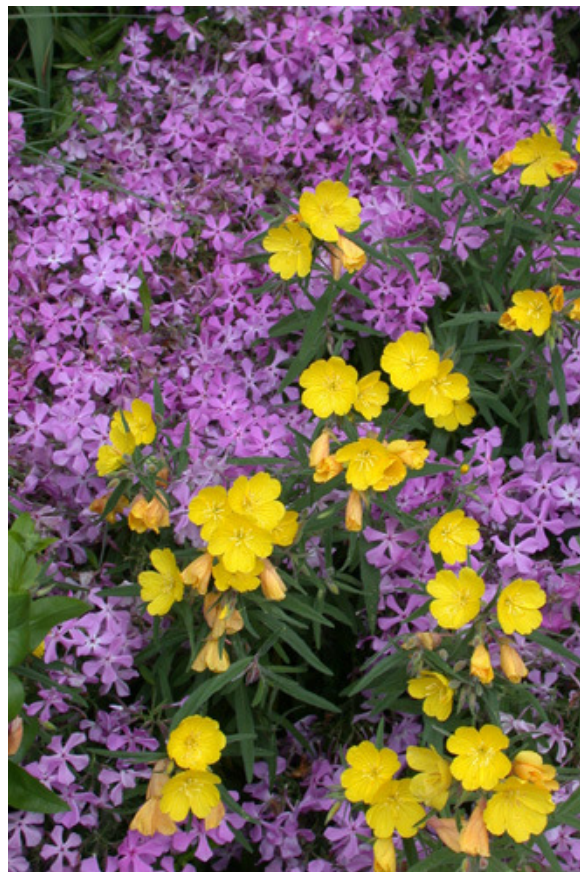


NORTH CAROLINA BOTANICAL GARDEN  
THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Certificate in  
Native Plant Studies  
HANDBOOK



North Carolina Botanical Garden  
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# NORTH CAROLINA BOTANICAL GARDEN

THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

## FOREWORD

The North Carolina Botanical Garden is pleased to offer the Certificate in Native Plant Studies, which enables students to increase understanding of the native flora of the southeast United States. The certificate enhances the experience of the professional and dedicated amateur botanist and provides strong credentials for those involved in botanical, ecological, and conservation endeavors. It is our hope that each student graduating from this program will come away with botanical knowledge and a renewed appreciation for the natural beauty of plants.

The Garden's mission is

**“To inspire understanding, appreciation, and conservation of plants in gardens and natural areas and to advance a sustainable relationship between people and nature.”**

The Certificate in Native Plant Studies expands this mission with its goal

**“To provide a well-balanced botany, ecology, and taxonomy curriculum that enables students to expand their knowledge and develop a greater appreciation of native flora of the southeastern United States.”**



Photo: Dot Wilbur Brooks

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# 1 Introduction

The North Carolina Botanical Garden (NCBG) is a university-affiliated botanical garden with an outstanding reputation as a garden that integrates a conservation ethic into all of its programs. We are the region's most comprehensive center of knowledge on plants in North Carolina and the southeastern United States, and we provide a broad audience with inspirational experiences, opportunities for health and wellness through outdoor activities, and educational programs within a scientifically based institution. It is the Garden's vision to have a profound influence on how people value and interact with the environment and the biologically diverse world.

The Garden's three greatest accomplishments to date are: defining and promoting sustainable gardening and botanical garden practice (recognized by a national award, the Program Excellence Award of the American Public Garden Association, and a state award, the North Carolina Sustainability Award of Sustainable North Carolina); helping to found and participating in the Center for Plant Conservation, a network of thirty five gardens that protect the nation's most endangered plants through gene banks and restoration; and developing a rich array of education activities, including the Native Plant Studies Certificate Program.

This handbook is organized in six parts. Sections one through five provide introductory information and outline the details of the NCBG Certificate in Native Plant Studies program. Section six consists of other information relevant to the program.

## 2 General Program Information

The Certificate in Native Plant Studies is designed to provide students with a well-balanced curriculum combining basic scientific background and hands-on investigative opportunities. Classes are taught by NCBG staff, UNC professors, and other science professionals. Courses consist of lecture-style classroom sessions, outdoor field trips, field studies, and hands-on research project experience. For those in pursuit of professional employment in environmental science-related careers, the certificate will be a valuable résumé addition. Successful completion of the program requires passing grades in eight core courses and five elective courses—a total of one hundred sixty five hours—as well as completion of an independent project. Course offerings and scheduling are designed for graduation within a three-to-five-year period.

### Contact

Nancy Easterling, Associate Director for Education

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Mailing address: North Carolina Botanical Garden (NCBG), CB 3375, Chapel Hill NC 27599-3375

### 2.1 Program Policy

The NCBG Certificate in Native Plant Studies is a certificate of proficiency. The NCBG reserves the right to change the course schedule or fees, withdraw or modify a course, substitute faculty, or revise any other piece of this handbook as necessary for the efficient administration of the NCBG Certificate in Native Plant Studies program. All participants shall meet the required prerequisites and follow the sequence recommended for successful completion of the certificate. All core classes and the required number of electives must be taken for credit.

## **2.2 Semester Course Calendar**

- Fall semester: September–December
- Spring semester: January–June
- Summer session: July–August

NCBG will publish all semester course offerings in the quarterly NCBG member newsletter. The spring and summer courses will be included in the winter edition (January–April). Fall semester courses will be included in the spring edition (May–August). Courses will be posted on our Website at [www.ncbg.unc.edu](http://www.ncbg.unc.edu) following the newsletter publication.

## **2.3 Program Registration**

Students must be at least eighteen years of age in order to register for the program.

A registration fee supports program administrative costs. Students may take five years from the date of registration in the program to complete all requirements and graduate, after which time an additional registration renewal fee will be charged.

NCBG members and certificate program students will be given course registration priority. Registration is on a “first-come, first-served” basis and is recommended two weeks prior to the first day of the course, in order that the faculty may plan their schedules and, when applicable, course books and/or supplies can be acquired. Maximum student enrollment for a course is between twelve and twenty.

Some courses require textbooks and additional class supplies. Prior to the start of the course, students will be notified of any supportive course materials to be purchased.

