PROJECT DIRECTORS’ REPORT

Teacher Quality Higher Education Program Grant
Title II, Part A of Public Law 107-110, the “No Child Left Behind Act”


September 2005

Dr. Robert J. Hill, Dr. Tommy Jordan, Mr. Sean Beeching, Ms. Luanne Cooley, Mr. Joel Mercado Diaz, Ms. Nora Casey, Ms. Pamela Parks, Ms. Deborah Riddleberger, Ms. Anne Shenk, Mr. Richard Osorio
EXECUTIVE SUMMARY


Dr. Robert J. Hill
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Adult Education Program
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Lichens—symbiotic organisms comprised of algae and fungi—color trees, rocks, boulders, and soil, and they cover 8% of the Earth's surface. Lichens have many uses, including to monitor environmental quality due to their pollution sensitivity. Through this project, two years of fully-subsidized teacher workshops were designed and carried out to enhance educators' understanding of lichen biology, ecology, natural history, identification, and uses in the classroom, laboratory, and field studies, and to assist in building a lichen biomonitoring network in Georgia. Lichens are ideal organisms to illustrate environmental health status (bioindicators) and to track trends (biomonitor) in ecosystem health.

During 2004 – 2006, an interdisciplinary/international team of 10 expert educators and researchers conducted two summer residential (5-day) workshops and tri-annual sustained contact weekends (Autumn, Winter, Spring) using lichens as an entrée into teacher quality improvement. The team brought their knowledge—and resources from the University of Georgia (UGA) Department of Lifelong Education, Administration, and Policy, Adult Education Program; the UGA Center for Remote Sensing and Mapping Science (CRMS), Department of Geography; the UGA Georgia Project for Excellence in Environmental Education; the State Botanical Garden of Georgia; the Oconee River Georgia Youth Science & Technology Center at Northeast Georgia Regional Educational Service Agency; the University of Puerto Rico; and Trinity College Dublin and the National Botanic Gardens, Ireland.

Funding for this two-year project was provided by a Teacher Quality Higher Education Program Grant (Title II, Part A of Public Law 107-110, the “No Child Left Behind Act”) through an award amounting to $112,724 (2004-2006); $51,264 in YR1 (2004-2005) and $61,460 in YR2 (2005-2006). Inkind financial support from the sponsoring institutions equaled $9,331.02. Attendance each year was limited to 20 educators; during the two year period, 35 environmental educators in Georgia Early, Middle and High Schools or Education Centers participated fully, resulting in an 88% retention rate.

“Historically underrepresented learners are mixed in my classes. This workshop provides opportunities for learners to participate in building a lichen database and to become involved in the work of ‘real scientists’...[Inter]net tools like a GPS are just the ticket to spark interest and desire in learning.” Participant Comment
Results of the Project (2004 – 2006)

- **35 Educators** from 27 School Districts or City Schools participated
- Districts represented both urban and rural regions of the state of GA
- **60%** of the participants were environmental educators (non-school based but specifically serving school teachers and high numbers of school pupils)
- **38%** of the participants were environmental teachers (school-based)
- The Teacher Quality Improvement Project was highly successful in meeting its stated objectives.

The following **Four Objectives** were overwhelmingly met:

- **Objective 1:** Participants will acquire new skills, knowledge, and confidence to identify lichens to species (content-specific professional development and subject-area knowledge). Evidence for this is derived from formal evaluations. Participants self-reported, on a scale of 1 to 5 (1 = strongly agree to 5 = weakly agree), that “Content knowledge before the workshop” was weak (4.5 in 2004, 4.7 in 2005), but “Content knowledge after the workshop” was strong (2.3 in both years).

- **Objective 2:** Participants will have new skills, knowledge, and confidence to incorporate lichen data in lessons, fieldwork, labs, curricula, and environmental education programs important to state environmental education standards. Evidence for meeting this objective comes from participant self-reported data: In responding to the statement, “Confidence in ability to teach about lichens before the workshop” was weak (4.1 in 2004 and 4.9 in 2005), however, “Confidence in ability to teach about lichens after the workshop” was strong (1.9 in 2004 and 2.3 in 2005). Attendees registered strong (favorable) scores to the statement, “The workshop introduced new and useful concepts, terminology, resources and settings” (1.2 in 2004 and 1.5 in 2005).

- **Objective 3:** At the end of the training, participants will have new skills, knowledge, and confidence to participate in a statewide lichen monitoring network. There is now a web-based network of teachers and environmental educators building a statewide database. It has nearly 450 lichen locations documented and mapped by course participants and instructors. The database is housed on the CRMS web-server and can be accessed from the CRMS web site. Data and maps may be viewed and downloaded as well as interacted with using state-of-the-art web-based GIS tools. Please see:

  Georgia Lichen Workshop Web Site:
  [http://www.crms.uga.edu/lichen_workshop.htm](http://www.crms.uga.edu/lichen_workshop.htm)

  Georgia Lichen Database:
Objective 4: At the end of the training, participants will have new skills, knowledge, and confidence in web-based technologies, including use of a Geographic Positioning System to establish lichen locations for a Georgia Data Base on Lichen Distributions. Evidence is provided through quires such as, “Experiences with technology (GPS units and microscopes) increased knowledge and interest in using technology in future instruction.” Attendees responded favorably, with scores of 1.5 in 2004 and 2.0 in 2005 (1 = strongly agree to 5 = weakly agree).

“I hope to use the lichen bio-monitoring project as a hands-on learning experience for my students. While involved in such a project the students will be actually using the scientific process skills rather than memorizing them from a list in the textbook.”

Participant Comment

When asked “Which word best describes the overall quality of this workshop, In Year 1, 54% said “Superior,” 31 % reported “Very Good,” and 15% said “Good.”

After incorporating recommendations from Year 1, when asked in Year 2 “Which word best describes the overall quality of this workshop,” 88% said “Superior,” and 12% reported “Very Good.”

“I will use lichen collecting in my environmental class to show how scientists ...monitor the environment....It will give the students a real hands on project that can teach them how scientists work and what scientists do.”

