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Wild

"Providing places for wildlife in our communities—whether at home, schools, businesses, or at nearby parks.... There is no more rewarding way to stay connected to nature right outside your door."

— David Mizejewski,
Naturalist, National Wildlife Federation



How College and University Green Landscapes Provide Havens for Wildlife and "Lands-on" Experiences for Students

A NATIONAL WILDLIFE FEDERATION REPORT

By Kristy Jones, Courtney Cochran,
David J. Eagan, and Juliana Goodlaw-Morris

Forewords by
W. Daniel Svedarsky, University of Minnesota, Crookston
Doug Inkley, National Wildlife Federation



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The Dragonfly Garden,
laid out in a circle,
at the United Tribes
Technical College (ND).
Photo: United Tribes
Technical College

How College and University Green Landscapes Provide Havens for Wildlife and “Lands-on” Experiences for Students

This richly detailed guide highlights how colleges and universities are playing a dynamic role protecting wildlife and restoring habitats in campus green spaces—including on-campus landscapes and natural areas, as well as distant campus-owned lands. It explores how such green places—dedicated to “The Wild”—also can benefit students, faculty, and staff with leadership opportunities, hands-on learning, energy savings, water conservation, and much more.



A NATIONAL WILDLIFE FEDERATION REPORT

THE AUTHORS

Kristy Jones is Senior Manager for the Campus Ecology Program, National Wildlife Federation.

Courtney Cochran is Senior Coordinator for the Campus Ecology Program, National Wildlife Federation.

David J. Eagan is a writer and naturalist, and an Honorary Fellow in Botany, University of Wisconsin-Madison.

Juliana Goodlaw-Morris is the former Campus Field Manager, National Wildlife Federation, and currently is the Sustainability Manager, California State University, San Marcos.

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The Shaver Butterfly Garden at the University of Minnesota, Crookston.
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Photo: Caroline Lambert



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Luisa Grant, Senior Coordinator, Volunteer Management, National Wildlife Federation

Doug Inkley, Senior Scientist, National Wildlife Federation

Julian Keniry, Senior Director, Campus & Community Leadership, National Wildlife Federation

Ellen Lambeth, Executive Editor, *Ranger Rick* magazine, National Wildlife Federation

David Mizejewski, Naturalist, National Wildlife Federation

Mary Philips, Director, Garden for Wildlife, National Wildlife Federation

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Joe Angeles, Director—WUSTL Photos, Washington University in St. Louis, MO

McKenzie Beverage, Sustainability Coordinator, Butler University, IN

Eric Blackwell, Associate Professor of Biology and Director of Center for Science and Environmental Education Delta State University, MS

Becca Blundell, President, Fisheries and Wildlife Club, Michigan State University, MI

Lynn Boulger, Dean of Institutional Advancement, College of the Atlantic, ME

Kelly Boulton, Sustainability Coordinator, Allegheny College, PA

Rich Bowen, Professor, Environmental Science, Allegheny College, PA

Jake Brenner, Faculty Manager - Ithaca College Natural Lands, Ithaca College, NY

Dea Brokesh, Owner, LDB Landscape Architecture & Engineering, KS

Amanda Brown Olmstead, President, A. Brown Olmstead Associates, GA

Leah Bryant, Sustainability Fellow and Office Manager, Agnes Scott College, GA

Art Cameron, Professor of Horticulture and Director, MSU Horticulture Gardens, Michigan State University, MI

Peter Carrington, Assistant Curator, W.J. Beal Botanical Garden, Michigan State University, MI

Amelia Conrad, Emory University, GA

Stan Cross, Interim Director, Environmental Leadership Center, Warren Wilson College, NC

Mark Darling, Sustainability Programs Coordinator, Ithaca College, NY

Glenda Denniston, Volunteer, Friends of the Lakeshore Nature Preserve, University of Wisconsin-Madison, WI

Anna Demeo, Director of Energy Education and Management, College of the Atlantic, ME

Rebecca W. Dolan, Director, Friesner Herbarium, Butler University, IN

Barbara Donerly, Assistant Director, Administrative Services, Facilities Planning and Construction, University of South Florida, FL

Ronald Doran, Professor of Biology, Harding University, AZ

Dagmar B. Epsten, Founder and Owner of Epsten Group, GA

Brandon Euen, Student, Butler University, IN

David Foster, Director, Harvard Forest, Harvard University, MA

Yancey Fouche, Sustainability Coordinator and Associate Director of the David E. Shi Center for Sustainability, Furman University, SC

Collette Fournier, Photographer, Campus Communications, SUNY Rockland Community College, NY

Gayle J. Fritz, Professor, Department of Anthropology, Washington University in St. Louis, MO

Jess Gerrior, Sustainability Coordinator, Franklin Pierce University, NH

Rob Gogan, Recycling Supervisor, Recycling and Waste Services, Harvard University, MA

Susan Golz, Professor of Science, SUNY Rockland Community College, NY

Jim Graves, Professor of Botany and Environmental Studies, Green Mountain College, VT

Greg Haet, Associate Director, Environmental Protection, University of California, Berkeley, CA

Sylvia Halkin, Professor, Biology, Central Connecticut State University, CT

Benjamin Harris, Owner, Branch to Bud Tree Care, LLC, UT

Clarisse Hart, Outreach and Development Manager for Education and Research Programs, Harvard Forest, Harvard University, MA

Sean Hayes, A.J. Lewis Center Facilities Manager and Community Outreach Coordinator, Oberlin College, OH

Frank Howe, University Liaison, Utah Division of Wildlife Resources, Utah State University, UT

Linda Hugelen, Agroecology Extension Educator, United Tribes Technical College, ND

James Huppi, Landscape Architect, Facilities Planning, Design, and Construction, Utah State University, UT

Derek Kanwischer, Coordinator of Sustainability Projects, Western Michigan University, MI

Todd Kerzie, Associate Vice President Facilities Management, Emory University, GA

Susan Kidd, Director of Sustainability, Agnes Scott College, GA

Phylicia King, Sr. Account Executive, A. Brown Olmstead Associates, GA

Karen Klein, Assistant Professor of Biology, Co-chair of Sustainability Committee, Northampton Community College, PA

Arthur Kney, Associate Professor and Department Head, Civil and Environmental Engineering, Lafayette College, PA

Catherine Koning, Professor of Environmental Science, Franklin Pierce University, NH

Michael Kuhns, Extension Forestry Specialist, Utah State University, UT

Tom LaMuraglia, Landscaping and Blacksmith Supervisor, Warren Wilson College, NC

Lissa Legee, Director, Center for Sustainability and Professor of Biology, Georgia Southern University, GA

Karen A. Lefkowitz, Communications Officer, Institute of the Environment and Sustainability, University of California, Los Angeles, CA

Ludovic Lemaitre, Sustainability Coordinator,
Randolph College, VA

Brian Lemme, Stormwater Specialist, Environmental Health
and Safety, West Virginia University, WV

Daniella Lewis, Former NWF Fellow and Lead Project Director,
UT Concho Garden, University of Texas, Austin, TX

Robert Lynn, Facilities Manager, University of Nevada
Las Vegas, NV

Michael MacDonald, Graduate Student, Former NWF Fellow,
Northampton Community College, PA

Christopher Madden, Energy Analyst, Butte College, CA

Brenna Marsicek, Project Coordinator, Biodiversity Institute,
University of Wyoming, WY

Emily Marthinsen, Director of Physical and Environmental
Planning, University of California, Berkeley, CA

Paul Mathews, Assistant Vice President for Campus Planning
and Operations, Roosevelt University, IL

Marschelle McCoy, Office Manager, Biological Sciences,
Eastern Illinois University, IL

Jennifer McNamara, Campus Sustainability Manager,
Portland State University, OR

Tema Milstein, University of New Mexico, NM

Sarah Mincey, Administrative Director, Research and
Teaching Preserve, Indiana University, IN

Diana Morris, Chief Academic Officer, College of Menominee
Nation, WI

Hayli Morrison, Development Communications Coordinator,
KSU Foundation, Kansas State University, KS

Chris O'Brien, Director, Office of Sustainability, American
University, Washington, DC

Christopher Olsen, University of Montana, MT

Sue Paist, The Morton Arboretum, IL

Kevin Parris, Arboretum Director, Spartanburg Community
College, SC

Dustin Partridge, Graduate Student, Biology, Fordham
University, NY

Tim Pine, Environment, Health and Safety, University of
California, Berkeley, CA

Beth Pratt, NWF California Director, University of California,
Los Angeles, CA

Kimberly Reeves, Former NWF Fellow, Class of 2012, Agnes Scott
Arboretum, Agnes Scott College, GA

Gregory Russell, Division of Communications, Public Relations
and Marketing, University of Memphis, TN

Christian Ryan, Sustainability Coordinator, Western
Kentucky University, KY

Robert Schutzki, Associate Professor of Landscape Horticulture,
Michigan State University, MI

Doorae Shin, Student Sustainability Coordinator, University of
Hawaii Manoa, HI

Lee R. Skabelund, Associate Professor, Landscape Architecture /
Regional and Community Planning, Kansas State University, KS

Russ Soucek, Director, Environmental and Earth Sciences
Program and The Aldrich Prairie Research Site,
Doane College, NE

Heather Spalding, Sustainability Leadership and Outreach
Coordinator, Portland State University, OR

Lee Stanton, Director, Black Belt Conservation and Research
Institute, University of West Alabama, AL

Tom Stoelker, Senior Staff Writer, News and Media Relations,
Fordham University, NY

Ron Stolz, Professor of Landscape Architecture, University of
Arizona, AZ

Lisa Stratton, Director of Ecosystem Management, University of
California, Santa Barbara, CA

Maren Stumme-Diers, Sustainable Food Director,
Luther College, IA

Daniel Svedarsky, Professor and Director of the Center for
Sustainability, University of Minnesota, Crookston, MN

Frank Telewski, Professor of Plant Biology and Curator,
W.J. Beal Botanical Garden, Michigan State University, MI

Kathleen Thames, Associate Director of Communications,
University of Louisiana at Lafayette, LA

Gabrielle Torphy, Research Assistant and Head Gardener,
University of Rhode Island, RI

Tim Vitale, Public Relations, Utah State University, UT

Denice Wardrop, Sustainability Institute, Pennsylvania State
University, PA

Paul Warnick, Arboretum Horticulturist, University of Idaho, ID

John Wegner, Senior Lecturer, Environmental Studies,
Emory University, GA

Howard S. Wertheimer, Director of Capital Planning and Space
Management, Georgia Institute of Technology, GA

Ricky Whitsell, Instructor, Natural Resources Management,
Butte College, CA

David Wilber, Landscape Architect, Michigan State University, MI

Melinda Zoehrer, Assistant Director, University of Delaware
Botanical Gardens, University of Delaware, DE

National Wildlife Federation Staff

Collin O'Mara, President and Chief Executive Officer

Andy Buchsbaum, Vice President, Conservation Action

Kevin Coyle, Vice President, Education and Training

Adam Kolton, Vice President National Advocacy

Jim Lyon, Vice President, Conservation Policy

Maureen Smith, Vice President, Marketing

Karen Wagner, Vice President, Finance

National Wildlife Federation Campus Staff

Courtney Cochran, Senior Program Coordinator, Campus Ecology

Eriqah Foreman-Williams, Campus Field Coordinator,
Campus Ecology

Crystal Jennings, Coordinator, Education & Leadership
Development Programs

Kristy Jones, Senior Manager, Campus Ecology

Julian Keniry, Senior Director, Campus Ecology

About Campus Ecology and NWF's EcoLeaders Initiative

For more than 25 years, National Wildlife Federation's **Campus Ecology program**¹ has worked tirelessly with students, faculty, and staff across the U.S. to advance higher education leadership for biodiversity, climate action, and sustainability in the curriculum, on campus, and in the wider community. Through hundreds of conferences, student fellowships, consultations, and a rich electronic publication database, NWF's campus program has supported, documented, and celebrated thousands of projects—in every state and at more than half of the 4,600 U.S. colleges and universities. Organized by students and their faculty and staff allies, these projects have restored habitat, promoted community resilience, reduced carbon footprints, saved money, and most important of all, increased students' sustainability knowledge and career skills.

Restoring habitat and fostering a love of wildlife have always been at the heart of this campus program. This year, NWF celebrates the 20th anniversary of its landmark publication, *Ecodemia: Campus Stewardship at the Turn of the 21st Century*, which features pioneering efforts of students, faculty, and staff to transform campus landscapes, from precedent-setting prairie grass restoration projects at **Nebraska Wesleyan University** (NE) to one of the nation's first and most comprehensive integrated pest management programs at **Seattle University** (WA) that literally brought the campus songbird population back to life. This year is also the 15th anniversary of the first *National Campus Environmental Report Card*. When repeated 10 years later, the Report Card provided a longitudinal snapshot of campus practices, including those devoted to healthy landscape ecology and water conservation, at more than 1,000 colleges and universities. And it is the 25th anniversary of the annual *Campus Sustainability Case Studies* database, which now includes nearly 800 case studies in two dozen categories submitted by students and other campus leaders. "Wild"-related topics include everything from large-scale amphibian habitat projects to native species planted on a green roof. Other projects linked wildlife corridors, removed exotic invasive plants, developed GIS-based watershed protection plans, and restored natural areas. A 2009 NWF report, *Generation E*, highlights more than 150 of these campus projects, showcasing the myriad ways students have organized and financed them.



Juvenile barred owl, newly fledged from a nest at the Lakeshore Nature Preserve, University of Wisconsin-Madison in 2014.
Photo: Arlene Koziol

Students have been essential catalysts for transformation within their campuses and communities, with faculty and staff serving as vital mentors and allies. To further empower students and young professionals to cultivate leadership and career skills for wildlife and sustainability, NWF's Campus Ecology team has created the NWF **EcoLeaders Initiative**². The initiative is the first national (and now global) online community that offers students the space to create, to share, and to be recognized for their leadership efforts and sustainability projects and campaigns. The program not only enables student and young professional leaders to clarify and share their mission for sustainability and to plan projects, but it also provides valuable career and leadership certification.

Students may join the EcoLeaders program individually or as members of a team. Faculty may incorporate EcoLeaders as a curriculum enhancement for service learning, project-based or experiential learning, or other approaches that use campuses and wider communities as "living laboratories" to enhance learning and leadership in the classroom. Administrators and community leaders may call on EcoLeaders to foster campus-wide partnerships that advance student learning and leadership for sustainability. Many campus sustainability directors struggle to find ways to engage their students in meaningful ways and on a large scale, while providing recognition and tailoring engagement to the needs of the campus community. NWF's EcoLeaders community provides a significant way to do this.

Foreword

W. DANIEL SVEDARSKY³

The National Wildlife Federation has assembled a delightful guide which summarizes the many ways college campuses are connecting with nature and natural processes. This is fundamentally important in a world where the disconnect between built and natural environments can become more distant each day. We absolutely need nature. Nature, however, can do just fine without us.

Connecting to nature. I'm a wildlife biologist who has been teaching wildlife conservation in a college setting since 1969. Like many in my profession, my initial orientation was that we provide wildlife experiences in wild or semi-wild, rural settings that we needed to visit via field trips. But nowadays, most people live in urban, built environments—and more do so as time goes on. The same is true for educational settings; most are in urban, manicured spaces. So how do we more effectively connect people with nature?

One of my epiphanies came as I read *Invite Wildlife to Your Backyard* in the April 1973 issue of National Wildlife magazine. The setting was a new suburban backyard, in which a time sequence of 80 years or so was portrayed beginning with a mostly bare yard and progressing through the addition of plants, water features, and successional changes—all with corresponding changes in wildlife. This was pretty neat, I thought, and the concept could be applied at many scales, including a college campus. Since then, I've used this article as a resource for my wildlife students along with traditional species management guides appropriate to landscapes. Only a very few individuals in society can effect landscape-level wildlife habitat management, but most can do a little something in a backyard, front yard, or rooftop, or in a community or college space.

Special role of colleges and universities. Profiled in this report are a broad range of “wild-like” projects underway at some of the more than 4,600 U.S. colleges and universities. Some projects are incorporated into landscapes within neatly managed college grounds; others are hours from campus in more pristine natural areas. Some are recent and others, like the Harvard Forest, have been around since 1907. My early exposure to such sites was as a graduate student doing research at the University of Missouri's Tucker Prairie Reserve. I also made a visit to the University of Wisconsin-Madison Arboretum's Curtis Prairie, one of the oldest prairie restorations in the country, which was started by Aldo Leopold and others in 1933. I could not know it at the time, but these

would become foundational reference points for me as I began my academic career at the University of Minnesota and got involved in establishing nature areas large and small.

Higher education institutions are places where learning for life takes place. Michael Crow, president of Arizona State University, reminds us of our special responsibilities: “*While college and university campuses across the country are, in aggregate, responsible for only about three percent of the total greenhouse gas (GHG) emissions emitted by the U.S., we are educating 100 percent of our future political, business, and social leaders.*” I think of this often as I look out over the students in my classroom and consider their action-multiplying potential as they go forth into their careers. How can I convince each of them that with enough resolve and vision, they can brighten the natural world, one corner at a time?

From out there to here. There has been a transition over the years from wild areas being “out there somewhere” to ones more up close on campus. Beyond establishing these nature nooks, David Orr challenges us to think more holistically, and “to harness the talents and energies of faculty and students to redesign their own campuses so that one day they are climatically neutral, discharge no waste, enhance biological diversity, and support the emergence of locally sustainable economies. This means converting the university from just a place where education happens to one that educates ecologically.”

Indeed, the American College and University Presidents' Climate Commitment (with more than 680 signatories) has developed a greenhouse gas emissions metric that measures the ecological footprint of an entire campus and its operations in CO₂ equivalents. Wild areas come out well in this rating since they sequester carbon in their wood and roots. They also don't require mowing and they provide nature study areas within walking distance, thereby saving energy and reducing the combustion of fuel. The carbon sequestered by both on- and off-campus natural areas can be counted as offsetting carbon emissions from other campus operations. In addition, campuses are being studied as functioning ecosystems in terms of nutrient cycling and as hydrologic systems. Rain gardens, for example, are not only aesthetically pleasing but they also trap stormwater nutrients, pollutants, and excess runoff. They sequester carbon and provide diverse habitat for butterflies, bees and hummingbirds. How nice to put nature under our noses.