## **2.4 Enrollment Confirmation**

Confirmation of course registration will be made upon receipt of registration form and payment in full. If the course is filled with the maximum number of students, the student will be placed on a waiting list. Upon request, confirmation receipts will be sent to students.

## **2.5 Cancellation Policy**

If insufficient enrollment (four or less) occurs, students will be notified by e-mail or telephone, and the course will be cancelled. A decision with regard to the cancellation of class due to insufficient enrollment will be made seven to ten days prior to the start of the first class.

In the case of inclement weather, it is the student’s responsibility to phone the Garden and listen to the voice mail message or speak to staff regarding class cancellation. If a class is cancelled due to inclement weather and unsafe driving conditions, a make-up class will be scheduled by the instructor.

Instructors are responsible for informing students of class cancellation and rescheduling due to illness, after obtaining permission to do so from the associate director for education.

## **2.6 Refund Policy**

If a class is cancelled due to insufficient enrollment, or a class has been filled prior to receipt of your payment, you will be notified and your payment for the class will be refunded in full. Students who cancel seven or more days in advance will receive an eighty percent refund. Thereafter, the registration fee is forfeited.

## 2.7 Credit for Previous Classes

With an official transcript or other supportive documentation and permission from the associate director for education, one core course credit and one elective credit from another institution or university can be obtained

## 2.8 Attendance Policy

In order to obtain course credit, students must miss no more than one class and must complete the homework assignments for the missed class. If there are extenuating circumstances that require additional absence, allowances can be made at the discretion of the associate director of education in consultation with the course instructor.

# 3 Curriculum

Successful completion of the program requires passing grades in **eight core courses and five elective courses**—a total of one hundred sixty five hours—as well as submittal of an independent study project. Courses are structured so that higher-level courses build upon lower-level courses, with minimal overlap of information. For this reason, a student is advised to take the courses in the recommended sequence, observing the prerequisite requirements. Class time is typically three hours.

## 3.1 Core Courses Listing

The core courses provide instruction in achieving academic proficiency and understanding of the concepts of ecology and plant conservation. Eight core courses are required for certification:

- Botany (18 hours)
- Plant Taxonomy (12 hours)
- Local Floras: Spring, Summer, Fall, Winter (2 required for a total of 24 hours)
- Flowering Plant Families (12 hours)
- Plant Ecology (12 hours)
- Principles of Conservation Biology (12 hours)
- Plant Communities of North Carolina (15 hours)

Total certificate hours: 105 hours of core class instruction

## 3.2 Electives Listing

Elective courses offer development beyond the core courses, and the opportunity for supplemental academic knowledge and environmental science exploration. Specific elective courses are offered every one to two years. Some courses *may* require prerequisites. Five elective courses are required for certification and may be chosen from the following options:

- Applied Conservation Biology (12 hours)
- Beginning Drawing (14 hours)
- Dendrology: Trees of North Carolina (12 hours)
- Bryophytes (12 hours)
- Ferns, Lycophytes, and “Fern Allies” (12 hours)
- Field Sketching (14 hours)
- Invasive Plants (12 hours)
- Lichens (12 hours)
- Grasses, Sedges, and Rushes (12 hours)

Piedmont Savanna Ecology (12 hours)  
 Pollination of Flowering Plants (12 hours)  
 Rare Plants (12 hours)  
 Soil Ecology (12 hours)

Total certificate hours: Minimum of 60 hours of elective class instruction

### 3.3 Consolidated Listing

The following table is a consolidated listing of the core and elective courses with their prerequisites.

Course	Core/ Elective	Prerequisite
Botany	Core	None
Plant Taxonomy	Core	Botany
Local Floras: Spring, Summer, Fall, Winter	Core	None
Flowering Plant Families	Core	Plant Taxonomy
Plant Ecology	Core	None
Principles of Conservation Biology	Core	Botany, Plant Ecology
Plant Communities of North Carolina	Core	None
Applied Conservation Biology	Elective	Principles of Conservation Biology
Beginning Drawing	Elective	None
Bryophytes	Elective	None
Dendrology: Trees of North Carolina	Elective	None
Ferns, Lycophytes, and "Fern Allies"	Elective	None
Field Sketching	Elective	None
Invasive Plants	Elective	None
Lichens	Elective	None
Grasses, Sedges, and Rushes	Elective	None
Piedmont Savanna Ecology	Elective	None
Pollination of Flowering Plants	Elective	None
Rare Plants	Elective	None
Soil Ecology	Elective	None

### 3.4 Sample Course Sequence

Below is an example of a three-year course schedule that is sequenced so that a student could complete the certificate program graduation requirements.

#### Year 1

Course	Category	Prerequisite
Botany	Core	None
Plant Taxonomy	Core	Botany
Local Flora	Core	None
Local Flora	Core	None
Elective	Elective	Varies

### Year 2

Course	Category	Prerequisite
Flowering Plant Families	Core	Botany
Plant Ecology	Core	None
Principles of Conservation Biology	Core	Botany, Plant Ecology
Plant Communities of N.C.	Core	None
Elective	Elective	Varies

### Year 3

Course/Other Program Requirements	Category	Prerequisite
Elective	Elective	Varies
Elective	Elective	Varies
Elective	Elective	Varies
Independent Study Project	Graduation Requirement	Administrative Approval

### 3.5 Homework Assignments

The minimum amount of time students will be required to spend on homework assignments will vary. All assigned homework must be completed by a date specified by the instructor to receive course credit. If a student is absent from one or more sessions, he/she will be given sufficient time to submit missed assignments in order to ensure success at completing the course.

### 3.6 Standards for Grades

The three criteria upon which all homework and class assignments will be graded are these:

- ❖ Class engagement
- ❖ Demonstration of understanding
- ❖ Accurate completion of assignments

For each course completed, students will receive a Pass, Fail, or Excellent grade. The “Excellent” grade will be awarded to students exhibiting extraordinary proficiency. Students who have received a “Fail” grade cannot progress to a higher-level course until they receive a “Pass.” A failed core course must be repeated, and passed, in order to qualify for the program certificate. Students may wish to retake a

particular course until they have achieved a satisfactory level of proficiency. For all courses, faculty shall provide a means of assessment driven by learning objectives.

