, and whose diet could place them at risk of exposure to rodenticide baits. The risk assessment of potential exposure animals will include the federally-listed Nene (*Branta sandvicensis*), 'Io (*Buteo solitarius*), and 'Alala (*Corvus hawaiiensis*). The state of Hawaii-listed short-eared owl, pueo, could also be considered at risk. Once the risks to these birds have been quantified, control programs using toxicants will be designed in a way to minimize non-target effects with a large safety margin.
Conclusions
1) This project is ongoing and the development of risk assessment models has not yet been completed.
Major Impact(s) of Research
1) The development of risk assessment data for endangered and threatened species.
2) Management recommendations for future species recovery programs for avifauna in Hawai'i.
Other Project Personnel
Dr. Scott Weir, Postdoc – SREL
External Collaborators
Dr. Will Pitt – USDA Wildlife Services
Dr. Travis DeVault – USDA Wildlife Services
Products
No publications, presentations, or reports have yet been prepared.

External (non-SRS) Funding Received in FY14

Savannah Harbor Expansion Project: Cadmium in Birds
Funding Entity
U.S. Army Corps of Engineers
Start Date and Funding Amount
November 11, 2013; $96,905
SREL Investigators and Roles
Dr. Olin E. Rhodes, Jr. (PI) and A. Lawrence Bryan, Jr. (co-PI)
Co-Investigators and Affiliations
Dr. Susan B. Wilde, UGA

Kings Bay Rare, Threatened and Endangered Wildlife Surveys: Wood Storks and Wading Birds
Funding Entity
DoD-Navy/USACE
Start Date and Funding Amount
June 18, 2014; $35,745
SREL Collaborators
A. Lawrence Bryan Jr. (PI) and Dr. Olin E. Rhodes, Jr. (Co-PI)
Co-Investigators, Roles, Affiliations
None

Genetic Assessment of Gopher Frog Populations in Florida
Funding Entity
Florida Fish and Wildlife Conservation Commission
Start Date and Funding Amount
June 2014; $31,080.00
SREL Investigators and Roles
S. Lance (PI)
Co-Investigators, Roles, and Affiliations
Dr. S. Richter, (Co-PI), Eastern Kentucky University

Examining the effects of thermal emissions from industry on populations of lake and round whitefish in the Great Lakes
Funding Entity
Bruce Power
Start Date and Funding Amount
March 2014; $19,000
SREL Investigators and Roles
S. Lance (Co-PI)
Co-Investigators, Roles, and Affiliations
Dr. Chris Somers, (PI), University of Regina

Multi-year mating dynamics and population structure in a coastal population of Alligator mississippiensis at the Tom Yawkey Wildlife Center
Funding Entity
SCDNR
Start Date and Funding Amount
July 10 2014; $9,900
SREL Investigators and Roles
Stacey Lance (Co-PI);
Co-Investigators, Roles, and Affiliations
Dr. Ben Parrott (Co-PI), Medical University of South Carolina

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, 2013; $108,038
SREL Investigators and Roles
R. Kennamer, and Dr. I. L. Brisbin, Jr. (co-PIs)
Co-Investigators and Affiliations
D. A. Saxon, Jr., Augusta, GA Utilities Department

Survival and Cause-Specific Mortality of Juvenile Feral Swine
Funding Entity
USDA – Wildlife Services – National Wildlife Research Center
Start Date and Funding Amount
September 30, 2014; $25,300.00
SREL Investigators and Roles
Dr. James C. Beasley
Co-Investigators, Roles, and Affiliations
Dr. John Kilgo, Collaborator, USFS-SR,
Mark Vukovich, Collaborator, USFS-SR
Dr. Frederick Cunningham, Collaborator, USDA

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; $60,781 in total funding

SREL Investigators and Roles

Dr. James C. Beasley (PI) and Dr. Stacey L. Lance (PI)

Co-Investigators, Roles, and Affiliations

Dr. Thomas Hinton, Collaborator, IRSN, France

Dose Titration and Duration of Rhodamine B as a Biomarker in Feral Swine

Funding Entity

USDA – Wildlife Services – National Wildlife Research Center

Start Date and Funding Amount

May 1, 2014; $14,934.00

SREL Investigators and Roles

Dr. James C. Beasley (PI) and Dr. Olin E. Rhodes, Jr. (Co-PI)

Co-Investigators, Roles, and Affiliations

Dr. Frederick Cunningham, Collaborator, USDA

Development of Genetic-Based Mark-Recapture Tools for Feral Swine

Funding Entity

USDA – Wildlife Services – National Wildlife Research Center

Start Date and Funding Amount

May 1, 2014; $35,000.00

SREL Investigators and Roles

Dr. Olin E. Rhodes, Jr. (PI) and Dr. James C. Beasley (Co-PI)

Co-Investigators, Roles, and Affiliations

Dr. Frederick Cunningham, Collaborator, USDA
Dr. Toni Piaggio, Collaborator, USDA
Dr. Kim Pepin, Collaborator, USDA

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; $21,665.00

SREL Investigators and Roles

Dr. James C. Beasley (PI) and Dr. Olin E. Rhodes, Jr. (Collaborator)

Co-Investigators, Roles, and Affiliations

Dr. Mike Conner, Collaborator, Joseph Jones Ecological Research Center

Post-Translocation Movement Behavior of Feral Swine

Funding Entity

USDA – Wildlife Services – Veterinary Services

Start Date and Funding Amount

September 5, 2014; $45,870.00

SREL Investigators and Roles

Dr. James C. Beasley (PI)

Co-Investigators, Roles, and Affiliations

Dr. Ryan Miller, Collaborator, USDA
Dr. Dan Grear, Collaborator, USDA

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

Funding Entity

U.S. Army Center for Health Promotion and Preventative Medicine

Start Date and Funding Amount

September 1, 2013; $9,000

SREL Investigators and Roles

Dr. James C. Beasley (PI)