Involvement. There is something lasting and transformational when people do something themselves: restoring an ecosystem, growing and eating from a campus garden, or developing a rain garden or campus Nature Nook (its title at the University of Minnesota, Crookston). Aldo Leopold captured this reality in *A Sand County Almanac*: “There are two spiritual dangers in not owning a farm. One is the danger of supposing that breakfast comes from the grocery, and the other that heat comes from the furnace.” This guide contains many examples of student-driven projects, often with faculty and staff joining in after witnessing the student commitment. There is a special bonding that can occur when students labor alongside faculty. A personal example was when a student and I were harvesting cantaloupes from the university garden. A couple of melons were overripe. As we salvaged the good parts, the sweet juice and seeds flowed down our cheeks and chins, making a memorable mess. Teddy Roosevelt was big on involvement and getting in the arena. “It is of far more importance,” he said, “that a man shall play something himself, even if he plays it badly, than that he shall go with hundreds of companions to see someone else play well.”

W. Daniel Svedarsky is Professor and Director of the Center for Sustainability at the University of Minnesota, Crookston, and Past President of The Wildlife Society.

Making a difference for the future. Never in history have we understood more about how natural systems work, how we depend on them, and how we can lighten our ecological footprint to live within the biological and physical limits of our world. The challenges in making enough people care enough to pull this off are immense, but the alternative is grim indeed. It would seem, to me at least, that an important first step would be to surround ourselves with nature and living things in our learning, living, and working environments. With this intimate exposure, we can continue to learn and integrate nature into our culture. Using nature as a guide, we can then apply design principles to retrofit unhealthy spaces and maximize the vitality of future environments. All educational institutions have some sort of master plan to guide future development. If readers of *The Campus Wild* are moved to action, we will increase the chances that campus master plans will embrace the idea of “Design With Nature.” And that, in turn, will offer greater hope of a sustainable future with abundant natural delights.

White-tailed deer are found in all states
except Alaska and Hawaii.
Photo: Pamela Peters



Foreword

DOUG INKLEY⁴

As a college student at Michigan State University in the mid-1970s, I didn't realize at the time how fortunate I was that MSU was way ahead of the curve by providing green landscapes for wildlife and people interwoven throughout the campus. In fact, within the campus borders, I had numerous memorable and cherished wildlife experiences, although they had nothing do with another wild activity, "streaking," which was enjoying a sudden wave of popularity at the time.

On the way to class from my dormitory, I would often divert just a little out of my route to walk through Sanford Woodlot, which lay along the Red Cedar River and behind several dorms. It was a green oasis of relative calm within my busy schedule and a campus of 40,000 students. The big trees stretching for the sky, and the swirling river, were well-populated by nature's creatures and appreciated by many students, as evidenced by the well-worn trails.

Ducks on the water, male cardinals trumpeting their mating songs from the treetops, and numerous other songbirds were common. Even the smallest creatures found the woodlot a haven. One day after a winter storm, I happened upon a large tree that had been cracked open and felled by the blustering winds. The tree had been hollowed out by carpenter ants, which were now strewn about in a state of suspended animation due to the below-freezing weather. "Bird food," I thought. Protected from freezing by a build-up of glycol in their bodies, the ants revived in my warm dorm room when I brought a few inside. Another winter, the river flooded the woodlot and froze, leaving a shimmering glass sheet of ice across the forest floor as the water retreated, which crunched noisily under my feet. One spring in Baker Woodlot, I watched with fascination as a frog's worst nightmare unfolded right before my eyes. A garter snake mercilessly swallowed the frog in one very long, drawn-out swallow.

These green areas also provided places of study for wildlife students. Sanford Woodlot was populated by what I called the psychedelic squirrels, which had their tails lightly spray-painted in different colors so that individual squirrels could be tracked and identified for study. In Baker Woodlot I learned how to trap and band songbirds for migration studies. Another area was managed by wildlife biology students, and I remember using a torturous gas-powered post-hole digger to put in poles for bluebird nesting boxes. Looking back, I now realize how important these green areas on the campus were for me personally, and for providing a place for wildlife habitat, wildlife study, and natural places for people to visit and enjoy.

This guide, *The Campus Wild: How College and University Green Landscapes Provide Havens for Wildlife and "Lands-on" Experiences for Students*, shows how campuses across the country have greenspaces that offer multiple environmental and social benefits. These examples and the National Wildlife Federation's Campus Ecology Program can help provide ideas and tools to develop green landscapes at every college and university for the benefit of both people and wildlife.

Doug Inkley is the Senior Wildlife Biologist of the National Wildlife Federation.

Mascot Madness— a 2014 report by NWF— puts a new spin on March Madness⁵

It's surprising how many wild mammals, birds, reptiles, plants, and even weather events have been picked as college team mascots. This timely National Wildlife Federation report explores how the climate crisis is affecting the real-life species that have been chosen to represent many of America's college and university athletic programs. Our changing climate is the most serious environmental threat today to many animals and plants, and urgent action is needed at all levels, according to *Mascot Madness: How Climate Change is Hurting School Spirit*. "We have a new, non-sports version of March Madness: Extreme weather—which is fueled by climate change—is leading to deeper droughts, stronger storms, more intense wildfires, and more," said Doug Inkley, senior scientist with the National Wildlife Federation and lead author of *Mascot Madness*. "From wildcats to alligators, species that have spent countless centuries adapting to a 'home court advantage,' are now watching the rules of the game changing before their eyes, spurred by industrial greenhouse gas pollution," Inkley said. "If we're going to turn climate change into a happy-ending Cinderella story, we need to act now." *Mascot Madness* looks at the best available science on how climate change is impacting many of America's best-known mascots, from familiar species like bears, wolves, and bison to lesser known wolverines, bighorn sheep, and peregrine falcons.



Introduction

Try to imagine what your college or university lands might have looked like before the first shovels turned the soil. Only a few decades—or, at most, a couple of centuries—have passed since the place where your campus now stands was an unbroken wilderness of forest, savanna, grassland, wetland or desert, likely teeming with wildlife. But over a relatively short time, local development has pushed out most of the once-abundant indigenous species and has driven many to local extinction. Is there a way back to a wilder campus landscape?

While many campuses still retain remnants of natural places, including wooded or open areas, wetlands, and shorelines, most are now managed primarily for people, not wildlife. But is there room for both? A solid body of ecological research on natural systems and the changing climate, coupled with a growing commitment to sustainability in higher education, suggest that that this is a critical time to bring back the “wild” in campus places, whether large and small.

With the acceleration of habitat fragmentation, species extinction, and climate change in the U.S. and globally, there is a dynamic growing movement to go native and go local, to replenish indigenous species, and to make up for lost habitat—and lost time—for wildlife. We know why we need to “re-wild” American landscapes—and more important, we know how to do it. The 4,600-plus U.S. colleges and

universities offer ideal places to showcase such efforts. Not only will wild native species be given a boost, but there also will be a multitude of benefits for education—for students, faculty and staff—and for improvements to the campus bottom line.

The Value of Green and Wild Places on Campus Lands

Green spaces on campus vary widely in size and type, and include landscaped beds, vegetable gardens, grassy quads, exotic trees, natural forests, wetlands, river corridors, coastal zones, and stormwater control structures. Such places are often beloved parts of college or university campuses and serve many important roles. As institutions of higher learning, colleges and universities often use their green spaces as outdoor learning laboratories. Such campus-owned “wild” lands can provide opportunities for students to get hands-on training in ecological research, forestry, sustainable gardening, species identification and documentation, and many other disciplines. Landscaped areas are also essential for the look and feel of a campus, providing students, faculty, and staff with tranquil surroundings and comfortable spaces to relax, work, and study.

Green spaces can also support energy and water conservation, resulting in cost savings for campuses. Green, vegetated roofs, for example, provide insulation for buildings and filter

“If civilization consists of cooperation with plants, animals, soil, and men, then a university which attempts to define that cooperation must have, for the use of its faculty and students, places which show what the land was, what it is, and what it ought to be.” – Aldo Leopold⁶

Wildlife in a Warming World— Confronting the Climate Crisis⁷

As temperatures have increased due to climate change, land-based plants and animals have been moving further north and to higher elevations. For example, 177 of 305 species of birds tracked in North America have expanded their range northward, by 35 miles on average, during the past four decades. And 14 species of small mammals in the Sierra Nevada region extended their ranges up in elevation by about 1,640 feet during the past century.

– *Wildlife in a Warming World*, National Wildlife Federation, 2013



Hummingbird clearwing moth,
University of Delaware.
Photo by Melinda Zoehrer

stormwater. Strategically placed trees can help cool buildings in summer and allow the sun to provide heat in winter. Living forests and grasslands can act as carbon sinks, absorbing and sequestering carbon dioxide in woody plants and soils. And in what is essential to the National Wildlife Federation's core mission, campus green spaces can provide homes and havens for wildlife. Wild species, which face many challenges from urban sprawl and climate change, need ample space that will be well protected and maintained to ensure they can survive and thrive.

Nationwide, habitats and corridors for wildlife are increasingly threatened. According to a 2012 report⁹ published by the U.S. Forest Service, the area of urban and developed land in the U.S. will grow 41 percent by 2060. Forested areas will be most impacted by this growth, with losses estimated at 16 to 34 million acres in the lower 48 states. Another USFS study¹⁰, *Urban Forestry and Urban Greening*, reports the disturbing trend that tree cover in urban areas in the U.S. is declining at a rate of about four million trees per year. Such trends emphasize how important it is for higher education institutions to step up to protect and restore green spaces on their campuses. With several thousand colleges and universities in the U.S., and more than 21 million¹¹ students, faculty, and staff who study and work there, higher education can lead by example to protect, create, and maintain green space for wildlife. Campuses can be leaders in mitigating many of the impacts of environmental changes as well opening up new educational opportunities.

Peregrine Falcons in the Windy City

A 28-story building at the University of Illinois at Chicago (IL)⁸ has been home to nesting peregrine falcons for nearly 30 years. University Hall, whose high platform ledges are similar to cliffs the birds use in the wild, was one of the first locations in the Chicago area where the falcons were re-introduced. The Chicago Peregrine Program, which oversees the reintroduction, has been a resounding success: 27 pairs of falcons are known to be breeding in Illinois, with about seven pairs nesting regularly in Chicago.



Photo: S. K. Vemmer/UIC News

Peregrines had disappeared east of the Mississippi River in the 1970s due to poisoning by DDT, a powerful pesticide. After the chemical was banned in the 1980s, captive-bred birds were released at sites across the Midwest in the hope that they would thrive and reproduce. Since its first pair in 1986, University Hall has had a nest nearly every year. The current residents, Nitz (in photo) and Mouse, took over the nesting site in 2013 after Nitz, a female, pushed out Rosie, an older female who raised 32 chicks there since 1999. In two years, Nitz and Mouse have raised five chicks. A series of online videos shows the 2014 peregrine family from hatching to fledging, and a webcam ran 24/7 during the nesting season.

"Conservation is a cause that has no end. There is no point at which we say our work is finished." – Rachel Carson¹²



Photo: Michigan State University, Fisheries & Wildlife Club

THE CAMPUS WILD

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Appendix A – Resources for *The Campus Wild*

Appendix B – School featured in *The Campus Wild* by State

Endnotes

In the following sections of the guide we explore the many ways colleges and universities can make space for wildlife. And by wildlife we mean all wildlife, not just the charismatic birds and mammals that everyone loves to see. Equally important are the unseen and rarely-seen components of a diverse and healthy ecosystem: the immense variety of insects, small invertebrates, and microorganisms that live in the soil, water, undersides of leaves, and crevices of tree bark. Without this broad base of biodiversity, the higher animals would not find food for themselves or for their young. As scientists have shown everywhere they have looked, no part of nature is irrelevant or superfluous. Everything matters.

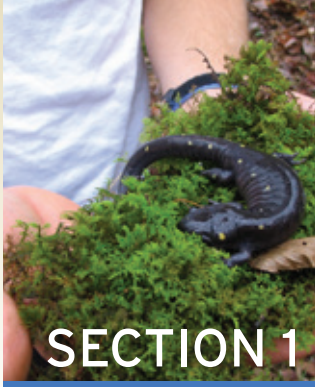
When it comes to green and wild, there is no shortage of good campus examples, and some schools already have a stunning abundance of habitats and wildlife. From gardens right outside the doors of Old Main to college-owned wilderness lakes and woods “up north,” campuses are keepers of wildlife-friendly spaces in an impressive variety of ways. We begin with on-campus landscaping, arboretums, natural areas, and other green spaces, and then extend our view beyond the campus grounds to remote properties and to the formal policies that serve to protect these places. In each section, we emphasize *Benefits for wildlife*, such as food, shelter, nesting places, and corridors for movement, and *Benefits for education*, especially opportunities for student research and leadership.



Wild turkey perched on a car at Harvard, sighted by a Campus Nature Watcher.
Photo: Harvard Recycling and Waste Services

Campus Nature Watchers

For 15 years, **Harvard University**¹³ (MA) has taken a unique approach to documenting campus wildlife. Its cadre of around 50 self-appointed Campus Nature Watchers keeps an eye out for wildlife, blooming flowers, and other nature happenings on the Cambridge campus, reporting sightings via Harvard’s periodic Recycling Update. In Spring 2009, for example, the watchers listed two mammals, 16 bird species including black-crowned night herons and a wild turkey (see photo), plus five plants in bloom. In the Fall 2014 issue, watchers reported peregrine falcons nesting on Memorial Hall earlier that spring, a migrating black-throated green warbler, and downy woodpeckers foraging for insects. Recycling supervisor Rob Gogan has been including nature sightings in his newsletter since 2000, and reports that many people read the newsletter just to keep tabs on campus nature events.



SECTION 1 Campus Landscaping for “Wild”

Whether small or large, almost every college or university campus has welcoming green places: a central “quad,” a river or pond, landscaped beds, or natural forest. Often these are special, treasured spots the campus is proud to showcase. It’s hard to find a college website or viewbook that doesn’t feature flowers, trees, or some other green scene. Schools make decisions about what to plant, how to manage open places and, in many cases, how their investments in landscaping can be tied to their educational mission. And while an argument can be made that anything green is better for wildlife than bricks, walls, and pavement, not all greenery is created equal from a wildlife point of view.

Wildlife-useful plants typically end up with holes in their leaves—a reminder of the link between caterpillars and birds. Nearly all songbirds are fledged on a diet of insects, and those insects have to eat something, too. Regrettably, the majority of exotic (non-native) flowers, shrubs, and other horticultural offerings are the equivalent of a “food desert” for native insects and wildlife. Because of this simple ecological connection, it is important that campus staff make landscaping decisions with native wildlife in mind. In most cases and places, that means landscaping with native plants to the greatest extent possible.

“I feel a strong identity with the world of living things. I was born into it; we all were. But we may not feel the ties unless we gain intimacy by seeing, feeling, smelling, touching and studying the natural world.”

– Bernd Heinrich, University of Vermont¹⁴

A good illustration is the new College of Architecture and Landscape Architecture building, which opened in 2008 at the **University of Arizona**¹⁵ (AZ) in Tucson. Native plantings were installed that represent five important biomes of the surrounding Sonoran Desert: mesquite bosque (open woodland), desert wetland, desert riparian, canyon and upper Sonoran. Valuable for their applied lessons in xeriscaping and sustainable water use, these demonstration landscapes—collectively, the Underwood Family Sonoran Landscape Laboratory—are used by students in several courses.

The gardens have attracted a variety of ground mammals, reptiles, and birds of prey. Several rare fish and reptiles, including the top minnow and the Gila Chub, find refuge in this on-campus desert oasis.

Planting native species is a good way to deal with difficult places to maintain on campus. **Allegheny College**¹⁶ (PA) planted 20 species of native wildflowers on an acre of land at the north end of its 524-acre campus, including black-eyed Susans, wild bergamot, partridge pea, and New England aster. This habitat restoration effort not only eliminated a portion of the campus grounds to maintain, it also provided filtration for parking lot runoff, cut erosion from a steep hillside, and became an outdoor research lab for the college.

Making sure native species are the default landscaping option can be achieved with wildlife-friendly campus policies. The recent sustainability policy at **Delta State University**¹⁷ (MS) calls for “resource-efficient” native plants and trees to be preferred for all new landscape projects as well as for any landscaping renovations. Indigenous trees have included bald cypress and water oak. Animal species recently seen on campus include fox squirrels and eastern garter snakes.



Members of the Tree Committee at Delta State University at a ceremonial planting of a yaupon holly (*Ilex vomitoria*), a native of southern and southeastern states.

Photo: Bill Moses

A landscape garden at **Black Hills State University**¹⁸ (SD) features a cultural connection. Established in 2013, the Ethnobotanical Garden located next to the new Life Science Laboratory includes useful native species such as buffalo grass, yucca, prickly pear cactus, sage, and purple coneflower. All plants were transplanted from prairies and the nearby Black Hills by a professor and his students, and are labeled with scientific and Native American names. The garden is used by American Indian studies classes and other courses.

The 97-acre campus of **Western Kentucky University**¹⁹ (KY) uses a comprehensive strategy for sustaining its landscaping—especially for keeping it healthy. It features regional native



Western Kentucky University
Photo: Clinton Lewis

plants and trees, urban wildlife habitat gardens, and water-efficient xeriscape plantings that include purple coneflower, rattlesnake master, and other Kentucky native wildflowers. A smart irrigation system monitors rainfall and evapotranspiration rates to eliminate unneeded watering. And an Integrated Pest Management (IPM) program employs an environmentally balanced approach to managing pests, including planting diverse groupings of species to encourage predatory insects that feed on invasive bugs.

This section, Landscaping for Wild, shines a spotlight on landscaping to create intentional green spaces on campus that offer benefits to native insects, birds, amphibians, mammals, and other wild creatures. It gives examples of native plants used in landscaped areas, and of “green” or vegetated roofs and their benefits to wildlife. It also describes campus food-producing gardens, which often shelter beneficial insects and provide trees and other habitat.

Why Native Species Matter²⁰

With wild places near towns and cities steadily losing ground, there simply are not enough unspoiled natural areas left to support the wildlife we both need and want. Douglas Tallamy, Richard Louv, Berndt Heinrich, Lorrie Otto, and other scientist/writers have called attention to managed landscapes as one of our best hopes for “bringing nature back,” helping wild plants and animals survive the ongoing loss of original habitats. The writers argue that, with modest adjustments in both our thinking and our gardening, we can still have lovely gardens and green surroundings while providing food and refuge for wildlife. Properly designed landscaping can re-establish the complex food-web interactions among native plants, insects, birds, mammals, and other species. Creating these wild landscapes is simple; it just requires using the native trees, shrubs, wildflowers, and other plants that once formed the ecological bedrock of all other forms of life.