Students will receive final grades from instructors approximately two to three weeks after the final class session of the particular course. Grades are submitted by the instructor to NCBG for transcript records. Transcripts are sent to students at the close of the fall and spring semesters.

## 4 Course Descriptions

### 4.1 Core Courses

#### **Botany**

Prerequisite: None

Hours: 18

This class is designed with a broad audience in mind. It is a fundamental core course for students enrolled in either of the NCBG certificate programs. It covers basic principles of botany from taxonomy to morphology, anatomy, and physiology. Class time is divided between lectures and examining/dissecting samples. There are also opportunities for making observations of examples in the Garden.

#### **Plant Taxonomy**

Prerequisite: Botany

Hours: 12

This course builds on the fundamentals of the Botany course and prepares students for supplementary material covered in Flowering Plant Families. It is a core course for students enrolled in either of the NCBG certificate programs. Students learn the basic concepts of taxonomy of vascular plants and how to identify plant families by making observations of selected characteristics. The use of taxonomic keys is introduced. Interesting examples are studied to illustrate current issues in plant taxonomy and nomenclature.

#### **Local Floras: Spring, Summer, Fall, Winter**

Prerequisite: None

Hours: 12

There are four separate courses designed to teach students about the common southeastern native plants that are prominent during the respective seasons. These courses are intended for a broad audience, as well as for students who are enrolled in either of the NCBG certificate programs. Field trips and exercises provide experience in the use of identification keys and recognition of plants in a natural setting.

#### **Flowering Plant Families**

Prerequisite: Plant Taxonomy

Hours: 12

This course builds on the information covered in Plant Taxonomy and focuses on the study of plant diversity by targeting twenty major and fairly stable plant families of flowering plants found in North Carolina. Classroom discussions of evolutionary adaptations and relationships are combined with field studies in the Garden and close-up examination of representative examples.

#### **Plant Ecology**

Prerequisite: None

Hours: 12

Plant Ecology is a conceptual course designed for a broad audience interested in the interactions of plants within their environments. Ecological relationships at the organism, population, community, and

ecosystem levels are examined, using examples from the rich and diverse North Carolina flora. Students will learn about nutrient and energy cycling within ecosystems, as well as about current threats and trends for the conservation of ecosystems.

### **Principles of Conservation Biology**

Prerequisite: Botany, Plant Ecology (or with prior approval)

Hours: 12

This course is intended for an experienced audience and introduces students to the principles of biodiversity and conservation. Students learn about rare plants, conservation genetics, ecological restoration, conservation landscaping, and preserve design.

### **Plant Communities of North Carolina**

Prerequisite: None

Hours: 15

This course is intended for a broad audience and introduces students to North Carolina's rich diversity of plant communities. Variations in climate and soil types across the state as well as other factors have resulted in the creation of distinctive regions: subtropical maritime forests, salt marshes, longleaf pine savannas and sandhills, pocosins, oak-hickory forests, bottomland hardwoods, spruce-fir forests, rock outcrops and glades, relict prairies, and grasslands. This course explores the causes and history of North Carolina's plant community diversity. Class sessions include nine hours of lecture and a full day field trip with transportation provided.

## **4.2 Electives**

### **Applied Conservation Biology**

Prerequisite: Principles of Conservation Biology

Hours: 12

This course supplements information presented in Principles of Conservation Biology. It takes the conceptual and theoretical elements of ecological and conservation biology principles and applies them to conservation, rehabilitation, and management of natural areas. The subject matter demonstrates how concepts such as island biogeography, population genetics, metapopulation dynamics, community, and ecosystem functions are used by conservation planners and land use managers. Emphasis is placed on the conservation and management of NCBG natural areas, which are discussed in the classroom and in the field.

### **Beginning Drawing**

Prerequisite: None

Hours: 14

This course is designed to get your drawing skills up to speed before tackling the complex subjects of traditional botanical illustration. In a friendly, nonjudgmental atmosphere, students cover the basics of contour, negative space, perspective, and tone. This class is for anyone who hasn't tried drawing in years, or for those who want to refresh their drawing skills.

### **Bryophytes**

Prerequisite: None

Hours: 12

This course is intended for a broad audience. Bryophytes include the mosses, liverworts, and hornworts. Although these plants are very beautiful and diverse, they are often underappreciated. In this

course, students will learn basic biology and morphological characteristics of the major groups of bryophytes and will use keys to identify specimens collected locally.

### **Dendrology: Trees of North Carolina**

Prerequisite: None

Hours: 12

Dendrology is the study and identification of woody plants. This course is designed for anyone who wishes to learn to identify most of the common Piedmont tree species. Students spend much of the class time outdoors in the Garden learning to identify trees in mid- to late fall using morphological characteristics such as leaves, bark, twigs, and fruits. In addition, the ecology and natural history of each tree species are discussed.

### **Ferns, Lycophytes, and Fern Allies**

Prerequisite: None

Hours: 12

This course is intended for a broad audience and explores many aspects of the ancient evolutionary history, current distribution, biology, and identification of the “vascular cryptogams.” Through lectures, lab work, and short field trips, students learn to identify these fascinating components of our flora, which are often considered challenging.

### **Field Sketching**

Prerequisite: None

Hours: 14

Take your sketchbook outdoors and reconnect with plants in their natural environment. In this course, students are encouraged to shed old habits and try new techniques as they travel to a variety of gardens and habitats. Through a combination of guided exercises and free experimentation, students discover new ways of seeing plants, new problem-solving skills, and a refreshing way of thinking about layout and color. Several media are used, from ballpoint pen to watercolor to pencil.

### **Invasive Plants**

Prerequisite: None

Hours: 12

This course is intended for a broad audience and explores the science and issues of invasive exotic plants in North Carolina and the southeastern United States. Through lectures and short field trips, students learn to identify invasive species and discuss their impact on our native flora and ecosystems. The course reviews recent scientific literature on some of our most problematic invasive species.

### **Lichens**

Prerequisite: None

Hours: 12

This course is introductory in nature and intended for a broad audience. Lichens (lichenized fungi) are symbiotic organisms that consist of fungal and algal partners. Among the first life-forms on land, lichens have occupied nearly every habitat on Earth and grow on many surfaces of our environment. Through lectures, classroom exercises and a field trip, this course covers general lichen biology, the diversity of local lichen flora and the importance of lichens as indicators of environmental health.