Participant Comment
PROJECT DIRECTORS’ FINAL REPORT

Teacher Quality Higher Education Program Grants

Title II, Part A of Public Law 107-110, the “No Child Left Behind Act”

Teacher Quality Project Number: RH216-154
http://www.coe.uga.edu/teacherquality/download/coversheet1.pdf

Project Title:


Project Directors:

Dr. Robert J. Hill, Principle Investigator, University of Georgia, Department of Lifelong Education, Administration, and Policy, Adult Education Program – Principle Investigator (PI) (YR 1, 2004-2005; YR 2, 2005-2006). Report author. Email: bobhill@uga.edu

Dr. Tommy Jordan, University of Georgia, Center for Remote Sensing and Mapping Science, Department of Geography (Co-Investigator) (YR 1, 2004-2005; YR 2, 2005-2006)

Mr. Sean Beeching, Atlanta, Georgia, Lichen Consultant (Co-Investigator) (YR 1, 2004-2005; YR 2, 2005-2006)

Ms. Luanne Cooley, University of Georgia, Department of Lifelong Education, Administration, and Policy, Adult Education Program (Project Administrator) (YR 1, 2004-2005; YR 2, 2005-2006)

Mr. Joel Mercado Diaz, Conservation Trust of Puerto Rico (www.fideicomiso.org) and Department of Biology, University of Puerto Rico at Rio Piedras (International Lichen Consultant) (YR 1, 2004-2005; YR 2, 2005-2006)


Ms. Pamela Parks, Oconee River Georgia Youth Science & Technology Center at Northeast Georgia Regional Educational Service Agency (YR 2, 2005-2006)

Ms. Deborah Riddleberger, Oconee River Georgia Youth Science & Technology Center at Northeast Georgia Regional Educational Service Agency (YR 1, 2004-2005)
Ms. Anne Shenk, University of Georgia, State Botanical Garden, Director of Education (YR 1, 2004-2005)

Mr. Richard Osorio, Georgia Project for Excellence in Environmental Education, a project of the University of Georgia, Department of Environmental Health Science; the Georgia Department of Natural Resources, Environmental Protection Division, Land Branch; and the Environmental Education Alliance (EEA) of Georgia (YR 1, 2004-2005)

Institution of Principle Project Directors:

The University of Georgia

GRANTEE ACTIVITIES

All school systems whose personnel participated in project activities:

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<td>Morgan County</td>
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<td>Rome City Schools</td>
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<td>Worth County</td>
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1. Additional information that may provide a better description of your grant activity.

   This project involved the education, training, and in-service professional development for teachers and environmental educators who assist teachers in school systems throughout the state of Georgia, to improve their skills and quality of environmental instruction.

2. Check the professional development need that best describes the difference of this grant activity: (Please circle only the major focus)
   - □ In-service professional development for teachers to improve their skills

3. Indicate the subject(s) of your grant activity:
   - □ c) Science
4. Check the item that pertains to the number of contact hours per participant in your major grant activity

60 Contact hours for 6 PLUs (2004-2005)
50 Contact hours for 5 PLUs (2005-2006)

5. Please describe how the project has helped teachers to meet the needs of students from historically underrepresented groups including females, minorities, individuals with limited English proficiency, the economically disadvantaged, and individuals with disabilities.

Answer: Please refer to **Objective 5** of this report for details.

6. Provide the number of participants by each of the following positions: (List only under one category which is the participant’s primary function)

   It was the intention of the Workshop organizers to train 20 participants each year (40 for two years). Retention rate for the two years of workshops and subsequent sustained contact days was 35 of 40 or 88%.

Categories that best describe participants (YR 1 & YR 2):

   60% Environmental educators (non-school based but specifically serving school teachers)
   38% Teachers
   02% Other school staff

Disaggregated Data:

   a) Teachers (N = 13)
   b) Pre-Service teacher candidates (N = 0)
   c) Teacher aids and assistants (N = 0)
   d) Other school staff (N = 1)
   e) School & district administrators/supervisors (N = 0)
   f) State level administrators/supervisors (N = 0)
   g) Policymakers (N = 0)
   h) Others, Specify (Environmental educators, N = 21)

7. Provide the number of participants for each of the following categories:

   Self-Identified:

   95% Euro-American (white)
   5% Hispanic
a) White, non-Hispanic (N = 34)
b) Black, non-Hispanic (N = 0)
c) Hispanic (N = 1)
d) Asian/Pacific Islander (N = 0)
e) American Indian/Alaskan Native (N = 0)
f) Other, not indicated above (N = 0)
g) Other, Specify: (N = 0)

8. Check all the following agencies or organizations that support your project with funds in addition to Teacher Quality Education funds

☐ a) U.S. Department of Education
   ☐ 1. Other Teacher Quality SEA: None.
   ☐ 2. Title I: None.
   ☐ 4. Other ED program funds Specify Program: None.

☐ b) National Science Foundation Specify Program: None.

☐ c) Other federal funds Specify Program: None.

☐ d) Other state funds Specify Program: None.

☐ e) Higher Education Funds: None.

☐ f) Local public funds: None.

☐ g) Local private funds including business funds: None.

☐ h) Foundations/non-profit organizations: None.

☐ i) Other funds, Specify: In-kind support:
   1. University of Georgia, Department of Lifelong Education, Administration, and Policy, Adult Education Program:
      Printing of instructional materials, $1011.02; Indirect costs, telephone, postal mailings, email support, administrative office space, clerical assistance to conduct the program, $1,120. Total departmental inkind support = $2,131.02

   2. University of Georgia, Center for Remote Sensing and Mapping Science, Department of Geography:
      The Center for Remote Sensing and Mapping Science (CRMS) and the Department of Geography provided venues for three of the extended contact meetings: one meeting utilized the Geography computer lab and classrooms for lectures and hands-on GIS-training using licensed software. Two additional meetings were held in a UGA Department of Geology research lab where the participants were able to use high-powered microscopes for detailed lichen identification. Lunch and breaks were provided in the Center for Remote Sensing and Mapping Science. Inkind support = $1,650

   3. University of Georgia, State Botanical Garden of Georgia:
      Lab and classroom provided, inkind support = $1,000.

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4. Oconee River Georgia Youth Science & Technology Center at
Northeast Georgia Regional Educational Service Agency:
Teachers and environmental educators servicing twenty-five (25) county school systems and two specific city schools participated during both years (8 in 2004-2005 and 25 in 2005-2006). Five participants received 6 PLUs in the 2004-2005 workshop, and 20 participants are scheduled to earn 5 PLUs in 2005-2006. The current cost for PLU's is $35 an hour, or $175 each for the 5 PLU's and $210 each for the 6 PLU's. Thus, in YR1, inkind costs were $1,050, and in YR 2 they will be $3,500 for a total of $4,550 inkind support.