“Because food for all animals starts with the energy harnessed by plants, the plants we grow in our gardens have the critical role of sustaining, directly or indirectly, all of the animals with which we share our living spaces. The degree to which the plants in our gardens succeed in this regard will determine the diversity and numbers of wildlife that can survive in managed landscapes.”

– Douglas Tallamy, *Bringing Nature Home*

Landscapes That Sustain A “sustainable landscape”—in its simplest definition—is not necessarily a place friendly to native plants and wildlife. A groundcover of English ivy, for example, or a lawn of no-mow fescue grass may require no pesticides or extra water. A green place can have non-invasive, low resource input and low-maintenance vegetation but still have little or no value for insects and native wildlife species. It may save water, energy, fertilizer, and maintenance costs, but may be ecologically empty in terms of its appeal or usefulness to locally-adapted native insects, birds, and other species. In NWF’s view, while a landscape should be sustainable, it is essential that campuses also seek to create *landscapes that sustain*—that support local native wild and migratory species. Such places almost always require native wildflowers, trees, and indigenous species.



FEATURED CAMPUSES

University of Nevada, Las Vegas²¹ (NV)

Facilities staff at the University of Nevada, Las Vegas (UNLV), have been practicing sustainable landscaping since 1986 when they installed a one-and-a-half acre xeric garden hosting a mixture of native and non-native desert-adapted plants. Guided by its Drought Plan, UNLV has converted over one million square feet of turf grass (approximately 22 acres) to xeriscaping in more than 20 different projects since 2003. This represents about one-quarter of the 80 landscaped acres within the 335-acre campus. Replacing grass with drought-tolerant plants has saved an estimated 55 gallons per square foot of water, or around 55 million gallons a year, exceeding—ahead of schedule—the university’s goal of reducing campus water use by 25%.



Xeriscaped area between buildings at UNLV with rocky median to slow storm runoff.

Photo: UNLV Photo Services

Facilities Manager Robert Lynn has been guiding UNLV’s efforts for decades. “Even before water regulations came into effect,” he explained, “we have been doing turf conversion to xeriscaping, using plants like yucca, agave, palo verde, ocotillo, senna (*Cassia*), and Texas rangers (*Leucophyllum*).” These conversions have become ever more important as Las Vegas has multiplied in size and Lake Mead, its source of water, has shrunk from overuse and drought. Thanks to xeriscaping, the UNLV campus has seen the return of many wild animals that are drawn to the more biologically diverse vegetation. Sightings include desert species such as roadrunners, Anna’s hummingbirds, Great Basin whiptails, and cottontail rabbits.

Turf conversion has been only one aspect of landscaping for the “wild.” UNLV has planted more than 5,000 trees on campus—and considers its entire campus as an arboretum. More than 3,200 trees and shrubs have been inventoried, comprising at

Xeriscaping The Greek term *xeric* (ZEER-ick) refers to plants and animals adapted to dry environments. Xeriscaping is a type of landscaping that uses plants that are drought resistant and typically require little or no extra water, beyond rainfall, once established. Examples include cactus, desert shrubs, bunch grasses, and other dry-adapted vegetation. In arid parts of the country, locally-sourced native plants are ideal for xeriscaping because they are pre-adapted to the climate.

least 186 species of trees and several hundred species of shrubs, both ornamental and desert-adapted. Students at UNLV have assisted by participating in Arbor Day tree planting activities, and a campus/community garden currently is in the planning phase.

UNLV courses enlist architecture students to develop landscape design plans for campus buildings. Campus regulations call for all new buildings to be xeriscaped. Mr. Lynn and his staff have helped students determine the most effective ways to irrigate landscape beds and to incorporate design elements that would enhance campus buildings. And to take advantage of its growing plant collection, UNLV has arranged for local community colleges to use the campus for plant identification courses. For field portions of the courses, students visit UNLV to identify the wide range of native and introduced plants on campus.



An iconic bird of the arid Southwest, the roadrunner is often seen moving quickly on the ground.

Photo: Joyce LeBombard, 2012

Taking a Stand for the Land

Campus lands are a tremendous asset to Green Mountain College, with values for academic programs and research, the social environment, and ecosystem function. We celebrate our unique place in the biosphere and seek to minimize the ecological footprint of our land use. We envision a campus landscape that supports the college mission to foster environmental responsibility.

– 2010 Native Species Landscaping Policy, Green Mountain College

Green Mountain College²² (VT)

Situated on the east bank of the Poultney River, Green Mountain College's 123-acre main campus has three land use types: 1) managed grounds with buildings, landscaping, and athletic fields (44 acres); 2) natural areas including the Poultney River, its buffer zone, and broad floodplains (39 acres); and 3) the Cerridwen Farm (40 acres), operated by students and staff, that provides food to the campus and community.

The Poultney River corridor offers riparian habitats with fast-growing cottonwoods and patches of ostrich fern. Kingfishers and phoebes hunt along the river and beavers are occasionally seen. The corridor supports many forest edge and riparian forest species such as warbling vireo, yellow-throated vireo, and rose-breasted grosbeak. Old-field areas are good habitat for yellowthroats, yellow warblers, song sparrows, bluebirds, deer and bobcats.

Over past fifteen years, Green Mountain has been shifting its campus landscaping toward gardens and beds that host native plants. In 2000, it established the first of seven native plantings, each with a different theme. The first garden was started by students in a botany course with 33 species of forest floor plants native to northern hardwood forests. A year later, a garden containing indigenous Vermont shrubs was created. Others now feature forest perennials, medicinal plants, bird-dispersed fruiting shrubs, and native meadow species in an old-field site.

Taking the idea to the next level, in 2010 the college approved a Native Species Landscaping Policy. The policy provides guidance in three main areas: 1) Plantings in designed spaces and natural areas on campus must be selected from species native to Vermont or to adjacent portions of New York, New England, and Canada; 2) Non-native species may be planted on the Cerridwen Farm and in lawns as long as they are considered non-invasive; and 3) Existing non-native plants that are identified as invasive (such as Norway maple) will be removed and replaced by native species, as spelled out by GMC's Invasive Species Control Policy, implemented in 2006. Currently, facilities staff control five invasives, including garlic mustard, dame's rocket, glossy buckthorn, shrub honeysuckles, and Japanese knotweed. Also in 2010, educational signs were

installed at six of the native species gardens to raise awareness of regional flora.

Guided by the landscaping policy, also called the Campus Flora Project, students in courses such as Local Flora, Ecology, and Botany have had a central role in documenting plant communities plus plant and animal species, sampling for long-term ecological studies of restoration and plant succession, planting trees and shrubs to restore riparian forest, and planning, installing and maintaining the native plant gardens



Students pulling garlic mustard, an invasive woodland weed, at Green Mountain College.
Photo: J.H. Graves, 2005

They have collected and propagated seeds of native species, and produced many of the plants that are in the gardens today. Nearly 250 students have participated directly. One of the most popular events occurs each Earth Day when about 80 students take part in the annual Garlic Mustard Pull to help eliminate a forest invasive. Financial support comes, in part, from GMC's Student Campus Greening Fund. The fund is replenished by allocations from a \$30/year student activities fee, which supports greening initiatives that increase awareness and decrease the college's environmental footprint.

University of Hawaii Manoa²³ (HI)

Located in Honolulu, the University of Hawaii Manoa (UHM) has a lush and diverse tropical landscape. The 320-acre campus is home to more than 600 varieties of plants and trees, including many native and endangered species and one of the largest baobab trees in the United States. As stated on its website, the mission of UHM's Office of Landscaping is "to develop the campus grounds into a botanical garden which students and faculty can use as a resource for teaching and learning."

To help the UHM community learn about its landscaping, an interactive map of campus vegetation was created, in part by two students, that identifies all woody plants and trees in a graphic and interactive way. For each plant, the map provides information about the plant's characteristics, geographic origin, uses, and rarity. The data come from an ongoing effort to map all plant species on campus using computer software tools including ArcGIS and Google Earth, as well as state-of-the-art surveying equipment. A 1996 brochure listing the huge variety of trees and shrubs on campus is also available online.

Due to their geographic isolation, the Hawaiian Islands have no native terrestrial mammals. But there are three important native bird species seen on campus: the 'auku'u or black-crowned night heron (*Nycticorax nycticorax hoactli*), which visits the campus pond and stream; the kolea or Pacific golden plover (*Pluvialis fulva*), which migrates to and from Alaska, and especially the *manu o kū* or fairy tern (*Gygis alba candida*). The *manu o kū* is an endangered species which nests in large campus trees. UH's landscaping division has protocols to check for nesting terns before projects begin and will reschedule tree work if needed. The landscapers also grow plants to support native insects, such as *māmaki*, the preferred food of the endemic *pulelehua* or Kamehameha butterfly (*Vanessa tameamea*), and crownflower, which is favored by Hawai'i's monarch butterflies.

UHM's landscape maps were first created by student employees of the landscaping department. Map updates, changes, and advancements continue to be made by students who research individual plants and historic campus buildings to provide other students, faculty, and staff with a valuable campus online resource. The plant maps are used in courses and for campus planning and construction projects, as well as for tree protection.

An innovative idea of the landscaping department is an adopt-a-landscape program where students, in collaboration with a faculty member, can manage a small portion of the



Black-crowned night heron. This species (*Nycticorax nycticorax*) is found near water and wetlands across the continental U.S.
Photo: Andrea Popick, 2011

campus landscape to develop small native plant gardens. This provides opportunities for students to gain hands-on experiences growing native plants, establishing gardens to support native insects, and practicing sustainability through gardening in an urban setting.

University of Minnesota, Crookston²⁴ (MN)

The University of Minnesota, Crookston (UMC) is committed to conservation on campus; two of its best examples are the Nature Nook, which contains the Shaver Butterfly Garden, and the Youngquist Prairie Garden. The Shaver Garden was dedicated in 2007 and is named after June Shaver, a long-time supporter of the university. The Nature Nook and butterfly garden are home to monarch and painted lady butterflies, bumblebees, robins, and goldfinches. Plant species include purple coneflower, ironweed, milkweed, and various other prairie wildflowers and grasses, plus shrubs and trees. The Nature Nook is about a tenth of an acre and contains microcosms of four natural biomes. As observed by Professor Dan Svedarsky, "With that amount of diversity, it's a stopover magnet for migrating birds like warblers and sparrows. From the second floor window of Owen Hall, the view into the tree canopy is like watching living TV."

The Youngquist Prairie Garden, dedicated in 2006, is named in honor of a former campus administrator who promoted natural history research. The garden has sections representing three Minnesota prairie types: dry prairie, mesic prairie and wet prairie. It features native plants including coneflower, pasque

flower, prairie smoke, prairie clover, goldenrod, blazing star, gentian and a variety of prairie grasses like little bluestem, side-oats grama, Indian grass and switchgrass. A walking path allows visitors to stroll through and learn about the native vegetation from labeled plants. The wide variety of native prairie and woodland plants on campus provides opportunities for students in plant identification and habitat management classes to learn plants in various stages of development right outside the classroom.

Students and faculty in UMC's Natural Resources program, with support from landscape architecture students, manage the Nature Nook and other theme gardens on campus. They also have established an ongoing wing-tagging project to assist in tracking the migration of monarch butterflies. Two endowment funds of more than \$25,000 each were established by June Shaver and the family and friends of Bernie Youngquist to help support a summer intern. The intern maintains the campus habitat areas and advances the conservation mission of the campus by assisting with interpretive talks to visitors.



The Shaver Butterfly Garden at the University of Minnesota, Crookston.
Photo: Dan Svedarsky

Pioneers in Sustainable Campus Landscaping

In 1995, the National Wildlife Federation published its landmark book *Ecodemia: Campus Environmental Stewardship at the Turn of the 21st Century*²⁵ by Julian Keniry. The book's 200 pages capture the rapidly expanding movement of campus sustainability, with one of its chapters focused on Landscaping and Grounds. The year 2015 marks the 20th anniversary of *Ecodemia*, and NWF would like to give a "shout out" to several pioneers in the field of sustainable campus landscaping.

Nebraska Wesleyan University (NE) in Lincoln transitioned to using native grasses, including buffalo grass, in turf areas on campus. The university researched the benefits of native plants vs. non-natives and found that native plants required less maintenance for grounds staff. The native plants also brought other benefits, such as an increased bird population—with regular visits from wrens, white-breasted nuthatches, downy woodpeckers, and others. Because most of Nebraska's native grasslands had given way to ranching land, Nebraska Wesleyan's restoration effort was not only important for the campus but also for the state, bringing back some of Nebraska's natural history.

Seattle University (WA) developed an Integrated Pest Management (IPM) plan instead of the usual approach to pest control (which typically employs chemicals to kill every bug and weed and results in very few beneficial bugs—or birds—left on campus). Among the strategies in IPM is a preference for killing pests in non-chemical ways, such as laying sticky traps, blasting pests with water, or even squishing them by hand. Another strategy is fighting insects with insects by introducing beneficial native insects, such as assassin bugs and damsel bugs, which wage war against harmful species. Cultural remedies are also applied, making sure landscape plants are selected for the environment where they were meant to live.

Texas Southern University (TX) in Houston initiated a community landscaping effort that involved students, faculty, and staff. The campus hosted a lecture series on horticulture and offered opportunities to get hands-on through an Adopt-a-Plot program, through which students and staff adopted a space on campus to design and create their own landscape. Tree and native flower plantings included blue flax, butterfly weed, and gold yarrow. Local businesses were called upon for donations of trees and to help secure matching grants from the U.S. Forest Service to provide supplies such as food, tools, and gloves.

To read about these and other sustainability pioneers, see the online copy of *Ecodemia* at <http://www.nwf.org/Campus-Ecology/Resources.aspx>

1A GREEN ROOFS

Green roofs, also called vegetated or living roofs, create a unique type of green space on campus. They offer a variety of environmental benefits (and operational challenges), such as stormwater runoff reduction, thermal insulation, energy savings, and mitigation of the urban heat island effect. Currently, the *International Greenroof and Greenwall Projects Database*²⁶ lists 130 green roof projects at North American colleges and universities, with the first dating back to the early 1990s. And though usually off limits to casual visitors, green roofs are often made accessible for students for research projects.

Candidates for green roofs can be existing buildings or new construction, as long as the structures can bear the extra weight. At **The Ohio State University**²⁷ (OH), a 12,000-square-foot green roof was installed in 2013 on 44-year-old Hewlett Hall when its existing roof needed replacing. This publically accessible space is gardened with native and non-native plants, and the new green space is now part of OSU's Chadwick Arboretum and Learning Gardens. In the campus arboretum at **Spartanburg Community College**²⁸ (SC), a small green roof was installed in 2010 on a new, square-roofed gazebo. It was originally planted with heat-tolerant plants such as sedum, agave, and ornamental grasses. The plant mix is still evolving, but one native plant on the roof, the false aloe (*Manfreda virginica*), flowered and set seed in summer 2014.

Most green roofs typically are planted with drought-resistant, non-native plants such as sedum, though many support locally adapted prairie grasses and wildflowers—which offer more for wildlife. Some also are used as gardens for herbs and vegetables. But after green roofs are planted, nature often finds ways of changing the plans (and plants). A study of the roof on the Carl L. Becker House at **Cornell University**²⁹ (NY) found that, seven years after being planted with four species in 2005—with three succulents and prairie dropseed grass—54 new species appeared. Some of the native volunteers included trees (red oak, black locust, staghorn sumac), vines (Virginia creeper, grape), grasses (big bluestem), and forbs (milkweed, nodding wild onion, yarrow, Canada goldenrod). In addition to growing plants, these aerial green islands can offer a secluded oasis for invertebrates, birds, and other animals that are able to reach them. A recent study by a graduate student at **Fordham University** (NY) in New York City documented many species on green roofs in the city (see box).



The male American woodcock makes distinctive calls and sounds during its spring courtship displays.
Photo: Sandy Wright, 2012

Green Roofs Offer a Big City Refuge for Birds³⁰

Fascinated by the number of wild species he observed in small green spaces in New York City, **Fordham University** (NY) graduate student Dustin Partridge wondered if green roofs held the same attraction. He designed a study to compare green roofs with traditional ones—ten of each, two to ten stories high, none at a college or university—and was surprised by what he found. Over two summers, he collected insects and arthropods, 20,000 in all, and set up recording devices to capture bird songs. Of 37 bird species, 26 were documented only on green roofs. Calls or sightings included American woodcock, kestrel falcon, peregrine falcon, flycatchers, warblers, and a ruby-throated hummingbird. The arthropod tally had bees, parasitic wasps, beetles, isopods (pillbugs), spiders, and migrating butterflies. Partridge's story was covered in the February/March 2014 issue of *National Wildlife* magazine. In the article, Partridge described green roofs as being like “flying islands,” harboring six times the biodiversity of conventional roofs. Green roofs in big cities demonstrate the “Central Park Effect,” he noted, where rare green spaces act like magnets to concentrate species. They seem to be particularly important during bird migration, offering food as well as a secluded spot in a sea of buildings, pavement, and people.

FEATURED CAMPUSES

University of Wyoming³¹ (WY)

The Berry Biodiversity Conservation Center at the University of Wyoming is home to Laramie's first large-scale green roof. Built in 2011, the 3,600 square-foot rooftop prairie was included in the design of the building for both environmental and educational reasons. It provides natural insulation for the building and serves as a heat sink for the hot Wyoming sun. Planted with native prairie plants, the "Berry Prairie" offers a dynamic educational space for the campus and community. Since its launch, it has been used for experiments in attracting native pollinators and as a research station for many studies of green roof plant-related processes, including species-specific mortality, seed set, and pollination rates. In part due to its living roof, the Biodiversity Center earned LEED (Leadership in Energy and Environmental Design) gold certification in 2013.

The original green roof was designed to mimic the high-elevation prairie environment around Laramie. After a summer 2014 remodel of the rooftop, however, it now hosts plants from a broader geographic area, with species from the plains, foothills, and alpine zones of the Rocky Mountains. The green roof showcases 60 species: grasses (7), sedge (1), herbaceous wildflowers (40), cactus (3), yucca (1), and shrubs (8), with a total of around 4,400 individual plants. Some of the native Wyoming species are the Laramie columbine and narrowleaf paintbrush, prairie dropseed and western wheat grass, and Wyoming big sage and fringed sagewort.