### **Grasses, Sedges, and Rushes**

Prerequisite: None

Hours: 12

This course is intended for a broad audience and explores many aspects of the evolutionary history, economic and ecological dominance, current distribution, biology, and identification of the “graminoids.” Through lectures, lab work, and short field trips, students learn to appreciate the subtle and detailed beauty of these plants with “inconspicuous flowers.” They also learn important materials and methods for identifying these distinct and important members of our flora.

### **Piedmont Savanna Ecology**

Prerequisite: None

Hours: 12

This course is intended to introduce students with varying backgrounds to the rare Piedmont savanna plant community. The initial lecture discusses the ecological history of the Piedmont savanna, evaluating the relative roles of climate, disturbance, and humans in grassland establishment and persistence. Subsequently, soil, flora, and fauna are discussed, with emphasis on rare and threatened species. The current status and future of this rare plant community are also reviewed, and students participate in a field trip to two restoration sites for field exercises.

### **Pollination**

Prerequisite: Botany

Hours: 12

This course is intended for a broad audience and explores the dynamic relationship between flowering plants and their pollinators. It includes floral reproductive biology, including flowering plant life cycle, breeding system biology and pollinator attraction mechanisms. Study of important common insect pollinators includes an introduction to insect taxonomic groups. Pollinator studies include important sensory systems, nutritional and energy requirements, foraging behaviors and nesting behaviors. Also included are aspects of pollination ecology and conservation and, specifically, the importance of pollination to our ecosystems and agriculture/food supply. The class format includes sessions dedicated to lecture, and indoor and outdoor laboratories.

### **Rare Plants**

Prerequisite: None

Hours: 12

This course is intended for a broad audience and covers the concepts and practice of rare plant conservation and ecology. From the Great Smoky Mountains to the coastal dunes, North Carolina is home to many rare plant species, each with its own story. The primary focus is on rare plants of North Carolina, as well as others from the southeastern United States. Through lectures, discussions, a field trip and the study of selected examples, this course examines the causes of plant rarity.

### **Soil Ecology**

Prerequisite: None

Hours: 12

This course is intended for a broad audience. Students are introduced to the complex world of soils including information on they are formed, characterized and populated by a wide array of organisms. An overview of soil types is presented, followed by the study of typical Piedmont soils and their properties. The various roles that soils play in both human society and ecological systems are discussed.

## 5 Program Completion

### 5.1 Graduation Requirements

Upon completion of required eight core courses and five electives, each student will be required to

- (1) complete an independent study project, and
- (2) make a final presentation.

It is the responsibility of each student to inform the associate director for education in writing of the intent to graduate at least six months prior to graduation. Coursework should be completed one semester in advance of your anticipated graduation date in order to ensure enough time to complete the final project.

### 5.2 Independent Study Project

The independent study may begin when half or more of the required classes have been completed. Students will submit their project proposals to the associate director for education, and a project advisor will be determined. With the approval of the associate director for education, and under the direction of an approved project advisor, the project will involve programmatic or scientific field research, writing, a final report, and a presentation. Depending on the scope of the project, a public forum and poster may be required. Time expended must be a minimum of 50 hours.

Independent study projects can be anything from an intensive field inventory of a designated area to a laboratory investigation at the molecular level, a preservation project related to conservation of plant communities to a programmatic study of educational components. All projects should advance the mission of the North Carolina Botanical Garden.

All research methods and field data must be submitted for review along with the final report. An evaluation of the student's work will be made by the project advisor. A date and time for a public forum will be arranged by the associate director for education. The student may be asked to create a poster to be exhibited in the NCBG Education Center.

### 5.3 Evaluation Criteria

The four main criteria used to evaluate the independent study projects are:

- Project methodology
- Project completeness
- Project value to education and plant conservation
- Final report and presentation quality

### 5.4 Graduation

**Proposed graduation dates:** All graduation ceremonies will be held on Sunday afternoon on the second weekend in July from 2:00 to 4:00 p.m.

## 6 Supplementary Information

### 6.1 Faculty

#### **Nicolette Cagle**

Nicolette Cagle received her Ph.D. in ecology from Duke University in 2008 with a concentration biology emphasis on landscape ecology. She is a passionate ecologist and educator with undergraduate and graduate-level teaching experience. Nicolette is also a certified environmental educator with the N.C. Environmental Education program.

#### **Christine Davis**

Christine Davis received a B.S. in botany from University of Florida and a Ph.D. in botany from Duke University, where she studied systematics and phylogeny of bryophytes. She currently teaches general biology and environmental biology courses at Durham Technical Community College.

#### **Stephanie Jeffries**

Stephanie Jeffries is a naturalist at heart and a forest ecologist by training. She has a Ph.D. in forestry from N.C. State, with minors in ecology and botany, and a B.S. in marine science from University of South Carolina. She has been a Fellow in the Thompson Writing Program at Duke University since 2007 but has taught in a variety of settings, including the Highlands Biological Station, NCSU, the N.C. Museum of Natural Sciences, and the NCBG. She has broad interests in plant conservation, forest dynamics and succession, and plant community ecology, as well as experiential and environmental education and service learning. She loves teaching outdoors and sharing the wonders of the natural world with students of all ages and backgrounds.

#### **Mike Kunz**

Mike Kunz is a conservation ecologist who joined the NCBG in the summer of 2005. He received his bachelor's and master's degrees in plant ecology from the University of Colorado at Boulder. Mike's studies and research focused on invasive species and their effect on native flora and ecosystems throughout Colorado and Arizona. Prior to coming to North Carolina and the Botanical Garden, Mike was a high school science teacher and administrator in Denver. At the NCBG, Mike works with management of natural areas, invasive species, and the rare flora program.

#### **Anne Lindsey**

Anne Lindsey (Ph.D. in botany, UNC-Chapel Hill, 1979, with dissertation work on pollination in umbellifers) has pursued pollination biology education through lectures and workshops at Wintergreen, High Hampton, the Cullowhee Native Plant Conference, the Georgia Native Plant Society, the Highlands Biological Station, and the NCBG. Anne has authored and published books and videos through Laurel Hill Press (founded with husband C. Ritchie Bell) on plant topics including identifying trees and shrubs in fall color, wildflower identification, exploring the woodland harvest, and the NCBG *Take a Closer Look* series. Anne also coauthored the second edition of *Wild Flowers of North Carolina*, published by UNC Press.