Co-Investigators, Roles, and Affiliations

Dr. Lawrence Tannenbaum, Collaborator, – U.S. Army Center for Health Promotion and Preventative Medicine

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; $11,660.00
SREL Investigators and Roles
Dr. James C. Beasley (PI) and Dr. Olin E. Rhodes, Jr. (Co-PI)
Co-Investigators, Roles, and Affiliations
Dr. Frederick Cunningham, Collaborator, USDA

Risk Assessment Models for Avian Species in Hawai'i

Funding Entity
US Fish and Wildlife Service
Start Date and Funding Amount
August 1, 2014; $43,341.00
SREL Investigators and Roles
Dr. Olin E. Rhodes, Jr. (PI)
Co-Investigators, Roles, and Affiliations
Dr. Will Pitt, Collaborator, Smithsonian

Indirect transfer of acetaminophen /rodenticides to non-target organisms through scavenging during BTS and rodent control

Funding Entity
Department of Defense - Navy
Start Date and Funding Amount
September 1, 2014; $439,705.00
SREL Investigators and Roles
Dr. Olin E. Rhodes, Jr. (PI), Dr. James Beasley (co-PI)
Co-Investigators, Roles, and Affiliations
Dr. Will Pitt, Collaborator, Smithsonian,
Dr. Travis DeVault, USDA

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

Funding Entity
Federal Aviation Administration
Start Date and Funding Amount
April 1, 2014; $164,339.00
SREL Investigators and Roles
Dr. Olin E. Rhodes, Jr. (PI), Dr. James Beasley (co-PI), Larry Bryan (co-PI), Robert Kennamer (co-PI)
Co-Investigators, Roles, and Affiliations
Dr. Travis DeVault, USDA

Testing bioclimatic thresholds of reptiles predicted by maximum entropy theory

Funding Entity
US Department of the Army – ERDC-CERL
Start Date and Funding Amount
April 2014; $90,734.00
SREL Investigators and Roles
Tracey Tuberville (PI) and Kimberly Andrews (co-PI)
Co-Investigators, Roles, and Affiliations
Dr. James Westervelt, University of Illinois
Dr. Jinelle Sperry, University of Illinois

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 2011; $246,659
SREL Investigators and Roles
Tracey Tuberville (PI), Kimberly Andrews (co-PI)
Co-Investigators, Roles, and Affiliations
Dr. James Westervelt, University of Illinois
Dr. Jinelle Sperry, University of Illinois
Dr. Nathan Nibbelink, UGA

Evaluation of head-starting as a recovery tool for the Mojave desert tortoise

Funding Entity
National Park Service
Start Date and Funding Amount
June 2013; $450,000
SREL Investigators and Roles
Dr. Tracey Tuberville (PI), Dr. Kurt Buhlmann (co-PI)
Co-Investigators, Roles, and Affiliations
Dr. Brian Todd, University of California-Davis

Effects of road fencing on desert tortoises

Funding Entity
Bureau of Land Management
Start Date and Funding Amount
July 2013; $230,000
SREL Investigators and Roles
Dr. Tracey Tuberville (co-PI), Dr. Kurt Buhlmann (co-PI)
Co-Investigators, Roles, and Affiliations
Dr. Brian Todd, University of California-Davis (PI)

Habitat suitability models and use of head-starting 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 (If no funding involved indicate No Funding Provided (NFP))

Nov 2010; $313,000

SREL Investigators and Roles

Dr. Tracey Tuberville (co-PI), Dr. Kurt Buhlmann (co-PI)

Co-Investigators, Roles, and Affiliations

Dr. Brian Todd, University of California-Davis (PI)

Evaluation of gopher tortoise populations on NAS Whiting Field & Holley OLF: Identification of threats affecting population viability

Funding Entity

US Department of Navy

Start Date and Funding Amount

August 2013; $34,947

SREL Investigators and Roles

Dr. Tracey Tuberville (PI)

Co-Investigators, Roles, and Affiliations

N/A

Rare, threatened and endangered wildlife surveys at the Naval Submarine Base, Kings Bay, GA

Funding Entity

US Department of Navy

Start Date and Funding Amount

November 2013; $36,660

SREL Investigators and Roles

Dr. Tracey Tuberville (co-PI), Larry Bryan (co-PI)

Co-Investigators, Roles, and Affiliations

Dr. Susan Wilde, UGA (PI)

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

Funding Entity

Disney Worldwide Conservation Fund

Start Date and Funding Amount

September 2013; $49,900

SREL Investigators and Roles

Dr. Tracey Tuberville (PI), Dr. Kurt Buhlmann (co-PI)

Co-Investigators, Roles, and Affiliations

Dr. Stephanie Koch, USFWS, Sudbury, MA

Head-starting to augment gopher tortoise populations on protected areas in Georgia

Funding Entity

Georgia Department of Natural Resources

Start Date and Funding Amount

October 2013; $93,335

SREL Investigators and Roles

Dr. Tracey Tuberville (PI), Dr. Kurt Buhlmann (co-PI)

Co-Investigators, Roles, and Affiliations

Dr. Terry Norton, Georgia Sea Turtle Center, Jekyll Island, GA

John Jensen, GADNR

Characterizing social interactions among gopher tortoises in a viable population: a pilot study with implications for translocation and long-term conservation

Funding Entity

Riverbanks Zoo Conservation Fund

Start Date and Funding Amount

March 2014; $4,800

SREL Investigators and Roles

Dr. Tracey Tuberville (co-PI)

Co-Investigators, Roles, and Affiliations

Dr. Betsie Rothermel (PI), Archbold Biological Station, Venus, Florida

Dr. Kelly Zamudio (co-PI), Cornell University, Ithaca, New York

Technical Expertise Requests in FY14

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
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. James C. Beasley
Date of Request
July 2014
Requesting Entity
International Atomic Energy Association
Nature of Request
Consult with Fukushima Prefecture, Japan

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
October 2013
Requesting Entity
Gopher Tortoise Council
Nature of Request
Judge student oral presentations at annual meeting

SREL Investigator
Dr. James C. Beasley
Date of Request
December 2014
Requesting Entity
International Atomic Energy Association
Nature of Request
Consult with Fukushima Prefecture, Japan

SREL Investigator
Dr. K. Buhlmann
Date of Request
August 2014
Requesting Entity
SREL Outreach Program
Nature of Request
Assisted with SREL Touch an Animal Day.