The Berry Prairie provides habitat for many invertebrates; a Master's student has documented specimens from eight orders of insects. The site harbors important pollinator species including mason, carpenter, and leafcutter bees. To provide good bee habitat, two "pollinator homes" and a bird bath for water were installed. Two hummingbird feeders also have been placed near the roof to support species such as the broad-tailed hummingbird, which also pollinates certain plants.

The green roof provides unique educational opportunities for students at the university as well as for school children and visitors from the broader community. Students in the graduate course Stable Isotope Ecology have used the Berry Prairie to test the ratio of heavy to light isotopes of hydrogen and oxygen in water extracted from soil, stem, and leaf samples. In 2012, a weather station was installed on the roof to monitor precipitation, wind speed, temperature, and humidity.



Native species plantings on the roof of The Berry Biodiversity Conservation Center building at the University of Wyoming.
Photo: Brenna Marsicek

Weather data are used for many projects across campus, including a study of the microclimate on the green roof compared with other sites in the area. And children from local schools have visited to learn about how plants and pollinators interact.

Pennsylvania State University³² (PA)

Penn State's main campus in State College currently has large-scale green roofs on five buildings, totaling 103,700 square feet (2.4 out of 80 acres of roofs on campus). Plans for more green roofs are under consideration for future buildings. These serve as learning tools for students in addition to creating additional campus green spaces. Two of the five are described here.

The Forest Resources Building was completed in 2006 and its 4,700 square-foot green roof was planted in Spring 2007. It was covered with drought-resistant sedum and offers a public patio open to the campus community. The green roof lies atop a one-story section of the building that houses classrooms and an auditorium. It is used as a teaching and demonstration project and has hosted a number of classes and conference tours. The project is managed by the Office of Physical Plant with maintenance performed by campus grounds staff.

The Root Cellar Building green roof was a cooperative project between Penn State's Center for Green Roof Research and the Office of Physical Plant. This 4,500 square-foot space serves both as an example of low cost, minimal input green roof construction (approximately \$7 per square foot) and as a living laboratory for students and faculty to learn about and work on green roofs. This old farm building was built in the 1920s and re-roofed in Fall 2006. Using a variety of plants they raised, students in the Horticulture Department's Eco-Roof class planted the roof in 2007. It is divided into six equal sections and comparative studies are underway of different soil (media) levels and vegetation types. The growing media contains compost from organic waste collected on campus. Typical green roof plants like sedum were used, but students are also testing new species and cultivars. A drainage system monitors flow rates of runoff from the roof.

In 2005, Penn State developed the nation's first-ever course on green roofs: Eco-Roof and Green Technologies. It is offered every spring to students in a variety of disciplines. The course examines the fundamentals of green roofs, living walls, constructed wetlands, and related technologies, and provides hands-on experience with installation and maintenance.

Kansas State University³³ (KS)

Green roofs planted with Kansas natives have been a feature at KSU since May 2009. A 2013 KSU article explains: "What began as a Natural Resources and Environmental Sciences class project in 2008 has blossomed into a research, engagement and educational opportunity in the College of Architecture, Planning and Design. Seaton Hall's two rooftop gardens—or green roofs—enable the study of stormwater runoff, irrigation requirements, and the viability of native prairie plants in a shallow soil environment with varying levels of wind and sun exposure."

The upper Seaton Hall green roof has provided data for KSU faculty and students on research into which native Kansas plants, once established, can survive without supplemental watering. The findings thus far, notes landscape architecture professor Lee Skabelund, is "not many." The project also aims

to help answer questions about life-cycle costs and long-term plant survival. Landscape Architecture faculty/staff efforts resulted in the 2013 publication: *A Designer's Guide to Small Scale Green Roof Planning, Design and Implementation*.

Research has also been done by landscape architecture and engineering students and faculty on stormwater harvesting and re-use, to see how Kansas rains can be captured to support similar rooftop gardens during dry spells. Colorful during the growing season and readily visible from the ground, KSU's lower Seaton Hall green roof is an attractive aerial complement to campus landscaping.

In 2007, the university's first native plant rain garden was created on campus to show how to reduce downstream flooding and pollution, while creating a perennial garden that needs no supplemental irrigation. This design-build project involved over 60 K-State faculty, staff and students, and subsequently received national acclaim



Planting native grasses, sedges, and forbs within Seaton Hall's rooftop integrated soil system (2012).
Photo: Tansly R. Skabelund

"The International Student Center rain garden and the two Seaton Hall green roofs demonstrate how faculty and students in architecture, landscape architecture, engineering, horticulture, and agronomy have successfully come together with K-State facilities staff to create two dynamic projects that beautify the campus, offer venues for practical research, and tutor many people in the community, region, and beyond."

– Hayli Morrison, Development Communications Coordinator, KSU Foundation

Washington University in St. Louis³⁴ (MO)

The first of two green roofs on the urban campus of Washington University in St. Louis (WUSL) was installed in 2009 on South 40 House, a student residence hall. The 10,150-square-foot space was first planted with grasses and native plants. It was expanded in 2010 to 17,600 square feet and now includes an herb garden to provide fresh herbs for the dining hall. Located partly at ground level, it offers accessible green space and benches for outdoor study and recreation. As noted by WUSL, besides acting as energy-saving insulation in both summer and winter, the green roof's vegetation and soil absorb 90% of rainfall.

A second accessible green roof was installed in 2013 on an addition to 106-year-old McMillan Hall, an arts and sciences building. It is planted with native plants, and also has horticultural garden plots used by faculty and students in anthropology who study the cultural uses of plants. Plants include Rocky Mountain beeweed, tepary beans, wild strawberries, spiderwort, and evening primrose. McMillan's demonstration gardens, which grow plants used for medicine, fiber, and food, support instruction related to ethnobotany, environmental anthropology, and global health. Although the gardens are located on rooftops, they are accessible to animals, which has meant that rabbits have sometimes been a problem. An abundance of bees and butterflies have been welcome, however.

"For teaching and learning about plants and ethnobotany, there's no substitute to having an actual garden that we can walk to from the classrooms and labs," said Gayle Fritz, professor of anthropology. "Some students might remember



Anthropology graduate students Kelsey Nordine and BrieAnna Langlie examine Rocky Mountain beeweed, a native plant used for food, medicine, and pottery decoration.
Photo: James Byard, WUSTL Photos

an interesting plant from images in books or lectures, but they'll definitely relate to plants they've seen, touched, and maybe tasted, or used to make something." For long-term success of such gardens, Fritz added, "communication between facilities managers, maintenance and landscaping staff, and gardeners needs to be ongoing."

Graduate students were involved in the selection of species to be planted, as well as in the planting and weeding. The green roof at South 40 House helped the building earn LEED Silver certification. The McMillan Hall renovation was also built to LEED specifications.

Wild

1B FOOD PRODUCING GARDENS

With the rise in interest in connections between food, health, social justice, and the environment, a current trend on campuses has been the creation of campus and campus/community farms and gardens. AASHE³⁵ (the American Association of Sustainability in Higher Education) has posted a list of more than 140 colleges and universities in the U.S. that have campus/community gardens. Most use organic growing techniques and integrate student learning. More than half of the garden- and agriculture-related reports in NWF's *Campus Ecology's Case Study Database*³⁶ (a compendium of more than 800 campus sustainability case studies from higher education institutions across the country) were submitted in just the past two academic years.

As green spaces—often with accompanying native landscaping, trees, and water features—campus garden projects play a role in nurturing wildlife as well as people. They can provide year-round food sources in the form of pesticide-free foliage, nectar, pollen, berries, seeds, and nuts. They offer shelter, migration corridors, places to raise young, and vital habitat for many beneficial insects. On a practical note, of course, the “harvest” of edible crops by insects and wildlife may be problematic, but over the course of a year most gardens and plantings have extra to share.

“Humanity is exalted not because we are so far above other living creatures, but because knowing them well elevates the very concept of life.”

– Edward O. Wilson, Harvard University

Campus gardens also offer valuable teaching opportunities. Many sites are student-run, providing practical, hands-on learning experiences not only in farming and gardening, but also in business management, community relations, and nature observation. Gardens are used for research projects in many disciplines, and provide places for reflection and creativity.

The **University of Montana**³⁷ (MT) in Missoula, for example, boasts an on-campus Dining Garden that allows the school to grow some of its own food while also providing a learning laboratory for UM students. The garden consists of three areas:

1) a dozen raised beds for vegetables; 2) a space for a small orchard, perennial plants, and sprawling plants like squash; and 3) a section reserved for edible native plants including serviceberry, currant, strawberry, red raspberry, and American plum. In total, the garden supports more than 60 varieties of plants and serves as a model closed-loop food production system. The gardeners save seeds from crops in the fall, grow them in spring, and compost garden waste to enhance the soil. In 2012, UM added a passive-solar greenhouse funded by graduating seniors. It was built using green building techniques including earthbag construction, super insulation, passive-solar design, and vermicomposting. Signs in campus dining areas let students know that some of their food was grown just a few yards away.

A related interest in permaculture (diverse perennial plantings that offer food, fiber, and ecological stability) has led to many campus plantings of fruit and nut trees, raspberries and other fruit-bearing shrubs, and herb gardens and herbaceous plants with various uses. Students in environmental studies at **Noropa University**³⁸ (CO) study permaculture on campus in a variety of ways. Two courses are dedicated to the topic, and the students participate in applied research both in the geodesic dome greenhouse and outdoors on projects such as food forests and heritage fruit trees, ancient irrigation methods, and mushroom cultivation.

Located on four sites within the **University of New Mexico**³⁹ (NM) campus, the Lobo Gardens collectively are named after the school mascot Lobo, which is Spanish for wolf. The goal of the gardens is to provide students, faculty, and staff with a living laboratory to learn about the importance of local, sustainable food cultivation for human and ecological health. Partnering with the campus food provider, the Lobo Gardens also provide supplemental seasonal produce to campus dining facilities. A special label designates dishes containing Lobo Gardens produce. The gardens use techniques that are compatible with the Southwest climate, such as natural soil building techniques, pollinator-friendly species, and groups of plants that support each other (an idea known as plant guilds). One garden was designed as a “food forest” with edible woody and herbaceous species planted to mimic a woodland ecosystem. Several UNM courses use the gardens for research.

FEATURED CAMPUSES

University of Texas at Austin⁴⁰ (TX)

The Concho Community Garden at the University of Texas at Austin was established in 2011 as a student project. Student Daniella Lewis received an NWF Campus Ecology Fellowship to establish UT's first community garden, and it has since become a well-known resource on campus. The garden is an ongoing collaboration among several UT entities: the Campus Environmental Center, the Office of Sustainability, and the Division of Housing and Food Service, with great support from Landscaping Services.

The Concho garden hosts 24 individual garden plots, plus demonstration plots and landscaping, fruit trees, and a row of compost bins. Everything is grown organically. The UT Division of Housing and Food Service harvests produce from three 4x16 foot plots in the garden. During the 2011-12 academic year, Food Service used more than 180 pounds of produce and herbs harvested from Concho and other campus gardens.



UT students working in the Concho garden.
Photo: UT Concho Community Garden Team

The garden serves as a platform for academic work and interdisciplinary collaboration. In summer 2013, Concho was used for a study of urban bee populations in Austin conducted by researchers in UT's Integrative Biology department. With funding from the UT Green Fee (\$5 per semester from all students), a bat house will be installed at Concho in 2014-15 to educate students and the community about the ecological role of bats in Austin.

The Concho garden is a certified National Wildlife Federation Habitat and has become home to a growing variety of wildlife. A lily pond was installed at the garden, providing a gathering place for birds and relief from the taxing heat often present in Austin. In 2012, volunteers constructed an "insect motel" to provide shelter for beneficial insects. Additionally, the neighborhood is home to a flock of roaming guinea fowl, and the garden became a nesting site for one expecting mother. Many native perennials are planted in the garden, like pequin chile pepper and flame acanthus (hummingbird bush), which provide food for birds.

Luther College⁴¹ (IA)

Luther College has a history of being a food-producing institution. It grew much of its own food back in the early 1900s. One hundred or so years later, it is producing again but on a much smaller scale. In 2004, a few students approached a professor with the idea to start a campus garden. They began with a 70 x 40 foot plot. It is now around 15 times larger—a quarter acre—and employs nine students during the fall, late spring, and summer. All of its produce—primarily greens, tomatoes, and other salad bar items—is served on campus after being sold to Sodexo, the college's dining services company.

Produce from the garden or "farm" are part of the 35% of food purchases that are produced locally—within a day's drive from campus. Luther reached the 35% local goal in 2013, working with a variety of other growers in addition to its campus garden. From 2004 to 2013, income from campus garden sales rose from \$500 to \$8,500 (the 2013 harvest was 3,800 pounds). There has been a "big learning curve to sell our own produce," said Maren Stumme-Diers, Sustainable Food Educator. "We have narrowed the number of items that we grow and tend to focus on ones not easily sourced from local farmers due to volume or cost."

Students are at the heart of the campus garden. With support from Stumme-Diers, student crew leaders direct the majority of daily operations including planning, communicating with Dining Services, planting, harvesting, invoicing, and delivering. In Fall 2014, the crew got some help. Students in a new sustainable foods course assisted in the garden as part of their coursework. The garden and farm/food topics have also been the focus of other class projects and senior papers.

In addition to the campus garden, Luther has two "edible landscapes" on campus. The first was initiated by a student in 2011 as part of an environmental philosophy class. Recently,

a “salsa garden” was planted with jalepenos, tomatoes, and cilantro to supply a salsa-night event for students. The edible landscape gardens are open to the campus community.

As with any farm or garden, wildlife can sometimes be an issue. Deer, woodchucks, and raccoons have done damage over the years. To reduce the problem, student staff monitor the perimeter netting around the production garden, mending holes when found. There are plans in the works for a sturdier woven wire fence to be installed. Pollinators are always welcome, of course, and beehives are located nearby. The bees are studied by a faculty member and students in an entomology class.

Western Michigan University⁴² (MI)

The Gibbs House, a historic 150-year-old student residence, is the epicenter of a dynamic new project on WMU’s College of Engineering and Applied Sciences campus in Kalamazoo. Surrounding the house are two acres of garden space used for a student farm and a permaculture living laboratory. The student farm, which recently relocated to the Gibbs House, has been producing organic, heirloom varieties of fresh produce since 2010. At the permaculture garden, students are experimenting with perennial crops, and a food forest is in the development stage. Vegetables from the farm are preferred for catered events sponsored by the university president, and often are served at guest speaker engagements and sustainability conferences.

WMU’s Office of Sustainability sponsors the Gibbs House, whose 2014-15 master plan calls for long-term self-sufficiency. Five students live in the house and work on farm chores and house maintenance, and another group of students work on the permaculture garden. The Gibbs gardens share a border with the 274-acre Asylum Lake Preserve, a campus natural area that offers many wildlife-learning opportunities for students, faculty, and staff. To keep deer and other large animals out of the gardens, students are planting a six-foot high living fence made of fast-growing hazel shrubs and grapevines. Another garden feature is a seven-layer food forest, modeled after a multi-level native forest with edible and useful nut and fruit trees and shrubs, plus edible perennials.

Randolph College⁴³ (VA)

The one-acre Organic Garden at Randolph College was developed through the efforts of students, staff, and faculty, and is dedicated to the principles and practices of organic gardening, including permaculture and indigenous knowledge. Launched in 2003, it now features vegetable beds, an apple orchard, edible landscaping nursery, and a food forest, plus a flock of chickens, a rainwater retention pond, and honeybees. The “food forest” is a small plot planted with food-producing woody perennials including pawpaw, persimmon, Chickasaw plum, chinquapin oak, figs, berry bushes, and more.

Indigenous Knowledge

“Indigenous knowledge refers to the experience and skills developed by local cultures which have had a long history of interactions with their natural environment. They established a balance to sustain themselves without depleting local resources. This is the type of knowledge we are after as we aim to teach techniques that are suited for the local ecosystem.”

– Ludovic Lemaitre, Sustainability Coordinator,
Randolph College

Up to 40 students are involved in maintaining the garden each year, and it is widely used as a living laboratory. Biology classes, for example, use garden plots to compare native and non-native crops, art students come to draw the chickens and learn about their behaviors, and environmental studies students practice soil and air sampling. The garden is located next to a forest that is home to a wide variety of wildlife, and the campus garden provides additional habitat for several species of toads and frogs, snakes, lizards, squirrels, moles, groundhogs, raccoons, skunks, box turtles, rabbits, many birds, and hundreds of insect species. Different parts of the garden are fenced as needed, however, to exclude deer, rabbits, and other animals to protect the crops.

To build on the success of the Organic Garden, NWF awarded an Emerging Leader Fellowship to Ludovic Lemaitre, Randolph’s Sustainability Coordinator, in 2013-2014 to establish a new 600-square-foot edible perennials nursery for the greater Lynchburg community. It contains American chestnut, pawpaw, beechnut, native grape, and many other plants.



Carpenter bees on the flowers of passion fruit at Randolph College.
Photo: Ludovic Lemaitre

Through the fellowship and assistance of students and local volunteers, the nursery aims to propagate and distribute edible trees, shrubs, herbs, and flowers to schools, local community gardens, nonprofit organizations, and businesses in the region. Focus is placed on native species—reducing the need for special care once transplanted—and on species that also provide suitable habitat and food for regional wildlife. Lemaitre notes, “I want the gardens to be places where people can come to learn about edible landscaping. They will provide a service to the community and wildlife and be places where students can learn how to propagate these plants.”

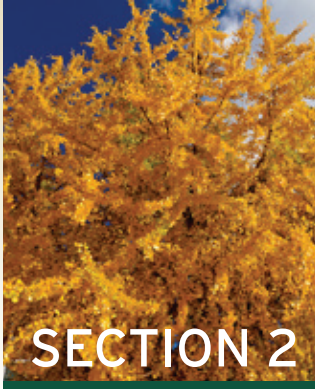
United Tribes Technical College⁴⁴ (ND)

One of sixteen gardens along a walking trail through the United Tribes Technical College campus, the five-acre Dragonfly Garden is a butterfly garden and more. It is both a community demonstration garden and research garden, intended to provide students with experiential learning opportunities that tie directly to Native American culture and heritage, as well as giving local community members a showplace to see many different types of plants. The Dragonfly Garden was created in a circular pattern that is symbolic of the Native American medicine wheel design.