Total inkind support for YR1 & YR 2 = $9,331.02

9. Your institution is a (check one):
   - a) Public 4-year university or college

10. There is no item 11 on form

11. To what extent was technology used during the project?
   - Extensively

12. If technology was used, how was it used?

Technology was integrated into many of the training sessions: Formal lectures included Fundamentals of Geographic Information Systems and Introduction to the Global Positioning System. Each participant was given a handheld GPS receiver and taught how to use it to record locations of lichen samples. These data were then included in the data submitted for inclusion in the project GIS data base. During the computer sessions, participants were instructed and given hands-on experience in 1) downloading and uploading lichen data records to the CRMS server; 2) downloading and installing free GIS software and data; and 3) building and viewing GIS databases for use in classroom instruction.

13. What do you consider to be the most significant impact your project had on the project participants?

   Overall Assessment of Workshops by Participants:

   55% Superior
   30% Very good
   15% Good

   [No “Fair” or “Poor” assessments]
15. If you were to conduct this project again how would you modify the project’s activities or objectives?

**Things We Learned in Year 1 (2004-2005), Which Were Changed to Improve Year 2 (2005-2006).** (Modifications were based on post-workshop Participant Evaluations and Instruction Team analyses).

**Improvements:**

We provided:

- A more in-depth introduction (overview and basic information) to lichens at the beginning of the workshop
- More field time facilitated by instructors
- A more basic text in addition to the technical keys
- Demonstration tables with 24 lichen samples, accurately identified, with characteristic features noted
- A “sample lichen kit,” to each attendee, containing accurately identified lichens
- More practice time to identify lichens with instructors present
- Demonstrations of several of the recommended lab and field exercises to show participants how these are conducted
- A formal (rather than voluntary) evening session on UV fluorescence in the field
- A handheld UV light to each participant

**Ways We Need to Improve the Workshop/Biomonitoring Network in the Future:**

- Purchase laser pointers, micro-cam so all students can see microscopic details of specimens projected onto a classroom screen
- Purchase several binocular (dissecting) microscopes for participant use. At this time instructors are providing their personal equipment
- Expand workshop locations (main workshop and sustained contact weekends) to include bioregions other than the Piedmont (e.g., coastal, and montane) region
- Acquire resources and coordinate with with participants ways to access grants for sub-projects, computer software, microscopes, and laboratory supplies
- Hire graduate assistant(s) to manage data and maintain the web-based database
- Better coordinate lesson plans and opportunities to share ideas with those teachers/environmental educators already using lichens in instruction
• Development of PowerPoints and other instructional tools to better aid learning; photographs and other short descriptions of species; illustrations of lichen body characteristics useful in lichen identification

• Aggressively recruit minority educators, or educators working with minority learners

16. List what you consider to be the three or four most important objectives for your project. For each objective describe the evidence you used to determine the extent to which the objective was met. Finally, under comment, please indicate the extent to which the objective was met. (if a survey or other instrument was used, please include it with the report.)

**Objective 1:**
At the end of the training, teachers and environmental educators will have new skills, knowledge, and confidence to identify lichens to species (content-specific professional development and subject-area knowledge).

**Evidence:** 35 teachers and environmental educators (N = 17 for YR 1, 2004-2005 and N = 18 for YR 2, 2005-2006) participated in the Teacher Quality Improvement project. Attendees self-reported, on a scale of 1 to 5 (1 = strong to 5 = weak), that “Content knowledge before the workshop” was weak (4.5 in 2004, 4.7 in 2005), but at the end of the project “Content knowledge after the workshop” was strong (2.3 in both years).

**Comments:**
Teachers’ comments provide further evidence of the value of the project:

“The workshop gave me…confidence [to communicate between teacher and student] because it was so intensive and professional and treated us all like scientists, and not just teachers.”

“This workshop gave me the resources and knowledge necessary to teach on the topics of lichens, biomonitoring, and air pollution by allowing me to participate in exercises I can use with my classes, by giving me the experience I need…to comfortably teach [about these topics].”

“I have met people in class who represent other organizations [environmental education centers and schools] that will be good resources for field study trips and hands-on type materials.”

**Objective 2:**
At the end of the training, teachers and environmental educators will have new skills, knowledge, and confidence to incorporate lichen data in lessons, fieldwork, labs, curricula, and environmental education programs important to state environmental education standards.

**Evidence:**
Participants reported that “Confidence in ability to teach about lichens before the workshop” was weak (4.1 in 2004 and 4.9 in 2005), however, “Confidence in ability to teach about lichens after the workshop” was strong (1.9 in 2004 and 2.3 in 2005). Attendees registered strong (favorable)
scores to the statement, “The workshop introduced new and useful concepts, terminology, resources and settings” (1.2 in 2004 and 1.5 in 2005).

Comments:
Teachers’ comments provide further evidence of the value of the project:

“This workshop has given me the skills…needed to develop interesting and relevant lichen related lessons to meet state mandated standards in 7th grade life science.”

“I will incorporate the information about lichens and air quality into the Environmental Science Curriculum. I see it as really enhancing our study of air quality.”

“We are currently developing some curricula for the 2006/2007 school year which will include [material from this workshop]. There are also other plans to use the information [in] staff workshops and activities for [students’] independent study.”

“When I am educated in a subject, then I am a better teacher to all learners….This course gave me new tools and methods of teaching about our shared environment.”