SREL Investigator
Dr. K. Buhlmann
Date of Request
September 2014
Requesting Entity
U.S. Forest Service-SR
Nature of Request
Assist USFS-SR with prescribed burning of the Craigs Pond Set-Aside on SRS

SREL Investigator
Dr. K. Buhlmann
Date of Request
May 2014
Requesting Entity
U.S. Forest Service-SR
Nature of Request
Assist USFS-SR with mid-story removal at the Compartment 24 Gopher Tortoise reintroduction site on SRS

SREL Investigator
Dr. K. Buhlmann
Date of Request
November 2014
Requesting Entity
University of Dar es Salaam
Nature of Request
Review graduate student's thesis. Results from reintroduction of Kihansi Spray Toads in Tanzania.

SREL Investigator
Dr. K. Buhlmann
Date of Request
2014; 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
2014; 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
2014; 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
2014, 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
January 2014
Requesting Entity
Turtle Conservation Fund
Nature of Request
Review, evaluate, and rank 35 proposals for potential funding support by this non-profit conservation group.

SREL Investigator
Dr. K. Buhlmann
Date of Request
June 2014
Requesting Entity
Turtle Conservation Fund
Nature of Request
Review, evaluate, and rank 29 proposals for potential funding support by this non-profit conservation group.

SREL Investigator
Dr. K. Buhlmann
Date of Request
November 2014
Requesting Entity
Jeykll Island Authority/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
Stacey L. Lance
Date of Request
November 7, 2013
Requesting Entity
Faculty member, Western Connecticut State University
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Stacey L. Lance
Date of Request
February 25, 2014
Requesting Entity
Faculty member, University of Georgia
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Stacey L. Lance
Date of Request
April 17, 2014
Requesting
Faculty member, University of Iowa
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Stacey L. Lance
Date of Request
May 30, 2014
Requesting Entity
Faculty member, University of Calgary
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Stacey L. Lance
Date of Request
April 9, 2014
Requesting Entity
Researcher, Centro de Investigaciones Biologicas del Noroeste (CIBNOR)
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Stacey L. Lance
Date of Request
March 17, 2014
Requesting Entity
Conservation Resource Biologist, Mississippi Museum of Natural Science
Nature of Request
Develop genetic markers (microsatellites).

SREL Investigator
Stacey L. Lance
Date of Request
May 7, 2014
Requesting
Faculty member, Instituto Politecnico, Mexico
Nature of Request
Develop genetic markers (microsatellites).

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 FY14. Below we provide examples of specific activities that SREL personnel have conducted in FY14 to assist DOE and other SRS 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 results of the SREL Technical Review requested by DOE in response to CAB Recommendation 317
- SREL personnel participated in site visits with UGA and ARS personnel to evaluate potential biofuel production technologies on the SRS
- 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 FY14 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 provided baseline reference data for evaluation of biological impacts of potential contaminants associated with the Salt Waste Processing Facility
- SREL conducted additional sampling and analytical services to SRR to address concerns related to the potential release of contaminants into the local watershed
- SREL personnel renewed a 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 involving long-lived reptiles, game species, Four Mile Branch, waterfowl 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 future IOU remediation activities
- SREL provided support to SRNS Corporate Communications by providing programs for 27 public tours to the general public or site visitors

Savannah River National Laboratory

- SREL hosted Dr. Larry Lowe to discuss research opportunities on the SRS in support of the SRNL's Minority Serving Institution Initiative
- SREL continued to provide support to SRNL towards the development of business in 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 future research
- SREL faculty collaborated with various SRNL scientists to accomplish a variety of research projects focused on environmental remediation and monitoring

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
- Dr. Kurt Buhlmann participated with USFS-SR to conduct prescribed burning and mid-story vegetation management to improve the habitat conditions at the Gopher Tortoise (*Gopherus polyphemus*) Reintroduction site (Compartment 24).
- Dr. Kurt Buhlmann helped design and participated in a prescribed burn at the Craigs Pond Set-Aside, with the goal of increasing habitat suitability for state-endangered Gopher Frogs (*Rana capito*)
- SREL personnel met multiple times with USFS personnel to discuss potential funding opportunities for SRS as a center for development of feral swine control methods
- SREL included USFS personnel in meetings with USDA National Wildlife Research Center scientists to discuss research opportunities for feral swine control on the SRS
- SREL personnel met multiple times with USFS personnel to discuss coordination of feral swine control activities on the SRS and research needs
- SREL personnel worked with USFS personnel to plan and implement habitat management objectives for various Set-Aside areas on the SRS to facilitate environmental stewardship objectives of the site

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 FY14, SREL faculty and staff mentored and supervised over a dozen 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 and mentoring for over 50 graduate students (Table 2) from universities across the country in FY14. 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 FY14 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 FY14.