Edible native trees and shrubs in the garden include buffaloberry, currant, elderberry, Juneberry, and wild plum. Horticultural woody varieties, including roses and fruit trees, are also featured, and parts of the garden are used for research on growing squash, maize (corn), and potatoes. Many species of bees and butterflies can be seen in the garden during the growing season. Wildlife visitors include pheasants, deer, raccoon, and numerous songbirds. The UTTC Land Grant Food and Nutrition Departments, the Agroecology Department, and the Theodore Jamerson Elementary School (located on campus) use the Dragonfly Garden as an outdoor learning lab.

The Dragonfly Garden, laid out in a circle, at the United Tribes Technical College.
Photo: United Tribes Technical College





SECTION 2

Trees and Woody Plants

College and university campuses are often defined by their canopy of trees, including unusual specimens and stately old landmark trees that remain in memory long after students graduate. The Century Oak at **Texas A&M University**⁴⁵ (TX) is one such example. This sprawling evergreen live oak is one of the best known of the 10,000 trees on the university's 5,200-acre campus. Another notable tree is a large-diameter post oak at **Harding University**⁴⁶ (AR), which sports a massive burl around its trunk and is known by all as the Pregnant Tree.

Unfortunately, many campus icon trees only make the news when diseased or dying. The Old Main Oak at **Eastern Illinois University**⁴⁷ (IL), a huge bur oak estimated to be 300 years old, was in decline for a decade and had to be taken down in 2014. In 2012, two students and a professor attempted to clone the tree to preserve its genetics, and published a poster describing their research. At **Purdue University**⁴⁸ (IN), an ailing horse chestnut tree—for decades a campus landmark and popular resting place—was cut down in 2009. Art objects were carved from its wood and sold as mementos.

Squirrels on Campus Take Steps to Avoid Sharing Nuts

For most of the past 19 years, biology professor Sylvia Halkin and her students at **Central Connecticut State University**⁴⁹ (CT) have studied the entertaining behavior of eastern gray squirrels on campus. A key finding: Squirrels apparently try to deceive other animals, including humans, when they conceal locations of nuts they cache to eat later, by digging and covering fake burying spots when hiding them. When students were observed (by the squirrels) looking for the nuts the animals had just buried, the familiar rodents shifted to craftier methods and hiding places. For example, they began hiding nuts under bushes where they would be difficult for students to find and access. More than 50 students have been partners with Halkin in squirrel studies over the years and most have presented their findings at regional and national scientific conferences. Two were co-authors of a 2008 article in *Animal Behaviour*, a prominent peer-reviewed professional journal. Also in 2008, Halkin was featured in NWF's *National Wildlife* magazine for her on-campus research. Three students appeared with Halkin and collaborators Professor Michael Steele and his students from **Wilkes University** (PA) in a 2006 episode of *Animal Planet*'s The Most Extreme show entitled "Pirates." Lately, Halkin's students are looking into how individual squirrels foraging together in the same area distribute their food caches around campus. In a recent interview, she commented, "Using the CCSU campus for wildlife studies makes it convenient for students to participate in original scientific research, and they have fun sharing the information they learn with fellow students as well as in formal scientific presentations. Answering questions from passers-by helps to educate the entire campus community about local wildlife."



An eastern gray squirrel in winter at
Central Connecticut State University
Photo: Tom Allison, CCSU student



Flying squirrels are nocturnal and rarely seen. They prefer mature trees with cavities for nesting and shelter.
Photo: Jean Scaraglino

In this section, the ecological role of campus landscape trees and other woody plants (shrubs, vines) is explored. For wildlife—such as birds, gray squirrels, flying squirrels, tree-climbing lizards, and more—trees are essential. They offer shelter and rest, escape from predators, foliage and fruits for food, and places to build nests. While native species are the preferred food for native insects (and by way of insects, sustenance for baby birds), non-native species of trees and shrubs still can provide much for wildlife.

Many colleges and universities regard their trees as more than improvements to campus aesthetics. Trees are sometimes labeled, used for field portions of biology labs, planted by students, and clustered into on-campus arboretums. Some schools even consider their entire campus to be an arboretum, usually with educational outreach efforts provided to showcase their tree “collection.”



Insects Prefer Native Fare⁵⁰

As summarized by **University of Delaware (DE)** entomologist Doug Tallamy, extensive research has demonstrated that the vast majority—around 90%—of insect herbivores (plant-eaters) are specialists, meaning they limit their host plants to a narrow range of species—primarily natives. Certain woody plants are champions among native food sources. The numbers here refer to species of butterflies and moths (primarily their caterpillars) supported by different types of trees and shrubs.

Oak 534	Birch 413	Pine 203
Willow 455	Blueberry 288	Rose 139

“Sometimes I tell myself, I may only be planting a tree here, but just imagine what’s happening if there are billions of people out there doing something. Just imagine the power of what we can do...”

– Wangari Maathai, 2004 Nobel Peace Prize Laureate and founder of the Green Belt Movement in Kenya

University of Delaware
Photo: Rick Darke



Tree Campus USA⁵¹

A program of the Arbor Day Foundation, Tree Campus USA recognizes colleges and universities that effectively manage their trees, engage the campus community in tree maintenance, and educate the campus and broader community on the importance of trees. As of April 2015, 245 campuses in the U.S. were certified. Find out if your school has been recognized at <http://www.arborday.org/programs/treecampususa/campuses.cfm>

To be recognized as a Tree Campus USA, the following five standards must be met:

- **Creating a tree advisory committee.** The tree committee represents diverse stakeholders including students, faculty, facilities staff, and a member of the broader community. It is charged with providing guidance for planning, approving a comprehensive tree plan, educating the campus community about trees, and building relationships with the community beyond the campus borders.
- **Developing a campus tree care plan.** The tree plan outlines policy and provides guidance on planting, maintenance, and removal of trees when necessary. It also features education goals for the campus community, and an outreach strategy to educate and to promote the importance of the campus forest.
- **Preparing an annual budget.** Campuses must allocate funds to support the campus tree care plan. The money can be used for purchasing trees, labor, and equipment; for maintenance; for funding education and communication strategies, and a campus tree inventory; or for paying fees to join relevant associations such as the International Society of Arboriculture, the Society of Municipal Arborists, and the state urban forest council.
- **Observing Arbor Day.** National Arbor Day is the last Friday in April each year (though many states observe Arbor Day according to their best tree-planting dates). Campuses are required to host an Arbor Day celebration, engaging students, faculty, and staff. This is a great opportunity to bring attention to the campus tree program, to get more people involved, and to continue to educate about the importance of trees on campus and in the community.
- **Hosting a service learning project.** This engages the student population with projects related to trees and can be part of a campus or community initiative.

FEATURED CAMPUSES

Emory University⁵² (GA)

At Emory University, all campus construction projects must abide by the university's No Net Loss of Forest Canopy Policy. Whenever a tree is removed, a sufficient number of trees must be planted in its place in order to maintain or exceed the original forest canopy of the campus.

The policy was created in 1999 when then-president William Chace noticed that trees were not being replanted adequately following campus construction. The University Architect, the Committee on the Environment, and Facilities Management joined forces to draft the new policy. It requires that prior to construction, the canopy expected to be lost is measured, and later replaced, if not on the exact construction site then elsewhere on campus. A recent University Hospital expansion led to the removal of 49 trees—many large and mature—which required more than 100 replacement trees to be planted at various campus locations.

If a project under construction is unable to replant the necessary trees on the site of the project, funds are taken from



Newly-planted magnolia tree with drip watering device
at Emory University
Photo: Kelly Weisinger

the project budget and placed in a “tree bank,” which pays for an annual tree planting. Both Emory’s main campus and its Oxford campus maintain separate tree banks, ensuring that trees are replaced appropriately at each site. Since 2006, campus canopies have been surveyed aerially every two years to track changes in tree cover. In 2012, approximately 58% of the main campus was covered by trees.

This replacement policy is “thought to be one of the most rigorous campus tree plans among universities across the country, providing a precise formula that measures the size of a tree and helps calculate the number of replacement trees that must be planted,” says John Wegner, a member of Emory’s Committee on the Environment and senior lecturer in environmental studies. “Most tree ordinances deal with tree loss and individual tree replacement,” Wegner added, “but our policy looks at it from a long-term forest perspective.”

Emory’s 740-acre main campus contains 306 acres of undeveloped space, including Lullwater Preserve, a 154-acre native Piedmont forest ecosystem. Emory’s canopy features dozens of native species including loblolly pine, chestnut oak, southern catalpa, American holly, tulip poplar, and winged elm. Despite its location in urban Atlanta, Emory harbors much wildlife. The Lullwater Preserve alone is home to about 175 species, including beaver, fox, otter, salamanders, seven turtle species, and more than 100 species of birds. Teams of staff and students regularly survey biodiversity in the preserve and offer suggestions to improve its ecological health. Students also are involved in the Tree Committee, which meets annually to review the No Net Loss Policy.

Utah State University⁵³ (UT)

As a graduate student at Utah State University (USU) in 2005, Ben Harris co-led a project to inventory all of the approximately 5,400 trees on campus, pinpointing the locations of each using a GPS device. Each tree was entered into a database and mapped using GIS (Geographic Information System) software. The resulting online, interactive map lets viewers find and click on a tree of interest and learn its common and scientific name, date planted (if known), diameter at breast height (when surveyed), exact geographic coordinates, and whether it’s in Utah’s Big Tree Inventory.

Harris was later hired by USU and worked as campus arborist for several years. Today, he runs a tree care company in the Logan, Utah area. As a student, Harris wondered if the tree inventory would be useful to students as a resource. He completed a Master’s thesis in 2010 on that question,



Using the online Campus Tree Tour for Utah State University, viewers can zoom in on specific tree locations, click the icon (green for conifers, yellow for deciduous), and see a photo of the actual tree with information about it.
Image: Utah State University

measuring the effectiveness of the online inventory as an educational tool for students in two woody plant courses. He found that it was a valuable supplemental resource not only for students, but also for the course instructors.

“It’s really important to study real trees in the outdoors, whether in a native or landscape setting. You get a much better appreciation seeing a tree in person than you do looking at it online or in a slideshow or book.”

— Ben Harris, Owner, Branch to Bud Tree Care and former USU student and employee

The inventory was used by Michael Kuhns, professor and Extension Forestry Specialist for the state, to create the USU Campus Tree Identification Tour which he released in 2012 (see illustration). Available as a printed brochure or online, the tour makes use of the original inventory with an interactive map that highlights 87 tree species. Kuhns published a similar tree tour for the lower campus of the **University of Utah**⁵⁴ in Salt Lake City.

Campus trees at USU are now a big draw for a wide variety of native bird life. Prior to settlement, the area was covered in sagebrush. Frank Howe, University Liaison, Utah Division of Wildlife Resources, uses the campus canopy as an outdoor lab for students in his applied avian ecology course. His students have documented many classic western species including red crossbill, western tanager, red-naped sapsucker, Oregon junco, and bohemian waxwing. Tree-roosting bats have been observed as well.

2A CAMPUS ARBORETUMS AND BOTANICAL GARDENS

Many campuses have designated places for special gardens or arboretums where collections of trees and shrubs are featured. The focus often is on horticultural varieties, but native species are widely planted or conserved.

The Georgeson Botanical Garden at the **University of Alaska Fairbanks**⁵⁵ (AK), perhaps the most northerly campus garden, specializes in plants that can withstand the university's subarctic climate. UAF staff and students conduct research on native Alaska plants for use in home and commercial landscapes. Woody examples include Sitka alder, Alaska blueberry, shore pine, and northern serviceberry.

The Botanical Gardens at the **University of Rhode Island**⁵⁶ (RI), created in 1940, cover 4.5 acres and showcase many indigenous species and sustainable landscaping practices. The gardens are an educational resource for students, faculty, staff, and the community, hosting about 3,000 visitors each year including school children. Among the plantings is the Rhody Native garden, featuring genetically local native plants, which was designed and planted with help from URI students. Garden natives include rhododendron, azalea, viburnum, blueberries, leatherwood, columbine, spicebush, sweetfern, and more.



The Botanical Gardens at the University of Rhode Island include many native plants, including purple foxglove (tall flowering spike).
Photo: University of Rhode Island

Hand weeding, mulching, composting, and diverse plantings eliminate the need for pesticides. Classes using the gardens come from many disciplines, among them horticulture, biology, entomology, and art.

At **The Evergreen State College**⁵⁷ (WA), there are ten Teaching Gardens on campus that follow sustainable themes: no pesticides used, native species preferred, no invasives, wildlife-friendly, and with cross-cultural connections. Students helped design and install many of the gardens, which teach through interpretive signs and plant labels. At least two of the gardens include woody plants. The Basket Garden includes western red cedar, red osier dogwood, willow, and other species that were used by First Peoples in the Pacific Northwest for making baskets. The Post-Glacial Forest Garden contains trees that grew in the centuries following the melting of the last Ice Age glaciers, as evidenced by pollen preserved in lake sediments. Species include silver fir, red alder, paper birch, quaking aspen, dwarf arctic willow, and mountain hemlock.

At a number of colleges and universities, the entire campus is considered an arboretum due to an extensive and diverse tree canopy. Often the trees are labeled and used for education. The 92-acre lower campus of the **California University of Pennsylvania**⁵⁸ (PA) is regarded as a whole-campus arboretum, with a map of tree locations available in print and online. The collection, which is used for a variety of courses, features more than 100 species including representatives of most indigenous Pennsylvania trees.



Group gathers around a massive black walnut at the California University of Pennsylvania.
Inset: Tree label for Kentucky coffeetree.
Photos: David J. Eagan

FEATURED CAMPUSES

Agnes Scott College⁶⁰ (GA)

Agnes Scott College's 100-acre campus is located in Decatur, about six miles from downtown Atlanta. Home to around 900 students and some of the state's oldest trees, the entire campus is a nationally recognized arboretum with a canopy of more than 2,000 trees made up of 40 species. These include many native Georgia species such as sassafras, persimmon, overcup oak, water oak, American hornbeam, southern sugar maple, American holly, and longleaf pine. In 2013, the arboretum was accredited through the Morton Arboretum Register of Arboreta, earning a Level 1 certification.



The urban forest blends with buildings at Agnes Scott College.
Photo: Jerry Mucklow, Mucklow Photography, Agnes Scott College

The Agnes Scott Arboretum invites visitors to reflect on the complex connections between trees and humans and the integral role that trees play in our lives.

– Agnes Scott Arboretum website

An educational walking tour, developed by student Kimberley Reeves in 2012, integrates the arboretum into the college's liberal arts curriculum. Featuring trees at 19 locations across campus, each stop on the tour highlights a tree-related topic



Tree tour label with QR code at Agnes Scott College.
Photo: Jim Abbot, Agnes Scott College

Arboretum Quest:

To find college and university arboretums in any state, search the Morton Register of Arboreta,⁵⁹ which is part of ArbNet—"the interactive community of arboreta"—sponsored by the Morton Arboretum in Illinois.

plaques at each location (readable by smart phones and tablets) allow students, staff, and visitors to access the written and recorded information via their mobile devices. Audio portions were recorded by staff, students, and even the college president. All parts of the tour also can be accessed through the Agnes Scott Arboretum website.

"The Agnes Scott urban forest is an important aspect of the college; it supports the college's core mission and its sustainability goals, as well as contributing to its widely recognized aesthetic appeal. In addition to the ecosystem services it provides and the educational opportunities furnished by its expansiveness and ecological diversity, the campus forest is a historic and enduring part of the Agnes Scott community."

– Claudia Mitchell, Office of Sustainability intern

Agnes Scott has received Tree Campus USA certification annually since 2012. Among the criteria for certification is implementation of a tree care plan and creation of a tree care advisory committee. This committee, made up of students, faculty, staff, and community members, advises the college on maintenance and management of its urban forest canopy.

Aligned with 2014 rules set by the City of Decatur Tree Ordinance, the college aims to ensure no net loss of tree canopy on campus. The most recent data collected June 2014 using the U.S. Forest Service iTree Canopy tool determined that Agnes Scott's tree canopy currently covers 53.6% of the 100-acre campus. This canopy provides habitat linkages for species such as red-tailed hawks, Cooper's hawks, red-shouldered hawks, great blue heron, American egrets, various songbirds, squirrels, muskrats, opossums, gopher tortoises, and snapping turtles. In addition to the tree canopy with its varying heights and "edge" habitat, the college's retention pond and its surrounding natural forest provide shelter for wildlife.

Furman University⁶¹ (SC)

In 2014, the George G. Willis Jr. Arboretum at Furman University was accredited as a Level I arboretum through The Morton Register of Arboreta. The 745-acre, on-campus arboretum was recognized for exemplary tree conservation, species diversity, and educational resources and events. It features mostly native trees including American sycamore, southern red oak, bald cypress, eastern hemlock, and American elm. The arboretum is home to many wildlife species such as the American and southern toads, eastern mud turtle, green anole lizard, northern water snake, copperhead snake, beaver, southern flying squirrel, white-footed mouse, and several bird species including the belted kingfisher, great blue heron, and green heron. Its rarest resident is the state and federally endangered wetland plant, the bunched arrowhead (*Sagittaria fasciculata*).

Kylie Stackis, a 2014 Furman graduate and fellow at the Shi Center for Sustainability is quoted in a press release about the accreditation: “Furman’s designation as an arboretum speaks to our commitment to the landscape as a means whereby people may learn and appreciate the value and services trees impart. Landscapes have the power to shape the identity of a place, and Furman would not be the same institution without its trees.”

Faculty and staff on campus use the Willis Arboretum as an outdoor classroom for several courses including Empirical Methods in Economics, Environmental Science, Biology and the Environment, and Remote Sensing. The arboretum is managed by the Furman Trees Committee comprised of students, faculty, grounds staff, and community partners. The committee follows a management plan to monitor and maintain tree health and safety, and to increase species diversity with a focus on local species. Highlights of the plan include ideas for expansion, the creation of a website, the implementation of new trails, and the installation of interpretive signs to encourage guided “tree walks” for the campus and local community.

The arboretum is named for George G. Willis Jr., a 1948 Furman graduate whose enthusiasm for the campus landscape led to a financial commitment to ensure the arboretum’s future. Furman has been recognized as a Tree Campus USA by The Arbor Day Foundation each year since 2008. Recently, Furman’s sustainability coordinator, Yancey Fouche, expressed her hope that “guests will come to walk our campus to explore the forests and tagged trees, and take advantage of outreach opportunities as they are developed.”