Objective 3:
At the end of the training, teachers and environmental educators will have new skills, knowledge, and confidence to participate in a statewide lichen monitoring network.

Evidence:
There is now a web-based network of teachers and environmental educators building a statewide database. It has nearly 450 lichen locations documented and mapped by course participants and instructors. The database is housed on the CRMS web-server and can be accessed from the CRMS web site. Data and maps may be viewed and downloaded as well as interacted with using state-of-the-art web-based GIS tools. Please review it at:

Georgia Lichen Workshop Web Site:
http://www.crms.uga.edu/lichen_workshop.htm

Georgia Lichen Database:
http://www.crms.uga.edu/lichens/georgialichens.xls

Georgia Lichen Interactive GIS Database
http://boston.crms.uga.edu:7080/lichen/default.asp
Comments:
Teachers’ comments provide further evidence of the value of the project:

“[The workshop] provided me with a network of professional contacts who are interested in involving our students in developing a lichen database which can be used to promote inquiry and thinking skills.”

“[This] is an innovative base on which I can build cross-curricular activities for many grade levels.”

“I will use the information and resources from this workshop to involve my students…[in] participating in the statewide biomonitoring project. Using ArcView software, local data…and our collected lichen data, the students will also look for trends in air quality in their own community.”

“I hope to use the lichen biomonitoring project as a hands-on learning experience for my students.”

Objective 4:
At the end of the training, teachers and environmental educators will have new skills, knowledge, and confidence in web-based technologies, including use of a Geographic Positioning System to establish lichen locations for a Georgia Data Base on Lichen Distributions.

Evidence:
When queried with the statement “Experiences with technology (GPS units and microscopes) increased knowledge and interest in using technology in future instruction,” attendees responded favorably, with scores of 1.5 in 2004 and 2.0 in 2005.

Comments:
Teachers’ comments provide further evidence of the value of the project:

“Historically underrepresented learners are mixed in my classes. This workshop provides opportunities for learners to participate in building a lichen database and to become involved in the work of ‘real scientists’….Internet tools like a GPS are just the ticket to spark interest and desire in learning.”

“I will use the geographic information system and mapping info to strengthen math skills.”

“This course provided knowledge and instruction on lichens and GPS training that all of my students can use in school yard field trips.”

“I will use [workshop information] in my environmental class to show how scientists measure and monitor the environment (transects…data recording, statistical methods, [and] computer modeling).”
**Objective 5:**

At the end of the training, the project will have provided teachers and environmental educators (in both categories of “met” and “did not meet” Adequate Yearly Progress under the No Child Left Behind Act [NCLB]) with continuing professional education opportunities—including creditable units.

**Evidence:**

Teachers and environmental educators servicing twenty-five (25) county school systems and two specific city schools participated during both years (8 in 2004-2005 and 25 in 2005-2006). Five participants received 6 PLUs in the 2004-2005 workshop, and 20 participants are scheduled to earn 5 PLUs in 2005-2006.

**Comments:**

Teachers’ comments provide further evidence of the value of the project:

“Inquiry based scientific investigation of lichens is proving to be a model alternative learning strategy useable with the ‘at risk’ student…While…still in its developmental stage, I feel assured that this workshop will prove to be a cornerstone for one of the best teaching strategies of our time.”

“Many enrichment opportunities for my students have emerged through the workshop.”

“Lichens…link the poor with the affluent, English-speaking with non-English speaking students. Lichen research levels the learning field for all learners.”

“Three of the four [nature] preserves (where I am employed) serve communities with significant minority populations.”

“Historically underrepresented learners can experience success on many levels with lessons developed through this workshop.”

“I am a special education teacher. My students all have a disability that affects their learning. [Lichens] will spark their interest…and provide an excellent ‘hook’ to engage these reluctant learners.”

“Lichens] are easily accessible in urban environments…They are something many urban or environmental restricted students [those restricted in their access to nature due to economic limitations] will have opportunity to observe and study.”

“[Including] an international co-instructor for this course…gave teachers the opportunity to relay to students how [lichens and information technologies] are being studied in other parts of the world, and provided a model scientist from the Spanish-speaking community.”
**Participant Evaluation – Results from 2004 & 2005 Summer Workshops**

**Lichen Biomonitoring Workshop**
2004 State Botanical Garden of Georgia, July
2005 Charlie Elliott Wildlife Area, July

**Principle Investigator: Dr. Robert J. Hill**

Following are the average scores (questions 1-30) and narrative responses (questions 11-40) gleaned from the evaluation forms received after the summer workshops.

Evaluation for the YR1 summer workshop was conducted by Richard E. Osorio; YR2 was compiled by Luanne Cooley. Both are doctoral students in Adult Education, University of Georgia.

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Responses next to each of the following questions is based on a scale of 1-5 (1=strong to 5=weak).

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<td>6.</td>
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Responses next to each of the following questions is based on a scale of 1-5 (1=strongly agree to 5=strongly disagree).