- SREL leveraged SRS site assets to acquire external resources to conduct UGA Maymester courses in wildlife ecology and genetics in May 2014

- SREL leveraged UGA funding against project specific funding from DOE and other sources to cost share over 25 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 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 6 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 U.S. 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 (12 credit hours) that are offered by the participating institutions. Within UGA, the classes are cross-listed in multiple colleges/departments to increase student participation, while broadening the employment opportunities for students within a diverse range of relevant academic disciplines. To further increase student participation, the classes were offered through the Biology Department within Georgia Regents University, formerly known as Augusta State University.

For Maymester 2014, two classes were offered: Introduction to Radioecology (3 hrs) and Environmental Geochemistry of Radionuclides (3 hrs). It was the second time that the Introduction to Radioecology was offered due to continued student interest. As in 2013, tours of various facilities on the DOE Savannah River Site were incorporated into the classes. Dave Fulton, a representative from Plant Vogtle, also presented a seminar to the classes discussing the progress to date on the construction of two new power reactors.

Three graduate students from UGA, an international student from the Georgia Republic, and six undergraduates completed the Environmental Geochemistry of Radionuclides class. Six additional undergraduates completed the Introduction to Radioecology class. All of the undergraduate students 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.

Table 10.1. SREL Undergraduate Student Program Participants, FY 14

Undergraduate	University	Faculty Advisor
Jeff Peterson	University of South Carolina-Aiken	Beasley
Chris Leapart	South Carolina State University	Beasley
Alyssa Frediani	University of Vermont	Buhlmann
Emily Scully	Fairleigh Dickinson University	Buhlmann
Kylie Stackis	University of Pittsburg	Buhlmann
Lindsay Chiquoine	University of Nevada–Las Vegas	Buhlmann
Chris Leapart	University of South Carolina - Aiken	Kennamer
Kimberly Price	Georgia Regents University	Lance
Austin Coleman	Georgia Regents University	Lance
C.J. Best	Georgia Regents University	Lance
Chris Murphy	University of Georgia	Tuberville
Amanda Jones	University of South Carolina -Aiken	Tuberville
Paul Thomas	University of South Carolina-Aiken	Unger
Kayla Fettro	University of South Carolina-Aiken	Mills
Sierra Mannix	Georgia Regents University	Lance

Table 10.2. SREL Graduate Student Program Participants, FY14

Student	Degree	University	SREL Faculty	Role
Amanda Holland	M.S.	University of Georgia	Beasley	Advisor
Kelsey Turner	M.S.	University of Georgia	Beasley	Advisor
Sara Webster	M.S	University of Georgia	Beasley	Advisor
Ricki Oldencamp	M.S.	University of Georgia	Beasley	Advisor
David Keiter	M.S.	University of Georgia	Beasley	Advisor
Ansley Silva	M.S.	University of Georgia	Beasley	Co-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
Michael Foster	M.S.	University of Georgia	Beasley	Committee
Sarah Sapp	M.S.	University of Georgia	Beasley	Committee
Sebastian Oritz	M.S.	University of Georgia	Beasley	Committee
Mark Peaden	M.S.	University of California-Davis	Buhlmann	Committee
Jared Green	M.S.	University of Georgia	Buhlmann	Committee
Nassor Mohammed	M.Sc.	University of Sares Salaam	Buhlmann	Committee
Jacob Daly	M.S.	University of Georgia	Buhlmann	Committee
Dan Quinn	M.S.	University of Georgia	Buhlmann	Committee
Richard Biemiller	Ph.D.	University of Kentucky	Fletcher	Host
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
Sara Webster	M.S.	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
Katherine Worsley-Tonks	M.S.	University of Georgia	Lance	Committee
Liyun Zhang	Ph.D.	University of Georgia	Lance	Committee
Kristen Hinkson	M.S.	Eastern Kentucky University	Lance	Host
Douglas Fairbanks	M.S.	Brigham Young University	McArthur	Co-Advisor
Jesse Thomas	Ph.D.	University of Georgia	McArthur	Committee

Student	Degree	University	SREL Faculty	Role
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
Matthew Baker	M.S.	University of Georgia	Mills	Committee
Michael Blackowicz	M.S.	Eastern Illinois University	Mills	Committee
Robert Thomas	M.S.	University of Georgia	Mills	Committee
Liyun Zhang	Ph.D.	University of Georgia	Mills	Committee
Guranda Ackopashilli	Ph.D.	Tbilisi State University	Mills	Co-Host
Erin Abernathy	M.S.	University of Georgia	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
David Keiter	M.S.	University of Georgia	Rhodes	Committee
Ansley Silva	M.S.	University of Georgia	Rhodes	Committee
Matt Beard	Ph.D.	Purdue University	Rhodes	Committee
Liyun Zhang	Ph.D.	University of Georgia	Seaman	Advisor
Matt Baker	M.S.	University of Georgia	Seaman	Advisor
R.J. Thomas	M.S.	University of Georgia	Seaman	Advisor
Savannah Harris	M.S.	University of Georgia	Seaman	Committee
Guranda Ackopashilli	Ph.D.	Tbilisi State University	Seaman	Co-Host
Marcus Zokan	Ph.D.	University of Georgia	Sharitz	Committee
Bryan Nuse	Ph.D.	University of Georgia	Sharitz	Committee
Tad Dallas	Ph.D.	University of Georgia	Sharitz	Host
Bess Harris	M.S.	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
David Haskins	M.S.	University of Georgia	Tuberville	Advisor
Nicole White	M.S.	University of Georgia	Tuberville	Advisor
Jacob Daly	M.S.	University of Georgia	Tuberville	Advisor
Melia Nafus	Ph.D.	University of CA.-Davis	Tuberville	Committee
John Finger	Ph.D.	University of Georgia	Tuberville	Committee
Nassor Mohammed	M.S.	University of Sares Salaam	Tuberville	Committee

Student	Degree	University	SREL Faculty	Role
Greg Skupien	M.S.	University of Georgia	Tuberville	Committee
Phil Vogrinc	M.S.	University of Arkansas	Tuberville	Host
Brett DeGregorio	Ph.D.	University of Illinois	Tuberville	Host
Henry Pollock	Ph.D.	University of Illinois	Tuberville	Host

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 10 DOE owned buildings with the largest of these being our 45,000 square foot main laboratory and office complex. We also have 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).