#### **Gary Perlmutter**

Gary Perlmutter is a UNC Herbarium Associate who is active in lichen biodiversity surveys in the Piedmont of North Carolina. He received a B.S. in zoology from Humboldt State University in northern California in 1991 and then returned to southern California to embark in a career in environmental sampling and monitoring. During this time he also studied the reproductive biology of the laurel sumac (*Malosma laurina*,

Anacardiaceae) with guidance from research staff of the Santa Barbara Botanic Garden. Gary came to the Triangle in 2003 to further his education and career, whereupon he joined the North Carolina Botanical Garden, and then entered the Native Plant Studies program in 2004, graduating in 2010. His final project—"Lichen Inventory of the North Carolina Piedmont," which includes surveys of William B. Umstead State Park and Mason Farm Biological Reserve—was completed in 2009. Currently he is a member of Wake Nature Preserves Partnership, a stakeholder group whose goal is to create a system of nature preserves in Wake County. Professionally, he works as an environmental specialist with the N.C. Division of Air Quality, where as part of his duties in environmental compliance he has conducted a citywide survey of Raleigh parks to assess the impacts of air quality on the environment, using lichen diversity as a bioindicator.

### **Milo Pyne**

Milo Pyne works as the southeastern senior regional ecologist for NatureServe, an offshoot of The Nature Conservancy. Milo and others at their office in Durham are engaged in the development of ecological classification systems and their use and application by conservation partners. A native of Durham and formerly a resident of middle Tennessee, he obtained a B.S. degree in botany from N.C. State University in 1991 and worked from 1993 to 1996 as a botanist for the Tennessee Division of Natural Heritage. Some of his other interests include local land conservation issues; natural landscape gardening; ecology of glade-, barren-, and prairie-related vegetation in the Southeast; and taxonomic issues in *Physalis* and *Liatris*. He has also been a board member of the Eno River Association since 1996.

### **Johnny Randall**

Johnny Randall received his B.A. in biology at the University of North Carolina at Charlotte and both his M.S. and Ph.D. in botany at Virginia Polytechnic Institute and State University. For a total of ten years, Johnny was a faculty member at Salem College, the University of North Carolina at Greensboro, and the University of North Florida. Johnny joined the North Carolina Botanical Garden in 1998 as assistant director for conservation and is also adjunct faculty at UNC-Chapel Hill. His training and research interests are in plant reproductive ecology, rare plant biology, and conservation biology. At the NCBG Johnny oversees the conservation and management of natural areas and administers rare plant programs. Johnny also serves on numerous boards and advisory committees and is the current president of the North Carolina Exotic Pest Plant Council.

### **Patricia Savage**

Patricia Savage has been a fine artist since 1989. She was awarded Best and Honorable Mention in Wildlife in the *Pastel Journal's* Sixth Annual Pastel Top 100. She served as artist-in-residence in Denali National Park and expedition artist for The 1899 Harriman Expedition Retraced. Her work has appeared in *Botanical Art: Eden Re-imagined*, *The Best of Wildlife Art 1 and 2*, *Focus (Italy)*, *U.S. Art*, *Wildlife Art*, and *Wildlife in North Carolina*. Patricia has exhibited her work at the Leigh Yawkey Woodson Art Museum, the Bell Museum of Natural History, the National Geographic Society, the U.S. Botanic Garden, and Walt Disney World's Animal Kingdom. She is a signature member of the Pastel Society of America and the Society of Animal Artists. She also belongs to the Guild of Natural Science Illustrators and GNSI-Carolinas, Paint N.C., and the Pastel Society of North Carolina. To see Patricia's paintings go to [www.psavageartist.com](http://www.psavageartist.com) and friend her on Facebook.

### **Emma Skurnick**

Emma Skurnick is a full-time freelance scientific illustrator whose work is published internationally. Her illustrations can be seen in the Brooklyn Botanic Garden, *American Scientist* magazine, the N.C. Aquarium, and the N.C. Wildlife Resources Center. Since 2000 she has been sharing her skills in traditional and digital drawing media, art marketing, and design by teaching at numerous venues throughout the Triangle. Emma received her B.F.A. from Binghamton University in New York in 1995 and her Certification in

Science Illustration from the University of California, Santa Cruz, in 2000. She has been a member of the Guild of Natural Science Illustrators since 2000, serving two terms as chapter president. See Emma's work at [www.geocities.com/emmaskurnick](http://www.geocities.com/emmaskurnick).

### **Andy Walker**

Andy Walker has an M.S. degree in botany from N. C. State University. His graduate work focused on rare plant communities associated with diabase rock Durham and Granville counties. After working for a year at the N.C. Department of Agriculture's Plant Conservation Program, Andy joined the NCBG as coordinator of the Millennium Seed Bank Project. During the course of this three-year project, Andy travelled throughout North Carolina collecting seeds for long-term storage at the Millennium Seed Bank in England. Andy continues to collect seeds and is involved in several restoration projects with conservation partners such as the U.S. Forest Service and The Nature Conservancy.

### **Wade Wall**

Wade Wall is currently a Ph.D. candidate at N.C. State University studying the population demography and genetics of several rare plant species in the Sandhills region of North Carolina. He has taught the courses Introduction to Ecology, Multivariate Analysis of Community Data, and Plant Anatomy at NCSU to both undergraduate and graduate students.

### **Alan Weakley**

Alan Weakley is curator of the University of North Carolina Herbarium, one of the oldest, largest, and most important collections of plant specimens in the southeastern United States. He also serves as an adjunct assistant professor in the biology department and Curriculum in Ecology. Prior to accepting those responsibilities in 2002, Alan had an extensive career in applied conservation with the N. C. Natural Heritage Program, The Nature Conservancy, and NatureServe. With Mike Schafale, he coauthored a book on the natural communities of North Carolina (*Classification of the Natural Communities of North Carolina: Third Approximation*, 1990), widely used to describe, inventory, map, and manage vegetation in North Carolina, and he is working on a new regional flora for the southeastern United States, drafts of which are available online at [www.herbarium.unc.edu](http://www.herbarium.unc.edu).