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<th>Question</th>
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<th>2005</th>
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<td>7. The goal(s) and objective(s) of the workshop were clear to me</td>
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<td>1.6</td>
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<td>8. The workshop introduced new and useful concepts, terminology, resources and settings</td>
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<td>9. The instructors assisted participants to make connections and applications between the scientific information and potential integration into K-12 classroom settings</td>
<td>2.3</td>
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<td>10. Presentations by instructors were too technical</td>
<td>3.6</td>
<td>4.9</td>
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<tr>
<td>11. Presentations by instructors increased interest in lichens</td>
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<td>1.8</td>
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<td>12. Instructors explained confusing concepts, terminology and content</td>
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<td>2.1</td>
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<td>13. Experiences with technology (e.g., GPS units and microscopes) increased knowledge and interest in using technology in future instruction related to lichens</td>
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<td>2.0</td>
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<td>14. Field experiences with instructors increased knowledge and interest in lichens</td>
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<td>15. The workshop provided ample resources in lichens to assist with content information</td>
<td>1.2</td>
<td>2.0</td>
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</table>
16. The workshop provided ample resources in lichens to assist with my instructional needs  
   2004 2005  
   2.1 2.4  
17. Adequate sharing time was provided to discuss current and new applications of the material in formal, informal and nonformal settings  
   2.6 2.2  
18. Host site provided an ideal location for a lichen workshop  
   1.1 2.1  
19. Classroom environment was suitable for learning  
   1.9 2.5  
20. Length of days during the week were too long  
   3.7 4.8  
21. Housing for the workshop was adequate  
   1.3 2.4  
22. Information provided to you prior to the workshop was clear and timely  
   2.0 2.7  
23. Registration materials were appropriate and useful during the week  
   1.5 2.6  
24. Opportunities to learn about and conduct lichen identification were too brief  
   3.6 4.1  
25. Sufficient time was allocated to learn how to use and apply the GPS unit for exercises during the workshop  
   1.9 2.9  
26. Learning about GIS at the Geography/Geology computer lab was helpful to me  
   2.7 2.8  
27. The purpose of the next three meetings over the course of the academic year is clear  
   2.4 2.8  
28. Adequate time was appropriated for the noon meals and breaks  
   1.3 2.8  
29. Instructions prior to any activity were always clear and direct  
   1.8 2.9  
30. Amenities (allocation for meals, lodging, and transportation) were generous  
   1.4 2.9  

31. Why did the lichen workshop appeal to you?  

2004  

The relationship of plants and air pollution, and how youth, and others, could be involved in a program which would show them the error of their polluting ways and the effect it has on the environment.  

Interest in expanding biomonitoring program with students and volunteers. Always get questions about lichen, wanted new knowledge.  

I was generally interested in learning about lichens so most everything appealed to me. I would of liked Bob to go over the exercises that are used for grades 2-5 I think that applies to most of the non-formal educators. I enjoyed Thursday the most because it took me a few days to get acquainted with the information.
I was interested in learning more about lichens and their role in the environment. The chance to spend most of the week at the botanical gardens was also appealing.

Georgia Conservancy’s *Native Seasons* curriculum has an entire chapter devoted to lichen. I wanted more information to better help me present this subject. Also, I work with numerous middle and high schools throughout the state helping them creative environmental projects that they can later present at the annual Youth Environmental Symposium. Lichen is a great match for this program.

I was already very interested in the topic. I saw this as a unique opportunity to learn much more about lichens than I could even imagine. Other educator workshops rarely spend as much time devoted to a specific area of study. I knew the instructor was a lichen expert. I had heard very positive comments about the session the instructor presented at the Environmental Education Alliance of Georgia conference (great content knowledge and enthusiasm).

As an environmental science teacher, I was looking for opportunities to involve my high school students in “real world” environmental experiences. I wanted to increase their awareness of the complex ecological interactions in their local environment and their understanding of the local environment as part of the larger global picture. I was also interested in new and meaningful ways to incorporate GIS into the environmental education curriculum. Dr. Hill’s infectious enthusiasm on the topic of lichens during his presentation at the EE conference, the opportunity to involve my students in a statewide air quality biomonitoring project, and the possibility of using GIS to collect/process real data all made this workshop appealing to me.

My coworkers and I developed an air quality program for 4th, 8th, and HS using the lichens found on the outcrops and we wanted to make sure we had identified the lichens correctly and were determining results correctly. I was also interested in knowing more about the lichens covering the trees in some parts of the park—why were they growing nicely on some trees and growing poorly on others and did that have to do with the substrate or air pollution.

I am always looking for new ideas to teach students in an outdoor classroom environment.

To me lichen is as fascinating as any alien species we might discover on another planet. How these kingdoms merged for survival is a wonderful example of “life finding a way”. DNA studies of lichen will reveal many secrets about the role of symbiosis in the evolution of other life forms as well. I would love to see algae take up residence in man—photosynthetic people—wow.

I am interested the environment and life science. It is also helpful to network with other teachers whenever possible.
I didn’t know much about lichens except in a brief overview in a college biology course. I enjoy learning about new things and I thought that might be able to use the link to air quality and the GPS as a draw for middle/high school students to come to Vines Botanical.

Textbooks give little space to descriptions of lichens in general and no specific information about their morphology or ecology. I have had little formal or informal instruction on lichens and I really wanted to know more about them.

2005

To gain information in a weak area and to be able to introduce the subject to others.

Lichens are common organisms in the field. Students have access to them and questions. Many opportunities to integrate them into studies. Learning more about a new, poorly understood area of botany.

I have a genuine interest in field work and wanted to find a useful means to incorporate lichenology into my lessons.

I was originally interested in the workshop because it offered a new venue of education that I could bring to my students.

It provided a more in-depth, intensive level of instruction. Many teacher workshops are too simplistic. I wanted to learn more about lichens (improve my introductory knowledge). I am interested in bio-monitoring, and learning more about GIS.

I have always been involved in outdoor education, but knew nothing about identifying lichen and was eager to learn more. I met Bob and Sean at the EEA and knew after the night hike I had made a great decision in enrolling in the class and was eager for July.

I teach life science and I had very little knowledge of lichens, but I knew that our school had an abundance of lichens to use as examples. I wanted to be able to get the kids looking at them and I needed to know more myself.

It appealed to me to learn more about lichens and to use them more in my classroom.

I wanted to learn more – Know nothing, except that they are beautiful and fascinating.

I wanted to learn more about lichens. The workshop seemed to be a fun way to do this and earn PLU’s.

To increase my knowledge base. I knew so little about lichens.

Lichens have been minimized in my previous education and I wanted to learn more about them.
I plan to work at an environmental education center and I wanted to get more educational tools for my tool belt.

To increase my knowledge of lichens with possibility of adding new activities to the curriculum that I teach.

32. **How did you hear about the workshop?**

2004

Dr. Hill’s presentation at 2004 Environmental Education Alliance of Georgia Conference – 7  
Co-Worker/Peer/Friend – 5  
RESA - 1

2005

Conference/symposia: OCC = 1; Environmental Education Alliance of Georgia Conference = 1  
Co-worker/peer/friend: 3  
Past Participant: 5  
Internet: 6  
Flyer/handout: 3

33. **How far did you travel to attend? (Miles from home to Athens)**

2004

Shortest Distance: 25 miles  
Longest Distance: 200 miles  
Average Distance: 111 miles

2005

Shortest Distance: 42  
Longest Distance: 180  
Average Distance: 84
34. Briefly share how this workshop will be useful to you.