We operate our own maintenance staff consisting of two full time technicians, two part time temporary workers, and one custodial worker. This group is responsible for all grounds maintenance, custodial duties, routine infrastructure repair, and preventive maintenance duties for over 115 infrastructure assets. Our maintenance group also undertakes a limited number of fabrication projects in support of our research efforts.

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 maintenance 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 $100,000 towards the continual improvement of the facilities under our care. Some of these significant projects include:

- **The continued renovation of our faculty and staff offices:** This year we successfully renovated another four offices. This included re-carpeting, painting, and making any other necessary repairs.

- **The installation of a 15 ton HVAC in our office wing:** This involved replacing a 24 year old roof top HVAC that was responsible for the temperature control of 12 of our office spaces.

- **The painting and refurbishing of two emergency generators and fuel tanks:** We had two emergency generators that were severely corroded as well as their auxiliary fuel tanks. We had these assets cleaned of corrosion and repainted with high grade corrosion resistant paint.

- **The renovation of our old computer lab to create an under-graduate student room:** The renovation of this room included the removal of three modular offices, re-carpeting and painting the area, and installing a doorway adjoining the existing student room. We then installed new furniture and computer accessibility for up to 12 new students.

- **The complete renovation of two laboratories:** We totally refurbished two of our original laboratory spaces by removing all existing case work and fume hoods and installing new hoods and furniture. We also replaced the floor tile, painted the walls, and replaced the suspended ceilings. Due to discovery of asbestos in the lab counter tops and floor tile mastic, we had to have a professional abatement completed in the laboratories, before any work could begin.

- **The continued repair of our aged main air handling systems:** This year in support of our air handlers, we repaired two major steam coils and replaced a number of chill water and steam related valves. We also replaced one major air volume control damper system in our office section.

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 hired a temporary worker and directed his efforts to the cleaning of our laboratories and storage facilities, and disposing or excessing any clutter and unneeded supplies. We made significant progress in this area and we will continue to work diligently in the coming year to continue to improve our facilities in terms of proper organization and housecleaning.

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. To that end, we are actively planning for a number of renovations and improvements that we hope to carry out in the coming year, so as to continue the overall improvement of our institution.

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, the SREL Safety Manual, and the Savannah River Site Policy Manual promulgated by the U.S., Department of Energy. 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 **12** (twelve) lessons learned and other site safety notices in FY2014 to targeted groups at SREL. Additionally, in excess of **50** (fifty) 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 4 **(four)** work related recordable injury/illness during FY2014. This represents and increased injury/illness rate over the previous fiscal reporting period and was attributed to employee error, failure to wear appropriate protective equipment, and inadequate supervisory instruction with three of the four injuries occurring with the same field research subunit. A safety stand down and review was conducted with this research subunit by the SREL Director to reinforce SREL's expectations and commitment with regard to safe conduct of field work operations.

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 **41 (forty-one)** SREL personnel received this required training during FY2014. Additionally, SREL personnel received EH&S related training during FY2014 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 **671 (Six hundred and seventy-one)** pounds of hazardous wastes in FY2014. Approximately **20 (twenty)** percent of the hazardous wastes generated was from disposal of excess laboratory chemicals. The balance of hazardous wastes was generated as the result of active laboratory 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 **438 (four hundred and thirty-eight)** separate chemical purchase orders made by SREL personnel.

SREL received no Notices of Violation in FY2014 as the result of external or internal reviews, inspections, or assessments. During FY2014, SREL's assigned DOE Facility Representative (FR) conducted periodic walk-down inspections of SREL operated SRS facilities in which minor safety issues were identified and promptly corrected. 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 FY14 was $196,766.

Table 11.1. SREL Equipment Purchases in FY14.

Description	Total Cost	Category	Programs Served
Blood chemistry analyzer	$10,000	Diagnostic assay of small blood samples to assess animal health.	
Freeze Drier	$13,305	Bench top freeze drier to expand sample processing throughput for chemical analysis	Ecotoxicology; Disease Ecology; Population Genetics; Conservation Genetics
Thermal Imaging Camera	$10,000	Thermal imaging- locating darted animals at night; monitoring night behavior; surveys	Wildlife Ecology
qPCR/Real time PCR	$23,795	Determines absolute and relative quantity of nucleic acids	Population Genetics; Conservation Genetics
X-Caliber dart projector with night vision scope	$5,950	Used to immobilize captured pigs	Wildlife Ecology
Shot guns (2)	$1,800	Wildlife collection	Wildlife Ecology
ISCO water samplers (2)	$38,600	Automated water sample collection	Ecotoxicology; Environmental Chemistry
Microplate Reader	$14,906	High throughput analysis of many biometric assays	Ecotoxicology; Disease Ecology; Wildlife Ecology
Canberra Coaxial HpGe Detector	$61,610	Radionuclide Counting	Ecotoxicology; Disease Ecology; Population Genetics; Conservation Genetics
Handheld Gamma Spectrophotometer	$14,135	Radionuclide Counting	
Liquid Scintillation Counter (upgrade)	$8,727	Radionuclide Counting	
Canberra Low Background Gross Alpha/Beta Counter	$35,894	Radionuclide Counting	
Canberra Alpha Analyst	$22,894	Radionuclide Counting	
Totals	**$196,766**		

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 FY14. See Task 11 (above) for summary of facilities upgrades.

SECTION III. Cost Status Report

Provided to DOE-SR budget office monthly and final FY14 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 FY14.