### **Peter White**

Peter White is the director of the North Carolina Botanical Garden, an institution that is helping to define the Conservation Garden. The Garden became one of the first gardens to enact policies aimed at diminishing the risk of release of exotic pest organisms in 1998 and was presented with a Program Excellence Award in 2004 by the American Association of Botanical Gardens and Arboreta. Peter is an editor of the *Journal of Vegetation Science* and *Applied Vegetation Science* and serves on the North Carolina Plant Conservation Board and the boards of the Center for Plant Conservation and the Highlands Biological Station. He is chair of Discover Life in America and cochair of the Science Committee for the All-Taxa Biodiversity Inventory in Great Smoky Mountains National Park. Peter is a professor of biology at UNC-Chapel Hill.

## **6.2 Core Course Learning Objectives**

### **Botany**

Upon completion of this course, students will have an understanding of the following:

- General anatomy and morphology of plants and the main tissue types and organs;
- Characteristics of monocots and dicots, primary and secondary growth in flowering plants, and plant reproduction; and

- Diversity in and classification of the plant kingdom including an introduction to basic taxonomy.

### **Plant Taxonomy**

Upon completion of this course, students will have an understanding of the following:

- Procedures used for the identification, naming and classifying a plant;
- Important morphological features of vascular plants;
- Use of a dichotomous key;
- Techniques used to determine plant evolutionary relationships (morphological comparisons, biochemical relationships, genetic analyses, etc.); and
- Diversity of the plant kingdom through direct study of various taxa.

### **Local Flora**

Upon completion of this course, students will have an understanding of the following:

- Basic plant morphology;
- Naming conventions for plants and the history of scientific naming;
- How to identify the prominent plants of the season using a dichotomous key and field characteristics; and
- Other information specific to the season.

### **Flowering Plant Families**

Upon completion of this course, students will have an understanding of the following:

- How families represent lineages of plants connected by common evolutionary ancestors;
- How the concept of family has changed and is changing with modern research;
- How to readily identify twenty important flowering plant families; and
- Characteristics of families which are important in their evolution, ecology, and economic significance.

### **Plant Ecology**

Upon completion of this course, students will have an understanding of the following:

- How plants are adapted to their environments;
- Concepts of habitat and niche;
- Concepts of evolutionary fitness and life history;
- How populations of plants interact with their environments;
- Nature, organization and dynamics of communities; and
- Nature of ecosystems, including nutrient and energy cycling, as well as current conservation efforts.

### **Principles of Conservation Biology**

Upon completion of this course, students will have an understanding of the following:

- Value systems that have been used as the basis for a conservation ethic;
- Concept of biological diversity and threats to biological diversity;
- Species-area relationship and the theory of island biogeography and how these are used in conservation planning and in estimating extinction rates;
- Goals of “completeness” and “representativeness” in conservation planning;
- Basic concepts of genetics, population biology and metapopulations and how they are used in conservation biology;
- Conservation approaches at the community, ecosystem and landscape scales; and
- Conservation problems such as invasive species, habitat fragmentation, endangered species and ecological restoration.

### **Plant Communities of North Carolina**

Upon completion of this course, students will have an understanding of the following:

- North Carolina's vegetation types;
- How communities are classified and mapped;
- Processes that determine community structure and composition;
- How North Carolina's landscape diversity is fundamental to the state's economy history, land use, wildlife and species conservation; and
- Imperiled status of much of North Carolina's natural diversity.

### **6.3 Elective Course Learning Objectives**

#### **Applied Conservation Biology**

Upon completion of this course, students will have an understanding of the following:

- Importance of biological diversity and its conservation;
- Applications of conservation genetics, population biology and metapopulations, and how they are used in conservation design;
- Utility of *ex situ* conservation and seedbanking;
- Importance of strategic land management and habitat restoration;
- Methods used to increase both ecosystem resistance and resilience; and
- Importance of "completeness" and "representativeness" in conservation planning.

#### **Bryophytes**

Upon completion of this course, students will have an understanding of the following:

- What is a "bryophyte;"
- Basic diversity, taxonomy, physiology, anatomy and ecology of bryophytes;
- Differences between a moss and liverwort; and
- Identification of common bryophytes of our area.

#### **Dendrology: Trees of North Carolina**

Upon completion of this course, students will have an understanding of the following:

- Identification of 40-50 Piedmont tree species through characteristics such as leaf morphology, arrangement, and branching pattern, fruits and cones, bark, and twigs;
- Scientific and common names, family name, and natural history of each species;
- Species within important genera (such as pines and oaks) noting key differences, attributes and geographical distribution;
- Commercial uses of key Piedmont tree species; and
- Forest ecology, diversity, and conservation efforts.

#### **Ferns, Lycophytes and "Fern Allies"**

Upon completion of this course, students will have an understanding of the following:

- What is a fern, what is a lycophyte, what is a "fern ally," and how do they relate in evolutionary history to other plants in our surroundings;
- Biology, ecology, and life cycle of these plants;
- Ecology, distribution, and conservation status of these species in North Carolina and the Southeast; and
- Materials and methods for recognizing and identifying these plants.

### **Grasses, Sedges and Rushes**

Upon completion of this course, students will have an understanding of the following:

- What is a grass, sedge, and rush;
- Biology, ecology, and characteristics of these plants;
- Ecology, distribution, and conservation status of these species in North Carolina and the Southeast;
- Economic importance of these plants in our everyday lives; and
- Materials and methods for recognizing and identifying these plants.

### **Invasive Plants**

Upon completion of this course, students will have an understanding of the following:

- Characterization and history of invasive species;
- Biology and ecology of invasive species;
- Impacts and costs of invasive species;
- Invasive species found in North Carolina; and
- Strategies for invasive species control and eradication.

### **Lichens**

Upon completion of this course, students will have an understanding of the following:

- What is a lichen;
- Symbiotic nature of lichens;
- Basic terminology of lichen anatomy;
- Lichen diversity with regard to morphology, reproduction and ecology;
- Lichen habits (i.e., growth forms) and reproductive structures;
- Keys used for lichen identification and limitations of their use in field situations;
- Identification of local lichen species; and
- Presence and distribution of both pollution-tolerant and pollution-sensitive lichens and their usefulness in assessing environmental health.