2004

In 7th grade life science we talk about relationships, ecosystems, environment.

I will use lichen collecting in my environmental class to show how scientists measure and monitor the environment. (transects and other sampling techniques, data recording, statistical methods, computer modeling). It will give the students a real hands on project that can teach them how scientists work and what scientists do. Lichen can be brought in again when we cover symbiotic relationships. Also will mention lichens when we talk about the role of lichen as pioneer species in succession and as bio-indicators. We will use our collected data to talk about air quality and the effects of man on the environment later on in the semester. Overall, allowing the students to participate in the bio-monitoring project will be useful in maintaining the students’ interest and motivating them to be more precise in their observations and measurements during activities.

I will add another aspect to my outdoor environmental education program and I will try to install lichen i.d. for our watershed studies.

The workshop gave me some possible ideas on how to fine-tune the air quality monitoring programs. I also thought of some ways to incorporate the GPS unit in various programs.

I will use the information and resources from this workshop to involve my students in studying our local lichens and participating in the statewide bio-monitoring project. Using ArcView software, local data concerning major highways, industries, etc., and our collected lichen data, the students will also look for trends in air quality in their own community.

The workshop greatly increased my content knowledge of lichens and provided resources for furthering my knowledge even more. This knowledge will be useful in my current non-formal teaching position. It will help me create engaging science inquiry lesson plans for classroom teachers. If I return to teaching in the classroom myself, the workshop will provide interesting and meaningful ways to help my students master state curriculum standards.

I enjoyed this workshop and learned a lot about lichens. I want to share this information with students and other teachers and use this information to participate in the bio-monitoring that Dr. Hill is planning.

I am not sure yet. I will be able to decide more after the next session. I am very busy already at work but I would like to use the information at one of our nature centers.

New program to partner with Cobb County schools. Biomonitring project to do with schools that don’t have a stream on the campus.
With a little bit of knowledge I may become dangerous. I am inspired to dig more deeply into the subject, build my confidence, then share with youth and adults, both formally and informally.

I hope to use the lichen bio-monitoring project as a hands-on learning experience for my students. While involved in such a project the students will be actually using the scientific process skills rather than memorizing them from a list in the textbook. The workshop has already been very useful to me by recharging my enthusiasm while providing great resources and the opportunity to learn more about an organism that I had very little knowledge of.

I am offering a lichen class for middle and high school students at Vines Botanical this year- the flyer has already been distributed to Gwinnett schools. I hope that I have some takers. I do plan to do some personal monitoring for the project too.

2005

I will utilize my new knowledge with teachers and students in classroom presentations.

7th grade science objective standards include many concepts that can be taught using some of the lichen experiences from this workshop

Participating in the workshop will help me teach others about the importance of lichens in our eco-system.

I’ll be able to continue surveying lichens, teach my students how to survey them, and provide a real world application for science to my classes.

Teaching of organizational skills and diversity of wildlife.

I will teach this information to students as an instructor with Fernbank Science Center.

It will improve the GPS part of navigation classes I teach, it will allow me to help develop outreach programs that include bio-monitoring lichens.

I am better suited to teach my students about another element in the environment and their surroundings.

I will introduce students to the world of lichens and the pioneer work being done.

To explain lichens to my students.

I will apply to my work and share with volunteers at TNC.
I plan to get my Environmental Science kids involved in collecting and hopefully help add to the database to relate lichens to air quality.

Create a better knowledge base for me to teach to my students.

I will add lichens to my instructional portfolio at Fernbank Science Center, incorporating them in existing programs and (probably) writing some new ones.

I plan to use lichens in a bio-monitoring program as well as a part of nature hikes.

I can add a new activity to my curriculum on using a dichotomous key.

35. What proved to be the most difficult for you during the week?

2004

Vocabulary, keeping terms separated. A vocab. list with pictures of each lichen part would be helpful to use as a reference.

The most difficult was the frustration I had when I tried to identify lichen – I couldn’t see clearly, the scopes were always in use when I needed them, Bob was pressed for time and moved us on to the next interesting specimen before I could get settled. Nora was trying to show us her slides at the same time and that was a distraction to what I really needed to be doing. I’m old and slow so I need lots of uninterrupted quiet time.

Learning some of the terminology.

Keying out the different lichens. Figuring out which lichens had soridia or isidia on them and making sure I collected a “good” specimen so it would key out correctly.

The two most difficult aspects of the week — the physical challenges of the hikes and the mental challenges of tackling an unfamiliar subject — were also among the most rewarding aspects.

The most difficult part of the course was learning how to identify the lichens using the key. I have experience using dichotomous keys but knowing what you are looking at was quite difficult with my limited knowledge and experience looking at lichens.

Number of days away from the office.

Without a doubt the challenge will be in trying to identify the lichens correctly.

The first two days without the text book I had a hard time understanding the terminology.

Squamulose recognition. I suggest having a scope for each group to use in addition to the common stations. I’ve been to fungi workshops that requested participants bring a scope.
Identification of the various components needed to identify the lichens in order to use the keys.

Trying to remember many new vocabulary terms so that I could correctly identify lichens using the dichotomous keys.

Getting a handle on the terminology and being able to identify correctly the species of lichen.

2005

Not sure if I saw examples of descriptive terminology.

Becoming accustomed to the vocabulary use in the ID key
Identifying crustose lichens.

Learning the different terminology of lichens.

The physical exertion.

Absorbing new terminology.

Just getting a handle on the vocabulary used in the keys and transiting that to the specimen in question.

The end of it – having to return to civilization, not playing in the woods all day and night, not having Sean to confirm or redirect my lichen identification.

Keying out samples.

Determining the lichens.
Crust ID, knowing which key to start with on foliose lichens

Mastering enough information about lichens to feel confident in my identifications.

Brain overload/no internet.