SECTION V. Changes in Approach or Goals

In FY14 SREL implemented a number of cost sharing initiatives with main campus units at UGA 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 initiatives include:

- Cost sharing of 6 tenure track faculty lines with UGA main campus units (3 housed at SREL and 3 housed at UGA)
- Cost sharing graduate student stipends with UGA main campus units to leverage additional graduate students working on research issues on the SRS
- Leveraged research funding with UGA main campus faculty and with external funding agencies to increase SREL-based research activities on the SRS in mission critical areas such as radioecology and human wildlife conflict resolution
- Leveraged funding for postdoctoral researchers with UGA main campus units to increase the numbers of Ph.D. level staff conducting research in collaboration with SREL faculty to address SRS research needs
- Cost sharing facilities costs such as laboratory renovations for new faculty hires with the Office of the Vice President for Research at UGA to increase the quality of SREL occupied federal facilities for cutting edge research

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 FY14, external funding (non-SRS or UGA dollars) totaled 20% of the laboratories budget, up slightly from FY13 (Section I; Section II-Task 8). It is the intent of laboratory management to increase this proportion to >30% in FY15.

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

Due to delays associated with the FY14 federal budgeting process, the majority of funding from DOE-SR for FY14 was received through the cooperative agreement in April of 2014. The late arrival of funding resulted in carryover of approximately 2/3 of the FY14 allocated funds into FY15. However, it is anticipated that SREL will carry over less than 25% of FY15 funding into FY16.

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.

SREL continues to work with SRNS to achieve a balance in Site Services that meets the needs of the laboratory as it increases in size and work scope to meet the needs of the SRS site tenants. Delays have occurred in delivery of services to SREL for activities such as power reconnects for renewed use of research facilities and despite the availability of funding, responsibility for facilities repairs such asbestos abatement remain unresolved. The inability to get these issues resolved has resulted in delays in research activities as well as unexpected costs to SREL's operating budget to prepare facilities for renovation or repairs.

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

Administrative
Retired – Louise Zweifel
Hired – Lucy LopezdeVictoria
Hired–Vicky Sutton-Jackson

Research Scientists
Reclassified – Dr. Kurt Buhlmann

Tenure-track Faculty
Hired – James Martin
Hired – Dalia Abbas

Senior Research Associates
Hired – Dr. Kurt Buhlmann

Postdoctoral Researchers
Separated – Dr. Hyun-Shik Chang
Hired – Dr. Michael Byrne (Postdoctoc)
Hired – Dr. Scott Weir (Postdoctoc)
Hired – Dr. Michael Byrne (Postdoctoc)
Hired – Dr. Andrew Kremer (Postdoctoc)
Hired – Dr. David Coyle (Postdoctoc)

Research Professionals
Separated – Julian Singer
Separated – Dr. Shae Buettner

Research Technicians
Separated – Andrew Grosse
Separated – Shelby Weathersby
Separated – Sarah Webster
Separated – Matt Atkinson
Separated – Robert Thomas
Separated – Samantha Dean
Separated – Beth Harris
Separated – Nicole White
Hired – M. Baker
Hired – E. Beechuk
Hired – N. Bossenbroek
Hired – C. Burton
Hired – A. Coleman
Hired – J. Daly
Hired – D. Haskins
Hired – K. Hinkson
Hired – D. Keiter
Hired – C. Leapart
Hired – S. Mannix
Hired – C. Murphy
Hired – A. Mustion
Hired – L. Oliver
Hired – Z. Smith
Hired – S. Taylor
Hired – S. Yu

Support Staff
Retired – Paul Carroll

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

SREL faculty and staff added 39 new publications to the SREL reprint list in 2014

3266 Li, D., et al., Effects of matrix heterogeneity and aqueous humic acid on transport and deposition of mineral colloids in sandy sediments. *Journal of Environmental Chemical Engineering*, 2013. 1(2013): p. 875-883.

3267 DeGregorio, B.A., et al., Time in Captivity Affects Foraging Behavior of Ratsnakes: Implications for Translocation. *Herpetological Conservation and Biology*, 2013. 8(3): p. 581-590.

3268 Fletcher, D.E., et al., Spatial and taxonomic variation in trace element bioaccumulation in two herbivores from a coal combustion waste contaimated stream. *Ecotoxicology and Environmental Safety*, 2014. 101(2014): p. 196-204.

3269 Paller, M.H., et al., Effects of disturbance at two spatial scales on macroinvertebrate and fish metrics of stream health. *Journal of Freshwater Ecology*, 2014. 29(1): p. 83-100.

3270 Love, C. N., C. Hagen, B.D. Horne, K.L. Jones, and S.L. Lance. (2013). "Development and characterization of thirty novel microsatellite markers for the critically endangered Myanmar Roofed Turtle, *Batagur trivittata*, and cross-amplification in the Painted River Terrapin, *B. borneoensis*, and the Southern River Terrapin, *B. affinis*, using paired-end Illumina shotgun sequencing." *Conservation Genetic Resources* 5(2): 383-387.

3271 Carson, E. W., R. R. Beasley, K.L. Jones, S.L. Lance, M. De Lourdes Lozano-Vilano, L. Vela-Valladares, I. Banda-Villaneuva, T.F. Turner, and M. De la Maza-Benignos. (2013). "Development of polymorphic microsatellite markers for the microendemic pupfishes *Cyprinodon julimes* and *C. pachycephalus*." *Conservation Genetic Resources* 5(3): 853-856.

3272 Morales-Leyva, A., R. A. Medellin, S.L. Lance, B. Rodriguez-Herrera, M. Del Real-Monroy, and J. Ortega. (2014). "Development of microsatellite loci for the Honduran white-bat (*Ectophylla alba*) by using Illumina paired-end sequences." *Conservation Genetic Resources* 6(1): 219-220.