### **Piedmont Savanna Ecology**

Upon completion of this course, students will have an understanding of the following:

- History of the Piedmont savanna community;
- Ecological processes responsible for prairie and savanna formation and persistence in the Piedmont;
- Characteristic soil, flora and fauna of Piedmont savannas;
- Ecological history and life history traits of select rare plants and animals associated with the Piedmont savanna community; and
- Savanna restoration strategies in North Carolina.

### **Pollination of Flowering Plants**

Upon completion of this course, students will have an understanding of the following:

- Basic floral reproductive biology and pollinator attractant systems;
- Common floral visitors and their relative importance in pollination; and
- Importance of the plant pollinator relationship and its value to ecosystem health and human food supply.

### **Rare Plants**

Upon completion of this course, students will have an understanding of the following:

- Characterization, causes and patterns of rarity;
- Current science and understanding of rare plant biology and ecology;
- Protection, laws, politics and controversy associated with rare plants;
- Strategies for rare plant conservation; and
- Species which are rare in North Carolina and the strategies and ethics essential for their conservation.

### **Soil Ecology**

Upon completion of this course, students will have an understanding of the following:

- Ecological importance of soils;
- Five processes of soil formation;
- Association of each of the twelve soil orders with their respective vegetation type, geology or climate;
- How to identify several Piedmont soils and their properties;
- Complexity of soil food webs; and
- Major soil conservation issues and solutions.

## **6.4 Mission and History of the North Carolina Botanical Garden**

The North Carolina Botanical Garden is a unit of the University of North Carolina at Chapel Hill. We further the University's mission of teaching, research, and public service through our mission:

“To inspire understanding, appreciation, and conservation of plants in gardens and natural areas and to advance a sustainable relationship between people and nature.”

The concept of the conservation garden was developed at the North Carolina Botanical Garden in the early 1990s to represent the many conservation-related activities that the NCBG is pursuing. The Garden has the following eight program themes within its mission.

1. Conservation through propagation of native plants, which ensures that wild populations are not damaged by direct use.
2. Seed banking and reintroduction, an ex-situ conservation program that protects germplasm reserves as a last resort against extinction in the wild and for use in reintroduction of wild populations.
3. The protection and restoration of natural areas.
4. The elimination of invasive species and replacement with noninvasive alternatives.
5. Gardening in nature's context, which seeks to promote plants that support native biodiversity.
6. Sustainable gardening, which seeks to promote environmentally friendly gardening practices.
7. Supplying critical information on conservation of the flora of the southeastern United States and on the Garden's conservation programs.
8. People-nature relations, which describes how important plant diversity and natural areas are to the physical and psychological health of all of us.

The history of the North Carolina Botanical Garden is a history of the people and the botanical legacy of the University of North Carolina at Chapel Hill.

In 1903 William Chambers Coker, the University's first professor of botany, began planting a teaching collection of trees and shrubs on the central campus. This collection was to become the Coker Arboretum. Starting in the late 1920s, Coker and his student Henry Roland Totten proposed a more complete botanical garden south of the main campus. Although some plantings were done by the 1940s, it was in 1952 that the trustees dedicated 70 forested acres for botanical garden development. To this tract

were added 103 acres of dramatic creek gorge and rhododendron bluffs donated by William Lanier Hunt, a horticulturalist and former student of Coker and Totten.

Hunt also helped to found the garden's membership support organization, the Botanical Garden Foundation, in 1966. In 1961 Dr. C. Ritchie Bell was appointed the Garden's first director. The Garden's first public offering was the Nature Trail, opened on Arbor Day in April 1966. The first state appropriation came five years later, when the first employee, J. Kenneth Moore, was hired.

Director Bell, a professor of botany and tireless promoter of the flora of North Carolina, enlisted the support of the Botanical Garden Foundation and the Garden Club of North Carolina to publish a book of photos by William S. Justice. *Wild Flowers of North Carolina* filled a need among wildflower lovers and students of natural history, and it brought valuable attention to the fledgling North Carolina Botanical Garden. Dr. Bell also enlisted many students to help at the Garden, even before he hired its first employee.

The Garden's formative period coincided with a surge of interest in plants and conservation fueled by Earth Day celebrations and the environmental movement. The Garden's early era was characterized by limited resources and unlimited idealism and energy. During the 1970s and 1980s, students, volunteers, and a growing staff under the leadership of superintendent Ken Moore constructed habitat gardens—displays representing the major plant communities of the state and illustrating the theme of botanist B.W. Wells's *The Natural Gardens of North Carolina* (published by the University of North Carolina Press in 1932 and revised in 2002). The Totten Center, named for UNC botanist Henry R. Totten and his wife, Addie, opened in 1976.

The 1960s saw the initiation of field research on a contiguous 367-acre tract of old farmland and native woodlands dedicated by the UNC trustees in 1984 as the Mason Farm Biological Reserve. Today the reserve provides research facilities (greenhouse, cultivation beds, and natural areas) for diverse projects in disciplines such as ecology, bird behavior, population biology, genetics, and developmental biology.

Encouraged by the North Carolina Wild Flower Preservation Society (now the North Carolina Native Plant Society), whose members had helped start the Garden, superintendent Moore promoted "conservation through propagation" as an alternative to the unethical collection of native plants from their natural habitats. He recruited a growing corps of volunteers who provided valuable assistance to staff in welcoming visitors, leading tours, conducting "plant rescues," propagating plants, and constructing the Mercer Reeves Hubbard Herb Garden. In partnership with the Botanical Garden Foundation, the Garden became a steward of natural areas near Chapel Hill and elsewhere in the state.

As the Garden matured and added staff with expertise in other areas, it developed programs and collections of national significance, such as the Southeastern Carnivorous Plant Collection. In 1984 the North Carolina Botanical Garden became one of the founding members of the Center for Plant Conservation, a network of gardens and arboreta responsible for the collection of propagules and for research about and protection of our nation's rarest plants. Staff members and volunteers were motivated to undertake this work by a desire to practice conservation and demonstrate a high standard for all public gardens. The same year, in order to focus their efforts, staff members drafted a long-range plan for the Garden. In 1985 more than 15 years' work at the Garden was summarized in the book *Growing and Propagating Wild Flowers*, written and illustrated by NCBG staff and published by UNC Press.