Students and staff attend a tree planting event at Furman University.
Photo: Furman University

University of Delaware⁶² (DE)

The University of Delaware’s Botanic Gardens, administered through the College of Agriculture and Natural Resources, is composed of twelve distinct gardens totaling 15 acres on the 2,011-acre main Newark campus. Clark Garden, the first to be established in 1973, is located in front of Townsend Hall, the college’s home. Others, including a native garden and a grassland restoration research site, were added over the years, with formal designation of the Botanic Gardens occurring in 1992. As far back as the 1950s, specimen trees and other plantings were used to support coursework, and today’s gardens serve as experiential learning labs for students in more than 45 different courses, including botany, plant pathology, landscape design, insect field taxonomy, wildlife research techniques, ornithology, herpetology, and drawing. The gardens also host workshops and provide information to community members on native gardening, sustainable landscaping and related topics.

“It’s fantastic to be able to see the actual plants we’re studying in class out in the gardens, as they reveal so much more than an image. The gardens also provide a great place to teach about and collect insects in an outdoor lab setting.”

– Melinda Zoehrer, Assistant Director, University of Delaware Botanic Gardens



Male monarch butterfly nectaring on swamp milkweed (*Asclepias incarnata*) at the University of Delaware.
Photo: Melinda Zoehrer

The gardens feature many native tree species including pawpaw, persimmon, American yellowwood, blackgum, American hickory, white ash, sweet birch, river birch, and pitch pine. A wide variety of birds and “herps” have been sighted there: woodcocks, Virginia rails, northern waterthrush, green frogs, bullfrogs, garter snakes, black snakes, and Eastern painted turtles. Numerous butterflies and moths also have been documented including Eastern swallowtail, American lady, painted lady, and cloudless sulphur.

Located close to the Botanic Gardens is a 35-acre pristine natural area called Ecology Woods. There, where access is restricted, students study the effects of habitat fragmentation and other stresses on threatened species. Ecology Woods is the site of the longest (more than 35 years) continuous ecological field study in North America on the population health of forest songbirds, including the wood thrush. Research by more than 100 undergraduate and graduate students over the last three decades has provided important insights on the relationship

between habitat size and change in songbird populations over time. A recent graduate student project looked at nesting parasitism of wood thrush nests in Ecology Woods (with 20 birds) and elsewhere in Newark, finding that wood thrush nest success was heavily affected by cowbirds, which lay their eggs in the nests of other birds. Other research efforts include determining if insects are more attracted to native plant cultivars or to wild native plants, and which native plants provide pollinators with the most nutritious pollen and nectar.

The Botanic Gardens and Ecology Woods offer year-round internship opportunities for students to gain hands-on research experience and skills for working in public gardens. Internships not only help the university maintain the gardens and advance research on native plant and animal species, they also provide the experience needed for students to be successful in their careers.

Michigan State University⁶³ (MI)

For decades, Michigan State University (MSU) has considered its entire campus an arboretum. Besides an extensive canopy of trees, the 2,100-acre East Lansing campus features five curated gardens and landscapes, including the W.J. Beal Botanical Garden, the Horticulture Gardens, and a seven-acre plot of land managed by the Fisheries and Wildlife Student Club.

MSU has been preserving tree and plant species and adding new trees since the campus was founded in 1855. When Professor William James Beal came to MSU in 1874, he began a small nursery with seeds from around the world. MSU has dated some of these still-living original trees, along with a ginkgo that was given to the campus in 1863 by Professor Asa Gray of Harvard University. Past MSU presidents have valued green space and preservation of campus natural places, a tradition that continues to the present day.



Painted turtle basking in the sun.
Photo: Gail Durant

Recently, MSU has undertaken a tree and woody plant identification program. So far, 25,000 trees from 1,900 different species across campus have been identified and mapped, with a major emphasis on native Michigan tree and plant species. The university has started a heritage tree program, collecting seeds to preserve the genetics of native trees growing on campus and throughout Michigan. A tree nursery is dedicated to propagating these important species.

In addition to the all-campus arboretum, the five-acre W.J. Beal Botanical Garden has an important collection of native trees and shrubs, and is a living laboratory for teaching, research, and outreach. Its specialty gardens feature economically important plants and species that are threatened and endangered in Michigan. Another area rich in woody plants is the six-acre Clarence E. Lewis Landscape Arboretum on the south side of campus. Dedicated in 1984 as a “learning experience in the making,” the arboretum is used by students who study landscape development. The late professor Lewis is remembered for saying, “Look up to enjoy what is overhead, look through the foliage ... Remember that trees can do so many things in a garden.”

Within the gardens, MSU also has a Native Bee Hotel, which houses native bees that are critical for pollinating the wide variety of plants on campus. Of the 400 native bee species in Michigan, the bee hotel shelters more than 30 species.

Campus trees are used extensively for research by MSU students and local school children. The state of Michigan requires elementary students to prepare a leaf collection of different species of trees. Thus, in early fall, it is common to see children searching for and pressing a wide variety of leaves.

University of Idaho⁶⁴ (ID)

On the south end of the University of Idaho campus, occupying about 60 acres, are two places dedicated to plant collections. The original 14-acre parcel, now named the Shattuck Arboretum, was begun on a bare hillside in 1909 and today is the largest and densest patch of forest in the city of Moscow. This grove of mature trees is thought to be the oldest university arboretum west of the Mississippi River, notes Paul Warnick, the arboretum horticulturist. Among its native arboreal gems are large specimens of American beech, Canada hemlock, California incense-cedar, and giant sequoia.

A second parcel of 45 acres, the University of Idaho Arboretum and Botanical Garden, is landscaped in a more traditional way, with many native western woody species. Over the years, its plantings and water features have attracted coyotes, squirrels,



Swainson's hawks are native to the western half of the U.S.
Photo: Terry Spivey

cottontail rabbits, muskrats, and an occasional wayward moose. Warnick also noted that for a couple of winters a group of river otters visited the ponds for a few days, where they ate lots of fish. Birdlife is abundant. Of 409 bird species in Idaho, 153 have been sighted on campus, mainly in the arboretum and the botanical gardens. Species reported in Fall 2014 include Swainson's hawk, western bluebird, Wilson's warbler, and pine siskin. In 2011, a butterfly garden was installed that has attracted a wide range of butterflies and other pollinators, as well as calliope and ruby-throated hummingbirds.

“In addition to opportunities for plant study and observation, the Arboretum provides a unique site for observing resident and migratory birds. The ever-changing habitats among the maturing ornamental plants provide food, nesting sites and stopping points for common and uncommon songbirds and raptors throughout the year.”
– “About the UI Arboreta” website

Many academic disciplines use the sites for course work including biology, entomology, landscape architecture, weed science, restoration ecology, and horticulture. Students in a plant pathology course, for example, conduct a population survey of sunburst lichen on trees in the arboretum, using the lichen as a practice organism for field pathology studies. A small corner of the Botanical Garden is being used as a study plot for a future Palouse Prairie restoration, to be planted on an adjacent parcel.

2B CARBON SEQUESTRATION VALUE OF TREES ON AND OFF CAMPUS

Because living trees are effective long-term repositories for carbon, colleges and universities can increase carbon sequestration on campus by planting trees and protecting existing trees and forests. Trees can be part of an overall strategy for campus greenhouse gas reduction.

Trees convert CO₂ from the atmosphere into wood, leaves, and sugars through photosynthesis. Thus, carbon storage is a natural process for trees, along with their ability to provide oxygen. By dry weight, trees are about 50% carbon. The amount of CO₂ that a tree can store as wood depends on the species, size, and health of the tree. One method to determine how much carbon trees can sequester is to use i-Tree⁶⁵, a tool created by the U.S. Forest Service for assessing and managing community forests.

The carbon sequestered by a university's trees, forests, grasslands, or unplowed agricultural lands can be used to offset some of its campus emissions.⁶⁷ In a 2006 report, the **University of Michigan**⁶⁸ (MI) estimated that its 5,800 hectares of forests and natural areas statewide can sequester 15,000 metric tons of CO₂ per year—a small percentage of its annual campus total—based on a per-hectare average of sequestration. At **Auburn University**⁶⁹ (AL), a graduate student conducted an inventory of trees on campus in 2010. He calculated that the 8,236 trees on campus hold 2,000 tons of carbon and can sequester 86 additional tons of carbon per year. While several other U.S. colleges and universities have supported projects to measure the capacity of campus trees to serve as carbon sinks, the percentage of total campus emissions mitigated by the trees is relatively small.

FEATURED CAMPUSES

Warren Wilson College⁷⁰ (NC)

With a mix of urban-style canopy and wild forests on the edge of the Blue Ridge Mountains, Warren Wilson College includes carbon sequestration in its long-term mitigation strategy to reduce campus greenhouse gas (GHG) emissions. The college's 2009 Climate Action Plan calls for sustainable forestry practices on its contiguous 700 acres of mostly forested lands, of which 59 acres form the central campus. One action item, completed in 2013, was to assess the carbon sequestration capacity of the central campus canopy. With support from the North Carolina

Aggie Replant: Students Plant Thousands of Trees in Texas⁶⁶

The nation's largest student-run tree planting project, at **Texas A&M University (TX)**, has been reforesting parts of the state for more than 20 years. Aggie Replant began in 1991 with 40 volunteers who planted a few hundred trees in parks and public places in the surrounding cities of Bryan and College Station. Today, Aggie Replant has become so popular it has to turn away volunteers for its annual Replant Day held in October. And since 2013, it has added a February planting event to help reforest Bastrop State Park, 80 miles away, which was decimated by a forest fire in 2011. In February 2014, 600 volunteers helped plant over 11,000 trees at the park, primarily loblolly pine. While no calculations have yet been done, the tens of thousands of trees planted by the students sequester an increasing number of tons of carbon every year.

Forest Service, Warren Wilson's landscaping crew of staff and students conducted an inventory of trees in the central campus, which is composed of two land types—landscaped/built grounds (39 acres) and semi-intact forest (20 acres).

In the landscaped areas around buildings, 1,153 trees were surveyed and 135 different species identified. Among the most common species were eastern hemlock and flowering dogwood, both natives. In the 20 acres of intact forest, trees in 20 representative sample plots were measured, showing an estimated 8,760 trees in the parcel. The most common were eastern white pine and tulip tree. The species, size, location, and overall health of each surveyed tree were noted. Using iTree software and the Tree Carbon Calculator of the U.S. Forest Service, students estimated carbon storage and sequestration potential as well as the overall value of the forest. In all, more than 50 students participated in the effort, logging more than 600 hours. Faculty from geographic information systems (GIS) and sustainable forestry programs consulted on the project and presented the results in their courses.

Given that dry wood is approximately 50% carbon by weight, it was estimated that trees in the 39-acre landscaped/urban part of the campus store around 480 tons of carbon in their wood. They add, or sequester, another 12 tons annually. Carbon storage in the densely forested 20-acre parcel, in contrast, is an estimated 1,940 tons, with annual carbon sequestration of about 56 tons. Combined, annual sequestration is 68 tons. To put this



Student measuring the circumference of a tamarack tree at Warren Wilson College.

Photo: Linden Blaisus, WWC Class of 2014

in perspective, the annual sequestration on the 59-acre central campus is equivalent to the carbon emissions of the college for 6 days, or about 1.6% of its annual total. This does not include, of course, the adjacent 630-plus acres of campus lands that are primarily forest-covered.

“Staff and students on the landscaping crew applied their academic coursework in environmental studies, biology, forestry, math, and GIS to the practical work of measuring, identifying, analyzing, and reporting on the carbon value of the core campus forest. In doing so, they have advanced the national dialogue regarding the importance of urban forests.”

– Stan Cross, Interim Director, WWC Environmental Leadership Center

The tree inventory has been used to create a campus tree management plan focused on increasing sequestration value and helping the college reach its goal of an 80% reduction in greenhouse gas emissions by 2020. “The inventory,” notes Tom LaMuraglia, Landscaping Supervisor, “has opened our eyes to the value of a relatively intact forest canopy in a semi-urban situation.”

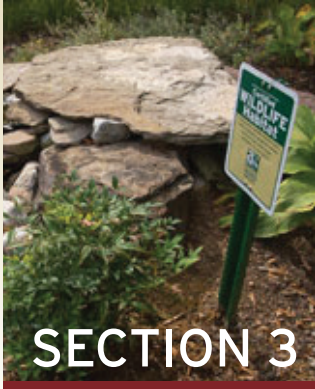
Allegheny College⁷¹ (PA)

The Bousson Environmental Research Reserve, located a few miles east of the Allegheny College campus, has 283 acres of woodlands, ponds, streams, and wetlands. It is home to many wildlife species and provides abundant outdoor learning opportunities for students. The reserve has native trees including sugar maple, black cherry, American beech, and hemlock. It provides habitat for beaver, white-tailed deer, and red fox, plus a wide variety of birds and other animals. Prior to college ownership, the property was used as a farm, cheese factory, fishery, and sugar maple plantation. Allegheny College acquired the property in 1935 and has maintained it as an undeveloped recovering forest, reserved for research. For many years, professors have engaged students at Bousson in investigations on the carbon sequestration of trees, soil types and organic matter, aquatic habitats, and local hydrology.

“Knowing this information about the college forest has been useful for our greenhouse gas inventory and allows us to take advantage of nature’s carbon storage to reduce our emissions.”

– Kelly Boulton, Sustainability Coordinator

As a charter signatory of the American College and University Presidents’ Climate Commitment, Allegheny conducts periodic greenhouse gas inventories. The first inventory was done in 2001, and the inventories include the carbon storage capacity of the Bousson Reserve. To find how much carbon the reserve’s forest can store, Allegheny’s environmental science students divided the acreage into vegetation types and calculated how much carbon each type can sequester. Trees were measured (diameter at breast height) and cored (a method for extracting a sample of the growth rings) to quantify growth. The data were used to calculate biomass changes over time. In the reserve, an estimated 627 metric tons of carbon dioxide equivalent is stored annually by the trees (equaling about 170 tons of carbon or 4% of annual campus emissions). As noted by Professor of Environmental Science Richard Bowden, “Students learned that forests can play an important role in reducing atmospheric CO₂ pollution, but also that reliance on natural ecosystems alone cannot solve the climate change problem.”

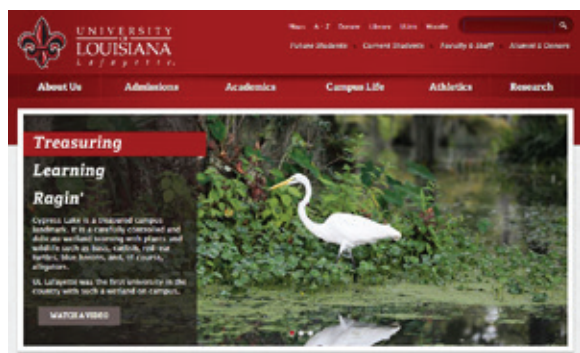


SECTION 3

Natural Areas on Campus

Campus natural areas are defined as any “wild” parcels within campus boundaries, composed mainly of native vegetation, whether natural (pre-settlement) or restored, large or small. These include wetlands, ponds, shorelines, rivers, forests, meadows, and prairies that are managed primarily for their “wildness.” Stormwater ponds and filtration systems have been installed and wetlands have been restored on many campuses, becoming magnets for wildlife. At some schools, the built parts of campus take up only a small part of the whole. At others, the wild spots are islands of nature surrounded by buildings, roads, and lawn. Many natural areas feature educational signs or trails and have recreational uses, and their close proximity to classroom buildings offers ready access for student research and learning experiences.

“Natural places are among the more scenic and photogenic places on campus. During 2014-15, one of the alternating photos on the homepage of the **University of Louisiana at Lafayette**⁷² (LA) featured a great egret with a caption about the university’s Cypress Lake and its wildlife, which includes alligators. Cypress Lake, according to Kathleen Thames, Associate Director of Communications, is a two-acre microcosm of the nearby Atchafalaya River basin. It was formed decades ago when an existing cypress tree grove was flooded. Today, the small lake is encircled by university buildings.



Roughly half of the **College of Menominee Nation’s**⁷³ (WI) 60-acre campus is natural area, composed of forest, wooded wetland, and fields. Part of the forest is old growth, with towering white pines, red oaks, and many other northern trees.

The forest also has a rich understory of shrubs, ferns, mosses, and wildflowers. An eight-sided shelter with interpretive panels about the Menominee Forest was installed along a footpath in 2014, and deeper in the forest is a 100x100-meter study plot used by students for a forest inventory project. Animals seen around the campus include black bears, sandhill cranes, bald eagles, red foxes, and porcupines.

Saint John’s University⁷⁴ (MN) is a school where, unlike most colleges and universities, the vast majority of its campus is earmarked for nature. Its central campus occupies only 80 acres out of a total of 2,740. As described on the university’s website, campus lands include “wetlands, several lakes, an oak savanna, a restored prairie and hiking trails that wind through an extensive pine and hardwood forest.”

FEATURED CAMPUSES

Ithaca College⁷⁵ (NY)

2014 marked the ten-year anniversary of the Ithaca College Natural Lands (ICNL) program. The ICNL is a four-parcel conservation reserve system totaling 560 acres of mostly hilly wooded lands that is collaboratively managed by IC students, faculty, and staff. The four preserves are South Hill Natural Area East and South Hill Natural Area West—both adjacent to campus—and the Ithaca College Natural Resource Reserve and Bob Robinson Family Reserve, each located a few miles away. The latter two are covered ahead in Section 4—remote campus properties.

More courses every year use the Natural Lands as their outdoor classroom, reaffirming the overarching value of the reserves as educational working landscapes. The core team of students managing the Natural Lands on a day-to-day basis now has 20+ members, with paid interns mentoring apprentices enrolled for course credit in the Student Intern Training Program.

– Ithaca College Natural Lands website, 2014



Students learn to identify sugar maple trees at Ithaca College Natural Lands reserve.
Photo: Ithaca College

The 365-acre South Hill East reserve provides an easily accessed teaching and research site (and popular place for outdoor recreation), and is the home for a student-run, non-timber forest management initiative yielding products including maple syrup, mushrooms, and honey that are sold on campus and in local restaurants. The 67-acre South Hill West reserve also supports teaching and research. Both places feature many native woody species including American crabapple, pitch pine, black chokeberry, scarlet oak, swamp white oak, and dozens of species of wildflowers, sedges, and ferns. Totalling 432 acres, these two properties are a significant part of the overall 668-acre campus.

“South Hill is an important piece of local habitat for wildlife, and we have found numerous ways to coexist with our resident fauna while also satisfying our primary educational mission.”