3273 Harrison, E., C. N. Love, K.L. Jones, S.L. Lance, J.C. Trexler, and T. Collins. (2013). "Isolation and characterization of 18 novel polymorphic microsatellite markers from the Mayan cichlid (*Cichlasoma urophthalmus*)." *Conservation Genetic Resources* 5(3): 703-705.

3274 Pruett, C. L., C. Whelan, A. Ricono, S.L. Lance, T. Glenn, B. Faircloth, and K. Winker. (2014). "Development and characterization of microsatellite loci for two species of Beringian birds, rock sandpiper (*Calidris ptilocnemis*) and Pacific wren (*Troglodytes pacificus*)." *Conservation Genetic Resources* 6(1): 175-177.

3275 Arcangeli, J., F. A. Cervantes, S.L. Lance, M.I. Salazar, and J. Ortega. (2013). "Twenty-four microsatellite markers for the gray mouse opossum (*Tlacuatzin canescens*): development from illumina paired-end sequences." *Conservation Genetic Resources* 5(2): 367-370.

3276 Schnellbacher, R. W., S. M. Hernandez, T.D. Tuberville, J. Mayer, Y. Alhamhoom, and R.D. Arnold. (2012). "The Efficacy of Intranasal Administration of Dexmedetomidine and Ketamine to Yellow-Bellied Sliders (*Trachemys scripta scripta*)." *Journal of Herpetological Medicine and Surgery* 22(3-4): 91-98.

3277 DuRant, S. E., W. A. Hopkins, G.R. Hepp, and L.M. Romero. (2013). "Energetic constraints and parental care: Is corticosterone indicative of energetic costs of incubation in a precocial bird?" *Hormones and Behavior* 63(2013): 385-391.

3278 Bryan Jr., A. L., C. Depkin, P. Schoenfeld and S. Wilde. (2012). "Avifauna in Maritime Forest and Shrub Habitats on Navy Submarine Base Kings Bay in Southeastern Georgia." *The Oriole* 77(3-4): 67- 80.

3279 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. *15th Wildlife Damage Management Conference*.

3280 Xu, C., M. Athon, Y.F. Ho, H.S. Chang, S. Zhang, D.I. Kaplan, K.A. Schwehr, N. DiDonato, P.G. Hatcher, and P.H. Santschi. (2014). "Plutonium Immobilization and Remobilization by Soil Mineral and Organic Matter in the Far-Field of the Savannah River Site, U.S." *Environmental Science and Technology* 48(6): 3186-3195.

3281 Buettner, S. W., M. G. Kramer, O.A. Chadwick and A. Thompson. (2014). "Mobilization of colloidal carbon during iron reduction in basaltic soils." *Geoderma* 221-222(2014): 139-145.

3282 Lovich, J. E., J. W. Gibbons, and M. Agha. (2014). "Does the timing of attainment of maturity influence sexual size dimorphism and adult sex ratio in turtles?" *Biological Journal of the Linnean Society* 112(2014): 142-149.

3283 Bagshaw, C., A. E. Isdell, D.S. Thiruvaiyaru, I.L. Brisbin Jr., and S. Sanchez. (2014). "Molecular detection of canine parvovirus in flies (Diptera) at open and closed canine facilities in the eastern United States." *Preventive Veterinary Medicine* 114(2014): 276-284.

3284 Atanassova, I. D., S. H. Doerr, and G. L. Mills. (2014). Hot-Water-Soluble Organic Compounds Related to Hydrophobicity in Sandy Soils. Soil Carbon A. E. Hartemink and K. McSweeney. Switzerland, Springer International Publishing: 137-146.

3285 Beasley, J. C., T. E. Grazia, P. E. Johns, and J.J. Mayer. (2013). "Habitats associated with vehicle collisions with wild pigs." *Wildlife Research* 2013(40): 654-660.

3286 Nussear, K. E. and T. D. Tuberville (2014). Habitat Characteristics of North American Tortoises. Biology and Conservation of North American Tortoises. D. C. Rostal, E. D. McCoy and H. R. Mushinsky. Baltimore, MD, John Hopkins University Press: 190.

3287 Chang, H., C. Xu, K.A. Schwehr, S. Zhang, D.I. Kaplan, J.C. Seaman, C. Yeager, and P.H. Santschi. (2014). "Model of radioiodine speciation and partitioning in organic-rich and organic-poor soils from the Savannah River Site." *Journal of Environmental Chemical Engineering* 2(2014): 1321-1330.

3288 Li, D., J.C. Seaman, H. Chang, P.R. Jaffe, P. Koster van Groos, D. Jiang, N. Chen, J. Lin, Z. Arthur, Y. Pan, K.G. Scheckel, M. Newville, A. Lanxirotti and D.I. Kaplan. (2014). "Retention and chemical speciation of uranium in an oxidized wetland sediment from the Savannah River Site." *Journal of Environmental Radioactivity* 131(2014): 40-46.

3289 Edwards, P. G., K.F. Gaines, A.L. Bryan, Jr., J.M. Novak and S.A. Blas. (2014). "Are U, Ni, and Hg an Environmental Risk within a RCRA/CERCLA Unit on the U.S. Department of Energy's Savannah River Site?" *Human and Ecological Risk Assessment* 20(2014): 1565-1589.

3290 Soteropoulos, D.L., S.L. Lance, R.W. Flynn and D.E. Scott. (2014). "Effects of Copper Exposure on Hatchling Success and Early Larval Survival in Marbled Salamanders, *Ambystoma opacum*." *Environmental Toxicology and Chemistry* 33(7): 1631-1637.