Dr. Bell retired as director in 1986 and was succeeded by Peter White. Dr. White led a review of the 1984 long-range plan, resulting in the "Report on Mission, Goals, and Objectives" (1988). Next came the completion of a new master plan by the firm Jones and Jones, approved by the University trustees in 1990. In 1997 the North Carolina legislature granted funds for design of the Herbarium Botanical Library building, one of two new facilities described in the master plan. Then in 2000, with support from a \$2.7 million bequest, the staff launched the design of the master plan's Education Center by Frank Harmon Architects, approved by the state in 2003. The Education Center, designed as a Platinum-level structure within the Green Building Council's LEED rating system, opened in November 2009.

In the years since its founding, the Garden has acquired responsibility for the four additional major units described below.

**Coker Arboretum** (part of the Garden since 1982)

Coker Arboretum, fondly known by many as a quiet haven in the middle of the busy University of North Carolina, lies at the heart of one of the most beautiful campuses in the nation. Managed by the NCBG, it is one of the Garden's oldest tracts.

In 1903 William Chambers Coker, the University's first professor of botany and the first chair of the University Buildings and Grounds Committee, began developing a five-acre boggy pasture into an outdoor classroom for the study of trees, shrubs, and vines native to North Carolina. Beginning in the 1920s and continuing through the 1940s, Dr. Coker added many East Asian trees and shrubs. These species, closely related counterparts to many North Carolina native plants, enhanced the beauty and education value of the arboretum. Today the collection consists of a wide variety of plantings including flowering trees and shrubs as well as bulb and perennial displays. The arboretum has something unique to offer during every season of the year.

In April 2003 the Coker Arboretum celebrated its 100<sup>th</sup> anniversary with exhibits and activities throughout the University's campus and Chapel Hill. Part of the celebration was the production of a book, *A Haven in the Heart of Chapel Hill: Artists Celebrate the Coker Arboretum*, that depicts scenes and specimens one might see on a walking tour of this special garden.

**Mason Farm Biological Reserve** (1984)

Mason Farm Biological Reserve (MFBR) protects natural areas, supports academic research and public education, and provides a place for contemplation and appreciation of the natural world. Mason Farm Biological Reserve and contiguous undeveloped tracts create an approximately 900-acre natural area that connects with the 41,000-acre New Hope Game Lands to the south. MFBR itself encompasses 367 acres and contains a combination of forests and old fields that support approximately 800 species of plants, 104 species of lichens, 216 species of birds, 29 species of mammals, 28 species of fish, 23 species of amphibians, and 67 species of butterflies. In fact, more different species of animals have been recorded at the reserve than in any other comparable-size area in the entire North Carolina Piedmont.

The University received the Mason Farm land in 1894 through the bequest of Mary Elizabeth Morgan Mason, one of the last descendants of the Morgan family who settled in the southeast corner of Orange County in the 1740s. Much of the area has reverted to woodlands, and some of its forests are at least 150 years old, with some trees exceeding 300 years in age.

During the 1960s and 1970s, several portions of this tract were set aside by the UNC Board of Trustees specifically for biological uses. The Mason Farm Biological Reserve was officially established in 1984, and today it is administered by the North Carolina Botanical Garden as both a natural area and a biological field station.

**Battle Park** (already a well-loved natural area in the late 1800s and part of the Garden since 2004)

On July 1, 2004, at the request of UNC chancellor James Moeser, the Garden assumed responsibility for Battle Park, a distinctive wooded tract on the east side of the University campus and downhill from Coker Arboretum. The tract includes one of the most awe-inspiring legacies of the University and a symbol of the important connection between nature and art: the stone amphitheater known as Forest Theatre.

Although the tract is not a pristine forest, much of the 93-acre Battle Park consists of woodland that predates European settlement in the area ca.1740. The Garden has restored trails there with funding supplied by the University. The park is named for Kemp Plummer Battle, president of UNC from 1876 to 1891. Battle laid out the original trail system and spent many happy and contemplative hours within the forest.

**University of North Carolina Herbarium** (founded in 1908 and part of the Garden since 2000)

On June 18, 2000, the Southeast's premier herbarium, the UNC-Chapel Hill Herbarium, officially became part of the North Carolina Botanical Garden. The facility, used by students, botanists, taxonomists, and other professionals from across the Southeast and the nation, currently contains more than 750,000 specimens of plants, algae, fungi, and fossils. Though some specimens in the collection date back to 1835, the herbarium was actually founded in 1908 by Dr. William Chambers Coker. It resided in Davie Hall from that year until 1957 and then moved to Coker Hall. In 2008, the herbarium celebrated its 100<sup>th</sup> birthday with a gala in Coker Hall.

A herbarium is a museum collection of plant specimens and associated label and research data. Herbaria constitute the fundamental documentation of plant diversity. The herbarium specimen is the unit of botanical knowledge. A herbarium is the only authentic source for identification of plants and their present and past distribution. It helps us understand the changing landscape and serves as the court of last resort for plant identification and distribution issues, including

- new weeds and their spread;
- species poisonous to people, livestock, and pets;
- hay fever-inducing plants;
- blooming and fruiting times;
- medicinal plants and their availability;
- the historical distribution of endangered plants;
- wildflowers and trees; and
- plants of state parks, national parks, seashores, riverways, and wildlife refuges.

Such information is crucial for planning North Carolina's future as our state and region continue their fast-paced development.

The UNC Herbarium spearheads the identification and study of the distribution and history of plants in our diverse state and is the largest collection of its kind in the Southeast. The National Science Foundation has designated it one of 25 National Resource Centers and one of 105 National Resource Collections and has ranked it third among university collections. The herbarium holds the results of over 150 years of botanical observation and documents the work of hundreds of collectors and botanists. It is a rich archive of field notebooks, maps, photographs, and illustrations. The facility serves all 16 campuses of the University of North Carolina as well as a wide array of other institutions and users, and it has supported the education of hundreds of students at UNC and elsewhere.

Today the lands of the NCBG have grown to comprise some 700 acres, not including 210 acres of nature preserve held by the Botanical Garden Foundation. The Garden is nationally known for its conservation initiatives, educational collections, and diverse programs, including native plant studies, botanical illustration, and horticultural therapy.