– Jacob Brenner, Assistant Professor, Environmental Studies and Sciences, and Faculty Manager of Ithaca College Natural Lands

In 2009, the Volunteer Stewards Program was established to monitor activities at the South Hill Area East and West reserves. Student, faculty, and staff stewards, numbering between 20 and 40 each semester, choose a segment along the more than five miles of established trails on the two reserves and monitor their zone for changes, including the growth of invasive plants. In serving as the “eyes and ears” of the ICNL management staff, the stewards benefit from learning the natural history and ecology of their zone. Stewards participate in training sessions each semester on topics such as forestry, birding, and trail maintenance. They, in turn, educate others in the campus community about the ICNL system, including

the plants and wildlife that call it home. To date, the Volunteer Stewards Program has played an important role in notifying the ICNL management staff and Ithaca College about important happenings in the reserves, including incidents of vandalism and illegal hunting, plant invasions, plant phenology, and wildlife behavior. Through the use of motion-sensing infrared camera traps, Spring 2014 wildlife sightings included coyotes, skunks, gray and red foxes, chipmunks, whitetail deer, and even a bobcat.



The red fox (here with kits) is expanding its range into urban areas across the U.S.
Photo: Simon Drabble, 2012

University of California, Santa Barbara⁷⁶ (CA)

The University of California, Santa Barbara (UCSB), campus sits on the Pacific coast and harbors a variety of habitats that are home to a great diversity of plant and animal life. Natural communities include coastal dune, salt marsh, coastal lagoon, coastal sage scrub, native grassland, and oak woodland. These little pockets add up to about 250 of the university’s 1,020 acres.

UCSB is dedicated to maintaining and restoring campus natural places and educating the community about their importance. Over the past decade, 17 interpretive signs have been installed to mark these areas and to explore topics such as whale migration, vernal pools, and bioswales. Three signs highlight completion of the San Clemente Stormwater Management and Habitat Restoration Project, covering the



Interpretive sign at UCSB's San Nicolas Wetland, with Lisa Stratton, right, Director of Ecosystem Management, and student Jenna Driscoll, both from the Bren School of Environmental Science & Management.

Photo: Division of Institutional Advancement, UCSB

area's natural history and highlighting one of its endangered residents, the southern tarplant, a yellow-flowered member of the daisy family. From initial concept to finished product, the signs take approximately six months to create. Funding comes in part from UCSB student fees, via the Associated Students Coastal Fund, a non-profit organization. Students play a central role in the development and installation of the interpretive signs, helping write and edit their contents with fellow students and community members.

Many students also work with the UCSB's Cheadle Center for Biodiversity and Ecological Restoration on campus restoration projects. The Cheadle Center offers an introductory field skills course to instruct students on techniques and tools for working in campus natural areas. The students then are qualified to work on ecological restoration activities such as seed collecting, plant propagation, site preparation, planting, erosion control, and non-chemical weed control.

Wildlife sightings at UCSB natural areas are an everyday delight. A diverse avifauna includes such wetland birds as great blue herons, great egrets, snowy egrets, black-necked stilts, long-billed dowitchers, double crested cormorants, brown pelicans, and terns. Birds of prey—white-tailed kites, red-tailed hawks, and red-shouldered hawks—also call campus home, along with songbirds like black phoebe, common yellowthroat, and song sparrow. Reptiles include gopher snake, ringneck snake, western fence lizard, alligator lizard, and blue tailed skink. Common mammals are ground squirrels, brush rabbits, and gophers. Bobcats and coyotes are occasionally seen.

"Because UCSB is a learning institution set in such a unique coastal environment, we felt it was particularly important to interpret these remnant examples of native and restored habitats as well as our techniques for managing the impacts of development."

— Lisa Stratton, Director of Ecosystem Management, Cheadle Center for Biodiversity and Ecological Restoration

A Wild Place of Their Own

Students in the Fisheries & Wildlife Club⁷⁷ at **Michigan State University** (MI) own and manage their own special corner of MSU's campus—a 7.5-acre parcel with upland forest, meadow, prairie, and a pond. The club holds frequent stewardship workdays for such tasks as removing invasive species, improving habitat, and maintaining the public hiking trail that runs through the property. A Management Committee develops and implements management plans for the land and wildlife. In recent projects, students created cover for small mammals and installed bat houses and wood duck boxes around the seasonal pond. Members conduct wildlife surveys on the property by trapping small mammals, mist-netting songbirds, and practicing other field methods.

The F&W Club had its origins in 1950 and continues a 64-year tradition of providing opportunities for students to enrich their education with hands-on research, outdoor activities, and educational programs. The club has 50 to 70 active members and is a vibrant part of the MSU campus. One of its most popular activities is the twice-yearly River Clean-Up, in which 80-100 volunteers help maintain the stretch of the Cedar River that runs through campus. The club's 2014-15 president, Becca Blundell, notes "we not only get our club members involved, but others as well—from student organizations, fraternities, and the general MSU and East Lansing community. We recycle 99% of the trash collected, including around 70 bikes that are hauled out of the water at each event."

University of West Alabama⁷⁸ (AL)

In 2004, the University of West Alabama (UWA) initiated a restoration project to increase species richness at its remnant native Blackland or Black Belt Prairie, which occupies 70 acres on campus. Less than one percent remains of the original Blackland prairies, making them one of the state's rarest ecosystems. Prescribed burning is one of the methods used to encourage long-term prairie ecosystem development. After an initial series of annual burns, the prairie is now burned every three years, most recently in February 2014. Fire season starts after the first hard freeze and continues until early February, a time when much of the prairie community lies dormant.



Blackland prairie in bloom at the University of West Alabama.
Photo: Doug Wymer



Controlled burn of the Blackland prairie at the University of West Alabama.
Photo: Curt Skipper

The prairie is home to many native plants including purple prairie clover, standing cypress, compass plant, and scaly blazing star. Birds seen include bluebirds, grasshopper sparrows, and northern harriers. Bluebird boxes are located throughout the prairie and counts are conducted each season.

UWA conservation and field biology students, faculty, and staff are active participants in the restoration, helping with the burns, collecting and planting native seeds, and monitoring the study plots.

UWA, in collaboration with The Nature Conservancy, established the Black Belt Conservation Research Institute in 2007 to raise awareness of the region's prairies and to encourage protection and restoration. Research findings are being applied to restore abandoned pastureland to native prairie across western Alabama. In summer, BBCRI hosts regular prairie strolls for visitors to learn about the blooming plants and unique geology that make the Black Belt prairies possible. "UWA's prairie is the only Blackland prairie that is accessible to the public in Alabama. With trails throughout, it's a great resource for both the campus and the community," says Lee Stanton, BBCRI Director.

Speckled Kingsnake⁷⁹

The Blackland Prairie is home to three species of kingsnakes: speckled, prairie, and eastern. Their populations are declining and survival is threatened because more than 99% of an estimated 355,000 acres of the original Black Belt prairie has been lost to agriculture and other development. But in healthy prairie remnants, the kingsnakes thrive on small rodents, bird eggs, lizards, and other prey.



Speckled kingsnake
Photo: USFWS

University of South Florida⁸⁰ (FL)

Situated across a road from the main campus in Tampa, the Forest Preserve at the University of South Florida offers 500 acres of wild lands for study and recreation. The preserve harbors a variety of native animals and plants, many of which are rare or fire-dependent. The site consists of dry sandhill and wetland ecosystems, which are used by students in a dozen different courses including plant ecology, hydrology, population biology, archeology, and herpetology.

In a typical year, some 15-20 undergraduate students also gain field experience in unstructured coursework research at the preserve. Past topics included gene flow and speciation in *Liatris* (blazing star) and competition between plants and animals. Field research by graduate students has led to many theses and dissertations, with ongoing projects focused on the effects of controlled burns and on threats to the gopher tortoise. Community wildflower walks and an annual Christmas Bird Count are held at the preserve.



Trees, ferns and wild iris (in bloom) in one of the wetlands in the Forest Preserve at the University of South Florida.
Photo: Anne C. Schmidt

Lists of plants and the resident and migratory animals found in the preserve are available online. Here is a wildlife sample: Florida softshell turtle, pine woods tree frog, Florida crowned snake, southeastern pocket gopher, river otter, southern flying squirrel, swallow-tailed kite, prothonotary warbler, red-shouldered hawk, and Carolina wren. The preserve shares a border with Lettuce Lake County Park, where more than 150 species of birds have been spotted. And safeguarding the area for future generations of students, the USF Master Plan stipulates that the Forest Preserve be protected from development.

Documenting and Sharing “The Wild” on Campus

Although many colleges and universities protect their natural and wild places, it is hard to find readily available lists of the resident and migratory birds, mammals, plants, and other wild species observed in those areas. In NWF’s view, keeping such lists—and posting them online—is one of the best ways to publically acknowledge the value and importance of the non-human denizens of campus and to make the information widely accessible.

Such lists are posted for species at the Lakeshore Nature Preserve at the **University of Wisconsin-Madison**⁸¹ (WI). The Preserve is made up of several natural areas which collectively cover 300 acres within UW’s 900-acre total. Diverse habitats include forests, fields, a restored prairie, marshes, and four miles of Lake Mendota shoreline. Both the UW Preserve and the Friends of the Lakeshore Nature Preserve organization maintain websites with many lists of the preserve’s mammals, birds, amphibians, insects, wildflowers, and trees.

The most detailed information is on birds. During more than 25 years of observation, 255 species have been seen, with around 70 species confirmed nesting there. The latest breeding bird survey was conducted in 2013-14 by Roma Lenahan, a Friends volunteer, with the number of nesting species close to the total found in her previous 2000-02 study. Some of the lists of species in the preserve have been made by UW students, which is a great way for them to make important contributions to the campus knowledge base. Other recent wildlife sightings in the developed parts of the campus include a den of red foxes and a pair of red-tailed hawks which nested on a building. A “hawk-cam” on the nest allowed viewers to watch the hatching, growth and antics of the pair of nestlings.



An adult barred owl – an uncommon resident in urban Madison – perches near its nest in 2014 in the Lakeshore Nature Preserve at the University of Wisconsin-Madison.
Photo: Arlene Koziol

3A STORMWATER MITIGATION STRATEGIES THAT PROVIDE WILDLIFE HABITAT

Over time, demand for growth has led most colleges and universities to turn to their parcels of undeveloped land, replacing them with buildings, sidewalks, parking lots, and other structures with impervious surfaces. Managing runoff from snowmelt and storms is an essential task at these and all campus properties. The aim in most places is to route runoff to the nearest drainage feature, channeling it away as quickly as possible. But water is essential to life, and campus landscape designs and features that slow and capture rainwater are providing important refuges for wildlife.

Not surprisingly, catchment areas, including bioswales, that retain runoff and support native plants adapted to wetland conditions attract the widest range of species. A bioswale was one of several components of a rainfall mitigation strategy at the Charles David Keeling Apartments on the **University of California, San Diego**⁸² (CA) campus. Earning a 2012 award for innovative landscape design, the Keeling Apartments—named after the first scientist to measure the steady rise of CO₂ in the atmosphere, now called the Keeling Curve—the bioswale receives and filters drainage from the building's green roof.

Another popular approach to enhancing rainwater infiltration is to create rain gardens, typically set in artificial depressions in the ground. These can be a few to dozens of yards across, receiving runoff directed from roofs or paved surfaces. Layers of sand or gravel underlie the sites, with soil and water-tolerant plants on top. The layers of media and the plants filter out sediments and pollutants, allowing water to percolate slowly into the groundwater or nearby surface waters. A rain garden installed in 2011 at **Raritan Valley Community College**⁸³ (NJ) helped the college earn “River-Friendly” recognition. Located at the south entrance to campus, the garden is filled with native plants that help slow down and filter runoff before it enters the Raritan River. It is now one of the featured stops on RVCC's campus Green Tour.

Launching new practices to mitigate runoff doesn't always come easy, notes David Wilber, a landscape architect at **Michigan State University**⁸⁴ (MI). Bioswales, rain gardens, low-mow turf, and wildflower meadows, when allowed to go “natural,” look very different than traditionally manicured landscapes. They tend to draw criticism, especially if not understood, so managing for invasives and educating the public through signage can help. “Sometimes we design a new landscape and it doesn't thrive as planned, so we are constantly learning and trying new ways to develop MSU's landscape to benefit wildlife, the environment and safety for campus users,” says Wilber.

FEATURED CAMPUSES

Georgia Southern University⁸⁵ (GA)

To help cut stormwater runoff on campus, Georgia Southern has installed several bioswales designed to trap particulates and pollutants that otherwise would flow into nearby surface waters. One bioswale site (see photo) was formerly a centrally-located greenspace that had been reduced to less than an acre by campus growth. Once part of an extensive wetland system, it had become surrounded by impervious-surface development, including a 300-car parking lot and a large campus housing development. The site received significant stormwater runoff from the encroaching developments.

This low-lying area had plagued the campus grounds crew for years. Maintained as a lawn and grassy swale, the site was nearly impossible to mow due to significant stormwater discharges and a high water table. Not only was the site too wet to maintain much of the time, it was allowing contaminants and oily water from parking lot runoff to flow freely into the campus wetland system.

Working as a team, campus faculty, staff, and student volunteers came together in 2011 to convert the grassy field into a living bio-filtration system. The new bioswale intercepts runoff through a series of carefully placed check dams and is planted with many native species that can tolerate a range of wet to dry conditions. It slows down contaminated runoff and allows the vegetation to filter out impurities as the water drifts downstream. In addition to scrubbing stormwater, the bioswale also has created new habitat for wildlife. Recent sightings include many butterflies, songbirds, herons, and small aquatic life.

Native vegetation in the bioswale at Georgia Southern University.
Photo: Lissa Legge



Northampton Community College⁸⁶ (PA)

In 2011, then-undergraduate Michael MacDonald, a NWF Campus Ecology Fellow, led a project to research and install a bioswale designed to filter and capture parking lot runoff at the Northampton Community College campus in Bethlehem. Besides filtering polluted runoff, the system collects and provides a summer water source for the East 40 Community Garden on the edge of campus. The benefits of the system include a decreased amount of untreated runoff that enters the local watershed and an increase in habitat for wildlife on campus.

The project was a joint effort between Northampton and civil and environmental engineering students at nearby **Lafayette College** (PA). Assays were performed on NCC parking lot surface runoff samples, testing them for hydrocarbons, coliform bacteria, lead, copper, and other heavy metals. Follow-up tests showed that the filtration system cut pollutants dramatically, putting the water below EPA thresholds for toxicity.

The bioswale works like this: Storm runoff is diverted from the parking lot retention basin to the nine-foot by nine-foot site. The contaminated water seeps through the first phase of filtration, a ten-inch layer of wood mulch that binds with hydrocarbons and grease. The second phase of filtration is an engineered soil mix that uses negatively charged clay particles to bind to heavy metals like lead and cadmium. This 36-inch deep layer of soil sits above a reservoir made up of plastic water tank units, and the filtered water seeps into the tanks through a porous fabric. The water is then pumped to two above-ground 1,500-gallon storage cisterns at the East 40 garden where it is used during dry spells. A solar electric panel system at the garden powers the pumps.

“A lot of very dedicated people worked with me to design and construct the project. And now that I’m pursuing Environmental Studies at UC Santa Cruz, the experience I gained building the bioswale is all the more relevant, considering the current crisis state of the drought on the west coast.”

– Michael MacDonald, Graduate student, University of California, Santa Cruz



Adding the engineered soil layer to the bioswale at Northampton Community College.
Photo: Michael MacDonald

The surface of the bioswale was planted with native plants that tolerate soaking during rainy times but can withstand drier periods. Cattails, sedges, bulrushes, and other natives were used for their known ability to absorb pollutants. Since 2011, the bioswale site and area around it have grown over and serve as habitat for many kinds of wildlife. In spring when the area is flooded, frogs breed in this transitional wetland. A groundhog burrow was located not far from the swale, and it is common to see red-winged blackbirds, Canada geese, mallards, deer, rabbits, foxes, and others stopping for shelter or a drink.



Mallard ducks (male on left, female on right) are common throughout the U.S.
Photo: Caroline Lambert

Portland State University⁸⁷ (OR)

Located west of the mountains of the Cascade Range and 60 miles from the Pacific, Portland State University gets its fair share of yearly rainfall. Stormwater management is thus especially important on campus. The 49-acre downtown urban campus lacks streams, wetlands, or other natural areas. Excluding the South Park Avenue city greenway that bisects the campus, 90% of PSU's land is covered by impervious surfaces. In 2005, a Stormwater Management Plan was created to improve and guide sustainable stormwater goals and practices. It calls for an annual review by the landscaping supervisor and Sustainability Office to implement updates and changes to the plan.



A bio-retention swale filters surface runoff from Lot 81 at West Virginia University.
Photo: WVU MS4 Program, 2014

West Virginia University⁸⁸ (WV)

Located in hilly Morgantown, West Virginia University has a strong history of stormwater mitigation practices on campus. In coordination with the West Virginia Department of Environmental Protection, WVU is implementing a U.S. EPA requirement known as the Municipal Separate Storm Sewer Systems to reduce runoff into surface waters.

Highlights of WVU's stormwater efforts include traditional detention ponds, underground detention systems, three rain gardens, and two green roofs—all of which help reduce runoff and flooding. The university also manages a regional stormwater facility located at the Erickson Alumni Center to address flooding in Popenoe Run and the Suncrest neighborhood. The campus has built approximately 20 new bio-retention swales (for underground stormwater infiltration) and plans to install four to six more in conjunction with new building projects. WVU's Environmental Health and Safety (EHS) department has amended the university's design guidelines and construction standards to ensure that low-impact building techniques and stormwater management efforts are always incorporated.

EHS has partnered with WVU's WECAN Sustainability Program to involve and educate the campus community on the importance of stormwater mitigation practices. At events like Earth Day and Campus Sustainability Awareness Week, students and employees participate in events such as tree plantings and litter clean-ups, which help mitigate runoff. WECAN provides student internships in several sustainability focus areas and welcomes students who wish to research water conservation methods. In 2013, EHS was awarded an Environmental Excellence Award for its stormwater initiatives from the West Virginia Department of Environmental Protection.