Collecting some of the crustose lichens, distinguishing the lichen colors used in the dichotomous key, and misleading descriptions (of conflicting descriptions in the keys. It as difficult identifying the lichens because there is a lot of grey areas and we are still learning to figure them out.

Teaching to key out lichens successfully. Some were very similar and key was hard to understand in some instances.
36. How can we improve future lichen workshops?

2004

Have about three more Seans to help Bob, maybe?

Having the textbook in front of us when the different lichen features were introduced would have been of great benefit. Next time you will be perfect!

A lichen overview would have helped me. (I would have done it for myself if I had the text). Names of lichens came in one ear and out the other because I didn’t have a schematic in front of me to help group similar lichens together. I needed a skeleton of knowledge on which to hang the new knowledge.

Spend more time on the parts of the lichens. It seemed like everyday we had to learn a new anatomy term.

Schedule in more time for identification. Spending field time looking at each lichen specimen together as a group and collecting on our own time. Maybe give everyone an assignment to collect a certain number of lichens and lead the group on keying out the lichens once back in the lab.

Having more dissecting microscopes available would be helpful. Using the dissecting scope helped me distinguish the characteristics of the different lichen structures. If necessary, perhaps teachers could bring school microscopes with them. (Also, I know you know it would have been helpful to have the books from the beginning.) The dates of the workshop need to move from tentative to confirmed status well in advance since most participants have many other responsibilities to consider. On the plus side, I thought the instructors were very receptive to group input on the schedule once we arrived.

My main suggestion would be to learn about and learn to identify lichen structures by first looking at numerous real examples instead of just diagrams. Slides of close up images of sorrelia, isidia, apothecia, podetia, squamules, rhizines, etc. would’ve been very helpful. Show confusing examples too – is this an apothecium or not and how do you know. Or, as another participant suggested, using a microscope connected to a TV screen to show these structures in real life would’ve also worked for this purpose. The TV microscope would’ve also made group practice using the keys much more productive and efficient. I did feel like we needed more guided practice using the keys.

I would’ve liked to spend a little more time just learning about lichen basics. I would’ve liked learning more about basic lichen biology, more background on the lichen
components of fungi and algae/cyanobacteria, how lichens may have evolved, how lichens grow and reproduce, etc. I thought roles of lichens in the ecosystem and human uses of lichens was covered very well. I would’ve like a little more detail about how lichens are used to monitor air quality.

If there’s any way to simplify the key for student use, I think that would be very helpful. Perhaps making a shorter key of the most common Georgia species of lichens or a key to ID lichens just down to genus level.

I think modeling/participating in some of the lichen labs and field investigations to do with students would’ve been helpful. Great that these were written up and given to us in the spiral bound notebook but would’ve liked to try some out with the group. Wish we’d had time for educators to do some of the activities they brought as well.

Make the lichen night hike with the UV light part of the course requirement – not optional. That was one of my favorite parts!

I still have concerns about being a useful contributor to the bio-monitoring project if I’m not confident in my lichen identifications. I’m not sure about the expectations for contributing to the bio-monitoring project. However, I understand this is a new project and a lot of is will be worked out as we go. That will be an advantage for future participants.

Shorten the length of the workshop. We really didn’t accomplish very much on Sunday. It was mainly used to distribute supplies and get acquainted.

My only complaint is that the dates changed and we did not know until a week before the workshop. I hated to leave before the workshop was over because I know I missed something important.

Have a room that has better light it started to hurt my eyes.

It was well structured. I’d have liked more time with the keys.

Instructors need to use laser pointer on projection through micro-cam so all students can see same identifying properties simultaneously. Recordings of most common terms, prefixes and suffixes would also help.

Provide more age appropriate lesson plans that are ready to use.

Books and supplies need to be there on day 1. Include a handheld black light and perhaps a tote bag for the books. I think you need to assume that the participants know nothing about lichens and start with the basics – showing slides and using microscopes to see real examples of soredia, apothecia, etc. I was struggling with taking notes the first day not
having a clue how to spell the terms much less knowing what they meant. More time
doing a group “walk through” identification of lichens would be helpful too. I felt lost
trying to id on my own on day 2.

2005

More space to spread out materials when working on identification.

The workshop was wonderful. Every detail taken care of.

An outstanding workshop. No improvement needed. For next year, providing one-page
handouts with key glossary terms and basic morphological characteristics would have
been helpful at the onset of the workshop. Even through this information is in the Brodo
text, it would have been helpful to have it readily available in simple format for quick
reference during the early lectures. Consider adding a lecture on the first day covering
the anatomy and structural function of lichens to get everyone on the same page at the
onset. Consider doing GPS lectures outdoors, weather permitting. Dong more guided
identification as a class might have been helpful. Learning from the experiences of the
instructors in ID’ing morphological characteristics is critical. Some people were shy
about seeking help individually.

None needed at all. Great site for the workshop and great access to resources. Keep it
hands-on oriented.

More information on how lichens interact with the environment.

I would like a comprehensive glossary (with sketch illustration or photos) to help speed
up the process of learning terms.

Bring more scopes – better lighting in main room. Make sure handy extra table space.

Have more sessions or meetings either formal or informal gatherings.

Dissecting kits to use on site.

At least demonstrate use of P

This was great. Perhaps more group work with keys to help use get comfortable and
confident.

Would be helpful to provide a dissection kit.

A few more working examples with the keys as a group exercise, but break it up with
keying on our own in between.
I think I needed more time with group keying. Several times I needed more help.

Vocabulary lists at beginning, before using dichotomous key. Some of this was approached, but still had problems.

37. How can we best meet your needs over the course of our next three meetings together?

2004

Give me clear expectations of my responsibilities to be done before I come to the next class.

Give me more experience with identification of lichens and more details about sampling methods (in writing) and other expected procedures for the biomonitoring project. I will need definite procedures spelled out for my students.

Confirm dates, times, and locations as far in advance as possible.

Practice identifying more lichens in field and lab—maybe give us some pointers on how Dr. Hill and Sean and Nora quickly identify certain specimens. We definitely need to spend some time discussing how to use all of this information in the classroom.