3291 Ramos, A.G., S.O. Nunziata, S.L. Lance, C. Rodriguez, B.C. Faircloth, P.A. Gowaty and H. Drummond. (2014). "Habitat structure and colony structure constrain extrapair paternity in a colonial bird." *Animal Behaviour* 95(2014): 121-127.

3292 Chang, H., S.W. Buettner, J.C. Seaman, P.R. Jaffe, P. Koster van Groos, D. Li, A.D. Peacock, K.G. Scheckel and D.I. Kaplan. (2014). "Uranium Immobilization in an Iron-Rich Rhizosphere of a Native Wetland Plant from the Savannah River Site under Reducing Conditions." *Environmental Science and Technology* 48(2014): 9270-9278.

3293 Kosnicki, E., S.A. Sefick, M.H. Paller, M.S. Jarrell, B.A. Prusha, S.C. Sterrett, T.D. Tuberville and J.W. Feminella. (2014). "Defining the Reference Condition for Wadeable Streams in the Sand Hills Subdivision of the Southeastern Plains Ecoregion, USA." *Environmental Management* 54(2014): 494-504.

3294 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." *The Auk - Ornithological Advances* 131(2014): 672-680.

3295 Tuberville, T.D., B.D. Todd, S.M. Hermann, W.K. Michener and C. Guyer. (2014). "Survival, Demography, and Growth of Gopher Tortoises (*Gopherus polyphemus*) from Three Study Sites with Different Management Histories." *The Journal of Wildlife Management* 78(7): 1151-1160.

3296 Kennamer, R.A. (1997). "Hooded Mergansers Breeding in the Upper Coastal Plain of South Carolina." *The Chat* 61(2): 117-119.

3297 Winans, G.A., J.D. Baker and S.L. Lance (2014). "Twenty-five novel microsatellite markers for English sole, *Parophrys vetulus*." *Conservation Genetic Resources* 2014(6): 417-419.

3298 Beasley, R. R., S.L. Lance, J.A. Ruskey and E.B. Taylor. (2014). "Development and characterization of twenty-five microsatellite markers for the longnose dace (Cyprinidae: *Rhinichthys*) using paired-end Illumina shotgun sequencing." *Conservation Genetic Resources* 6: 1011-1013.

3299 Bryan Jr., A. L., J.W. Snodgrass, H.A. Brant, C.S. Romanek, C.H. Jagoe, G.L. Mills and I.L. Brisbin Jr. (2014). "Precipitation Influences on Uptake of a Global Pollutant by a Coastal Avian Species." *Environmental Toxicology and Chemistry* 33(12): 2711-2715.

3300 Rabeling, C., M. Bollazzi, M. Bacci Jr., R.R. Beasley, S.L. Lance, K.L. Jones and N.E. Pierce. (2014). "Development and characterization of twenty-two polymorphic microsatellite markers for the leafcutter ant, *Acromyrmex lundii*, utilizing Illumina sequencing." *Conservation Genetic Resources* 6: 319-322.

3301 Rabeling, C., C.N. Love, S.L. Lance, K.L. Jones, N.E. Pierce and M. Bacci Jr. (2014). "Development of twenty-one polymorphic microsatellite markers for the fungus-growing ant, *Mycocepurus goeldii* (Formicidae: Attini), using Illumina paired-end genomic sequencing." *Conservation Genetic Resources* 6: 739-741.

3302 Ramos, A. G**.,** S.O. Nunziata, S.L. Lance, C. Rodriguez, B.C. Faircloth, P.A. Gowaty and H. Drummond. (2014). "Interactive effects of male and female age on extra-pair paternity in a socially monogamous seabird." *Behavioral Ecology and Sociobiology* 68: 1603-1609.

3303 Fletcher, D. E., A.H. Lindell, G.K. Stillings, G.L. Mills, S.A. Blas and J V. McArthur. (2014). "Variation in Trace-Element Accumulation in Predatory Fishes from a Stream Contaminated by Coal Combustion Waste." *Archives of Environmental Contamination and Toxicology* 66(3): 341-360.

3304 Witczak, L. R., J.C. Guzy, S.J. Price, J.W. Gibbons and M.E. Dorcas. (2014). "Temporal and Spatial Variation in Survivorship of Diamondback Terrapins (*Malaclemys terrapin*)." *Chelonian Conservation and Biology* 13(2): 146-151.

SECTION IX. **Special Accomplishments by Laboratory Personnel**

- Kurt Buhlmann was nominated for Partners in Amphibian and Reptile Conservation Visionary Leader Award
- Gene Rhodes was elected president of the Association of Ecosystem Research Centers
- Shem Unger named as 2014 Distinguished Faculty of the American Allied University
- Larry Bryan was invited to serve as a member of the Wood Stork Research Advisory Group to the U.S. Fish and Wildlife Service
- Rebecca Sharitz was invited to serve as an Executive Board Member for the South Carolina Audubon Society
- Rebecca Sharitz was invited to serve as and Executive Board Member of the International Association for Ecology
- Whitt Gibbons presented the 2014 Distinguished Herpetologist Award by the Herpetologists League
- Whitt Gibbons presented the 2014 Southeastern Outdoor Press Award for best daily newspaper column
- I. Lehr Brisbin served as a member of the Board of Trustees for the Hitchcock Woods Foundation
- David Scott provided photos for the SRS Annual Environmental Report
- Jim Beasley was invited to serve as a subject matter expert on 2 International Atomic Energy Agency missions to Fukushima, Japan
- SREL personnel and their research were featured in news articles in FY14 including the New York Times, O'Henry Magazine, Inside Edition, Living in South Carolina Magazine, Outdoor Indiana Magazine, UGA Red and Black, the Aiken Standard, UGA Columns, Atlanta Business Chronicle, Augusta Chronical, and over 52 weekly columns for newspapers in South Carolina, Alabama and Tennessee