The format we used in the workshop worked well for me with time divided between outdoor collecting and indoor identification with instructor help available.

I’d like to understand more clearly what is expected from us related to submitting data for the lichen monitoring project. How many submissions do you expect from us? Should we only submit genus if we are not confident about our species identifications? What if we if we aren’t even confident about genus? It would also be helpful to hear how teachers are using lichen studies in their classrooms and other educators are applying or sharing their lichen knowledge. Maybe sharing ideas for how to use lichens to captures students’ interest and help them master state curriculum standards.

It would have been nice to meet in various locations throughout the state, so we could have sampled more diverse areas. One thing might be to have each participant bring in enough samples from throughout the state to share.

I think our needs were met very well in the past workshop.

To have to workshop day on Saturday and be able to stay Saturday night in Athens.

Not sure what I need yet. I think it would be interesting to visit S. GA and Coastal GA to compare diversity.
(1) Simulate a project - beginning to end, taking coordinates, measuring diversity, coverage, and reporting. (2) Provide potential grant sites where we may apply for sub project funding for scopes and lab supplies, or even distribution sites for quality used equipment. (3) Using a topo-map program, or just the map, and marking the sample area.

Help me determine how to use this with my students.

I would like to hear a little more detail on some lesson plans that are being implemented and definitely need more practice with identification.

2005

Communication, which has been exemplary so far.

Please check my identification skills and help me learn to do it correctly.

Ensure access to telephone service, if possible.

Provide active links on the website for lichen oriented resources.

Support with keying.

Continued communication/interaction.

Just be there for support.

Continue answering all my questions.

I think everything has been taken care of.

Venue for each so we can expand database quickly.

Just help use get better at identifications.

I think the plan we have set forth is a good one.

For me a few group keying activities would be great.

More practice/support in identifying lichens.
38. **Given your current knowledge and understanding, are you interested in participating in a Georgia lichen biomonitoring project?**

**2004**

Yes – 13 (all respondents)

I’m not sure with my current knowledge and understanding, that I can be useful to this project. I’m interested, but am just not confident about making accurate identifications.

I am undecided and I do not feel confident yet with the lichens that I do find I need to practice.

I really do want to participate but do not feel that I have the skills to be effective at that level yet and the management issues of trying to use high school classes to do this are daunting.

I don’t think so. I would need more info of what was expected of me.

**2005**

Yes – 16 (all respondents)

39. **What resources do you feel you need to give you the confidence and skills to teach about lichens?**

**2004**

More experience with identification of lichens is vital in order to fully participate in the biomonitoring project.

Just more i.d. time.

I think we were given adequate resources during the workshop; I just need to sit down and read everything. I learned a great deal more on Friday when we were able to practice keying out specimens with Sean, Nora, and Dr. Hill on more of a one-on-one session.

With more time/practice with the resources already provided, I feel I will be ready to teach about lichens.

Sharing ideas and trying out lichen lessons, activities, investigations, etc. with the group.

More practice using the key and perhaps developing a simplified key to use with students.
Need to learn more about (and how to ID) the Georgia lichens that are most sensitive to air pollution.

I would love a microscope to help with identification! Also, a PowerPoint with photographs and a short description of the lichen would be helpful. More hand-on activities for elementary and middle school students.

I feel that these resources have already been supplied but it will take some time to be confident in lichen identification.

I have to practice and i.d. with someone who knows a lot about lichens.

Practice, practice, practice on my end. I would like to see what lessons have already been developed across the nation so we aren’t re-inventing the wheel.

Develop curriculums book for class and field activities, similar to the Project series.

The workshop provided great resources but I would like to have the name of someone locally that can help me with identification.

More experience in identifying them with the guidance of an expert and probably reading the Brodo text.

2005

Just more practice in identification and verification by instructors.

Non, I will dig around for information on evolutionary biology of lichens.

A microscope and reagents

Online resources and equipment (hand lens etc.). Since I teach at a Title I school (or access to resource suppliers).

The “key” information.

I would like to put together several (basic) small kits of field tools that students could share in class.

Just more time with lichens. Which will hopefully be accomplished in the continuing content days.

The books, lens, GPS that were provided.

I think I would like the Purvis book.
The books and handouts

I need more practice and study to be able to teach this, but have the basic knowledge and materials to accomplish on my own.

Practice.

Continue to key out lichens.

Interaction with Sean in the field and a thorough review of the introductory chapters of Lichens of North America

More practice with identification.

Not sure. Just need to feel more comfortable in identifying by name – suppose that comes with practice.

40. Which word best describes how you would rate the overall quality of this workshop? Choose among superior, very good, good, fair, poor.

2004 (N = 13 respondents or 76% response rate)

Superior - 7
Very Good – 4
Good – 2

2005 (N = 16 respondents or 89% response rate)

Superior – 14
Very good - 2
Pictured Above—Year 1 Participants in the Field; Photo by Bob Hill
Pictured Above—Year 2 Participants in the Field; Photos by Brian Sterner
LICHEN BIOMONITORING WORKSHOP INSTRUCTORS

Robert J. Hill, Lichen Ecology, Natural History, Taxonomy
Photo by Sheri Koenig

Tommy Jordan (Right), GIS Technology, Remote Sensing, Mapping
Photo by Leslie Carroll
Sean Beeching (Center), Lichen Ecology, Taxonomy
Photo by Leslie Carroll

Sean Beeching (Left) with Dr. Ernie Brodo, Author of the Workshop Text Book
Photo by Bob Hill
The Final Report can be found on the internet at:

http://www.crms.uga.edu/lichen_workshop.htm
[Click on Final Report located in the left margin]

Or

http://www.crms.uga.edu/lichens/Lichen%20Workshop%20Final%20Report%202005.pdf

The Final Report should be cited as:


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i Comments or questions regarding this report should be sent to the author, Dr. Robert J. Hill at bobhill@uga.edu or by calling 706-542-4016.

ii The formal evaluation was constructed by Richard Osorio, Program Coordinator for the Georgia Project for Excellence in Environmental Education, a project of the University of Georgia.