Students studying on the green "Eco Roof" at Portland State's Native American Student and Community Center.
Photo: Portland State University

Over the years, PSU has incorporated sustainable design into new and remodeled infrastructure and landscape projects. For example, rainwater harvesting on Epler Hall conserves drinking water by capturing and using rainwater for irrigation and toilet flushing. Stormwater-fed planters on campus slow runoff and filter pollutants before the water enters the watershed. Pervious pavement in a number of locations decreases erosion, reduces pollutants, and helps recharge the groundwater. Two bioswales use plants to filter pollutants from runoff. Several green roofs on campus buildings help to extend roof lifespans, reduce stormwater runoff, and provide additional greenspace and habitat for wildlife and pollinators. A campus/community garden and native plant garden also help filter stormwater runoff and provide added habitat.

3B NWF CERTIFIED WILDLIFE HABITATS

More than 180 colleges and universities in the U.S. have been certified under the NWF Certified Wildlife Habitat (CWH) program. Institutions that meet the criteria (see box) are recognized by a plaque that can be posted prominently on campus. And while CWH designation is a worthy goal for any school, it should be considered only one step in a long-term commitment to maintain and expand productive, green places on campus for wildlife.

At the urban campus of the **University of Memphis**⁸⁹ (TN), landscaping decisions have long provided wildlife-friendly settings for native birds and mammals. Sightings include red-tailed hawks, gray squirrels, flying squirrels, chipmunks, raccoons, red foxes, and coyotes. The U of M sustainability plan calls for an ongoing shift to native trees, shrubs, and other plantings in campus landscaping. Thanks to these efforts, the campus was designated a NWF Certified Wildlife Habitat in 2012. As noted by former university horticulturalist Joellen Dimond in a press release, “Students come here for academics, but the university also delivers experiences in nature through courses that will stay with them ... for many years.” Another member of the campus CWH group, **Warren Wilson College**⁹⁰ (NC), was certified in February 2015.



Raccoons live nearly everywhere, but being mostly nocturnal they are not often seen.
Photo: Charles Callahan

National Wildlife Federation's Certified Wildlife Habitat Program⁹¹

NWF's Certified Wildlife Habitat program has been helping individuals and organizations garden for wildlife since 1973. The program engages homeowners, businesses, schools, churches, parks, and other institutions that want to make their communities more wildlife friendly. Currently there are more than 190,000 certified habitats nationwide. Wildlife habitats are important to year-round residents as well as species that pass through during migration, including a number of birds and butterflies. Each habitat is unique for both its beauty and function. To qualify for certification, a property must provide four key elements of habitat and implement sustainable practices.

Food: Native plants, in particular, provide wildlife with leaves, seeds, nectar, and other food essentials. Feeders can supplement natural food sources.

Water: All animals need water to survive and some need it for bathing or breeding as well.

Cover: Wildlife need places to find shelter from heat, harsh weather, and predators.

Places to raise young: All species need appropriate places for bearing and raising young.

Sustainable gardening practices: Soil and water conservation, controlling invasive exotic species and eliminating or reducing chemical use.



FEATURED CAMPUSES

Doane College⁹² (NE)

In March 2009, Doane College's entire campus in Crete was recognized for its beauty and attention to native species when it became a NWF Certified Wildlife Habitat. NWF honored the 300-acre, 137-year-old campus for providing a variety of wildlife havens, including its own lake and small woodlands. Wilder parts of the campus include ponds, a natural spring, prairie areas, wetlands, and nature trails. Doane's student-led Wildlife and Conservation Organization (WACO) took the initiative and applied for NWF certification, demonstrating that the campus met the criteria of providing food, water, cover for wildlife, and places to raise young.

The college is home to more than 160 species of trees and shrubs, including 100-year-old groves of pine, ash, pin oak, and catalpa trees. Recently planted trees include native species such as maple, birch, hackberry, American yellowwood, persimmon, elm, and yellowthorn. The whole campus, in fact, is also designated the Osterhout Arboretum, named for a long-time administrator who oversaw the planting of many of Doane's trees. Doane is also the first college to become a member of the Nebraska Statewide Arboretum and is registered with the Morton Register of Arboreta.



Student officers of WACO at Doane College gather with facilities director Brian Flesner at the Certified Wildlife Habitat plaque in 2013.

Photo: Doane Wildlife and Conservation Organization / Sarah Genrich, photographer

Roosevelt University⁹³ (IL)

Roosevelt University has restored 8.5 acres to native tallgrass prairie at its 27-acre Schaumburg campus, northwest of Chicago. (The main campus is in downtown Chicago.) The university is halfway towards its target goal of converting all turf grass to native plants and all paved areas to permeable pavement at Schaumburg by 2023. The prairie area became a NWF Certified Wildlife Habitat in 2013.

The Schaumburg campus is located in a busy commercial complex. Thus the restored prairie provides crucial wild green space and a wildlife corridor within a heavily urbanized area. Since the transformation began in 2011, there has been a positive impact on native animal and plant species. Staff and students have observed an increase in bird and insect numbers and diversity. Rabbits, raccoons, and dragonflies are common sights. Looping through the restoration is a half-mile Prairie Walk, a trail that permits easy access.

"The prairie is a great place for the Roosevelt community to learn about and enjoy the outdoors. I especially like to take regular walks and see how it changes. We are excited to expand the idea of using the prairie as a teaching opportunity for our students. I also am very happy that it is a NWF Certified Wildlife Habitat."

– Chuck Middleton, President, Roosevelt University

Roosevelt works with local community partners to assist with different aspects of the restoration. Local Boy Scouts helped with plant identification (there are more than 25 different tree and shrub varieties) and educational labeling. The Institute of Continued Learning at Roosevelt uses it for a Master Gardener class. Members of Roosevelt's Students for Sustainability and RU Green also have assisted in the transformation.

The prairie is not only a benefit to wildlife, but it also saves money. Since conversion began three years ago, the university has avoided over \$60,000 in lawn maintenance costs. Paul Matthews, Assistant Vice President for Campus Planning and Operations, notes other ways the campus is committed to sustainability. "For example, we try to reuse everything," he said. "All food waste produced at our downtown campus is collected and turned into compost by the Resource Center and returned to our community garden adjacent to the prairie. We are working on closing the loop on resources to lessen our carbon footprint and make the connection for students that there is a better way."

Rockland Community College⁹⁴ (NY)

One of 64 campuses in the State University of New York (SUNY) system, Rockland Community College partnered with AmeriCorps and local utility United Water Company, starting in 2008, to restore a wildlife habitat adjacent to campus as an ecological and educational resource. The space is approximately 300 by 500 feet in size and features woods, a meadow, freshet stream, and an overflow pond. Restoration efforts were preceded by a natural resources inventory to identify the appropriate plants needed to enhance the habitat. A trail was built with rocks and mulch, and a site guide was developed that explains the importance of species diversity, sustainability, food webs, watershed protection, pollution prevention, and control of invasive plants. The trail has been used by classes of local K-12 school children and also by many RCC students.



Mallard duck guarding a nest at a water feature on the American University campus.
Photo: Michael Mastrotta



Three students and a staff member stand proudly by their NWF plaque.
Photo: SUNY Rockland Community College

Native plant species include flowering dogwood, tulip poplar, witch hazel, wild geranium, and purple coneflower. The site supports wildlife such as white-tailed deer, muskrats, mallards, wild turkeys, blue jays, and red-tailed hawks. In conjunction with this project, a policy was developed by the college to prohibit use of pesticides on the entire campus. “Earning NWF certification and posting the CWH signs gave significant recognition to the project,” noted Susan Golz, Professor of Science.

American University⁹⁵ (DC)

Recognized in 2010 as a NWF Certified Wildlife Habitat, the American University campus in Washington, D.C. met all four criteria for certification by:

- Providing food for wildlife through berries, nectar, sap, pollen, and foliage;
- Supplying water through rain gardens and a pond;
- Creating cover in the form of wooded areas, rock walls, dense shrubs, and evergreens; and
- Providing wildlife places to raise their young in mature trees, host plants, and a water garden.

Groundskeeping practices and other green measures at the university help support wildlife and the environment. Landscaping staff, for example, manage the grounds completely organically, eliminating the need for pesticides. They use native and pest-free plants and encourage “good bugs,” such as ladybugs, to keep insects that cause plant damage in check. The entire campus is a certified Arboretum and Gardens, open to the public. A walking tour with 18 stops has been developed, with downloadable audio recordings for each stop. Recognized for its efforts to promote and manage a healthy tree canopy, American has been designated a Tree Campus USA.

Student clubs, such as Ecosense and the Bee Keeping Society, have been involved in American University's community garden and pollinator gardens. Several students are hired each year to work with grounds staff where they learn sustainable landscape management practices. AU also hosts a one-day event called Campus Beautification Day, which draws 300-400 volunteers (mostly students) who spend a day working on a landscape-related beautification project.

Native woody plants and perennials featured on campus include redbud, black gum, sycamore, sourwood, oakleaf hydrangea, witch hazel, turtlehead, wild iris, Jacob's ladder, and Baptisia. Wildlife sightings include white-tailed deer, red fox, red-tailed hawk, and ruby-throated hummingbird, plus many songbirds, bees, and other insects.

Students at UCLA Conduct Research on NWF's Certified Wildlife Habitat Program

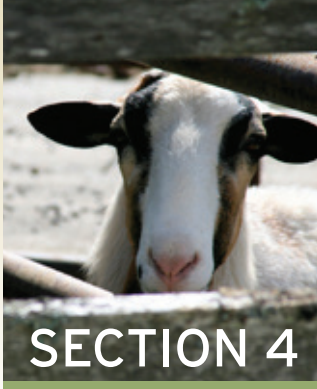
Do NWF's Certified Wildlife Habitats make a difference? That's the question seven seniors in an environmental science practicum at the **University of California, Los Angeles**⁹⁶ (CA), wanted to find out. In 2014, they worked with NWF to determine the value of the CWH program to homeowners in California. Their ultimate aim was to find ways to improve the program's benefits to wildlife and sustainability, and to increase public awareness of those benefits. Based on the results of surveys and CWH property assessments, the students compiled a set of findings and recommendations for NWF that can be found in their report, *Evaluating Certified Wildlife Habitats and the Minds Behind Them*.

Their research showed that NWF Certified Wildlife Habitats have around 50% more tree coverage than non-certified locations. Those extra trees help decrease surface heating, increase rainwater infiltration, curb erosion, and provide refuges for wildlife. In addition, homeowners report that about 40% of the plants in their CWH are water-conserving native species—offering an advantage during the state's extended drought. Of long-term significance was the finding that properties with CWH designation annually sequester around 217 tons of carbon more than conventional properties are able to do.

In a press release, Beth Pratt-Bergstrom, NWF's California Director, noted, "UCLA's students should be really proud. They helped improve a program that has far-reaching implications for citizen science and conservation. They are the environmental leaders of the future and their dedication really showed in how they pursued their work."

American University Rain Garden
Photo: Michael Mastrotta





SECTION 4

Remote College and University Properties

Many colleges and universities own land that is located beyond the borders of the main campuses. These properties can include educational or research-oriented biological field stations, experimental fields and farms for agriculture, and lands that come from gifts, bequests, and other sources. Most are rural with natural forests, grasslands, deserts, mountains, wetlands, lakes, streams, or other wild, intact ecosystems where wildlife abound. The majority are highly valued for the field research opportunities they offer to students at all levels. Many have laboratory facilities, sleeping quarters, and classrooms, and are equipped to study the ecosystems where they are located.

Featured below are several campuses with remote natural land holdings that are used for hands-on student learning. To see the range of the more developed, research-focused field sites around the country, check the list of members of the national **Organization of Biological Field Stations**.⁹⁷ OBFS was founded in 1968 and currently has around 130 members, with many operated by colleges and universities. Following are three examples:

Fifty miles west of the main campus of **Oregon State University**⁹⁸ (OR) is the Hatfield Marine Science Center. This 49-acre property on Yaquina Bay houses research programs from several colleges and other university programs, including the Marine Mammal Institute. HMSC is a hub of activity for studies of marine science, coastal ecosystems, and other oceanographic topics, offering a range of research and outreach opportunities for students from community college through post-doc.

Established in 2010, the **Towson University**⁹⁹ (MD) Field Station sits 19 miles from the main campus and is protected by a conservation easement. Its 223 acres of forest, floodplain, and slough are used as an outdoor laboratory by herpetology, ornithology, fish biology, and art classes. In one of the field station's long-term projects, deer exclosures were constructed and students study the impact of deer browsing on native plants, invertebrates, and salamanders.

The **University of Oklahoma**¹⁰⁰ (OK) owns the Kessler Atmospheric and Ecological Field Station, a 360-acre research and learning property 17 miles southwest of the main campus,

in a dry, hilly region dominated by grasslands. The Kessler station is the site of several long-term studies of weather and precipitation as well as the biology of the Great Plains.

FEATURED CAMPUSES

Indiana University¹⁰¹ (IN)

While Indiana University is known for natural areas right on campus such as Dunn's Woods, it also has a constellation of wildland preserves located off campus. Its Research and Teaching Preserve (RTP) is composed of seven separate properties, spread over three counties and at distances ranging from one mile (Griffy Woods) to 28 miles (Bradford Woods) from the main campus in Bloomington. Established in 2001 with two sites and 446 acres, it has grown to 1,600 acres. Each property has different characteristics, such as the natural aquatic habitats at Griffy Woods and Moores Creek, or the experimental crop fields at the Bayles Road property. RTP's stated mission is "to provide natural field settings for research, teaching, and outreach that complement existing facilities and infrastructure at Indiana University." Its Ten-Year Report 2001-2011 gives an excellent summary of preserve sites, their uses for student and faculty research, and much more.

Educational opportunities at the preserve are extensive. On average, 500 IU undergraduate and graduate students each year conduct course-based research or participate in outdoor laboratory exercises. In addition, the preserve hosts events like the Women In S.T.E.M. program for first year undergraduates, educational opportunities for high school students, and a citizen science experience for community members and volunteers. Stream monitoring, removal of invasive species, interpretive hikes, and other educational offerings are available.

Recently, the RTP was placed within IU's new Integrated Program in the Environment, which is developing innovative ideas for the preserve. RTP's Administrative Director Sarah Mincey is eager to integrate non-science based learning into the preserve. "Looking forward," she said, "we want to create a more multidisciplinary approach at the preserve. For example, a historian at the university is teaching a course on the cultural



Students hike through the Lilly-Dickey Woods property, owned by Indiana University.
Photo: Keith Clay

aspects of trees, and a portion of Lilly-Dickey Woods is dedicated to bringing the arts into the RTP experience. We are hoping writing courses and other outdoor programming will become a greater part of the preserve activities.”

A wide range of scientific research is being conducted at preserve sites. At Lilly-Dickey Woods, a study of tree regeneration and carbon storage is taking place within a 25-hectare plot. This is part of a multi-institution project with the Smithsonian Center for Tropical Forest Science in which 24 countries, 53 forest plots, 4.5 million trees, and 8,500 species are being monitored across the globe with the goal of increasing understanding of forest ecosystems and climate change. At the study site, 35 species of woody plants and trees are being monitored, resulting in the mapping of more than 29,000 trunks and stems.

Research on the abundant wildlife at the various preserve sites has focused on such species as southern flying squirrels, whitetail deer, prairie voles, salamanders, dark-eyed juncos, cicadas, and other invertebrates, as well as invasive fish, mussels, and insects like the emerald ash borer. Research and teaching opportunities for students, faculty, and others at the RTP are constantly evolving.

Ithaca College¹⁰² (NY)

Of the four Natural Lands (ICNL) reserves owned by Ithaca College, two are located a few miles south of campus. All are managed by committees composed of IC students, faculty, and staff. The two remote properties are the Ithaca College Natural Resource Reserve and the Bob Robinson Family Reserve (for the two natural areas located on campus, see Section 3). The Natural Resource Reserve is a rural reserve of 46 acres

that supports teaching and research in forestry management for students in the Topics in Natural Resources and Ecology course. As part of the management of the reserve, students participate in thinning trees, a regular practice to ensure the healthy growth of the forest. The Bob Robinson Family Reserve is 82 acres of upland and riparian flood plain forests of oak, eastern hemlock, tulip popular, and white pine, with a creek that is ideal habitat for trout and other native fish. The Robinson reserve provides a study opportunity for students to examine the relationship between eastern hemlock trees, stream water quality, and breeding populations of native trout. Other courses that use the two preserves as outdoor labs include the Environmental Sentinels, which uses wilderness awareness training to teach local natural history and ecology, and Land Use and Management, a course that focuses on land use science.

Two off-campus parcels, totaling 128 acres, are protected as part of the Ithaca College Natural Lands reserve system.
Photo: David J. Eagan



Harvard University¹⁰³ (MA)

The Harvard Forest, a property of Harvard University, is a 3,750-acre field site for research and education located 70 miles west of campus. Established in 1907, it has been a nationally prominent site for studies of biodiversity, conservation, invasive species, ecosystem processes, carbon cycling, and, most recently, for research on the successional ecology of returning a golf course to a meadow. Since 1988, Harvard Forest has been part of the Long Term Ecological Research program of the National Science Foundation.

On average about 1,000 students a year (K-12 and beyond) visit or study the Harvard Forest. Undergraduate and graduate students from Harvard conduct research for courses or thesis projects. A summer research program involves 20 to 30 undergraduates who conduct a range of independent research on wildlife and conservation topics. Of that number, around 80% come from different schools and 20% from Harvard.

One of the tools used in research is a game camera. There are more than a dozen of these motion-activated cameras in the forest, which take photos of wildlife in and around long-term study plots.

A central research focus is on how wild creatures impact the landscape and, conversely, how landscape influences wildlife. A current topic is the widespread destruction of eastern hemlock forests by the hemlock woolly adelgid, an invasive aphid-like insect. Researchers are looking into how the loss of tree cover affects forest floor dwellers like native salamanders, rodents, and ants, as well as its effects on larger wildlife like deer and moose that are adjusting their diets to trees that replace the hemlock.

A new project at Harvard Forest is the conversion of a former 70-acre golf course back to an open meadow. Grazing by cows is used to help keep the land free of trees, and teams of scientists and students are documenting the birds, mammals, butterflies, and other insects that colonize the area. Notably, it took only two years from the project's launch for bobolinks, a threatened bird species, to begin using the new meadow.

College of the Atlantic¹⁰⁴ (ME)

The College of the Atlantic, located along the coast in Bar Harbor, owns 300 acres of nearby farmland and forests used for research, education, and conservation opportunities for students. Properties include Beech Hill Farm, which is 15 miles west of campus near the town of Mt. Desert. Beech Hill is a working farm that provides organic vegetables and heirloom apples for college dining halls. Of its 73 acres, 67 are forested. Closer to campus, the 125-acre Peggy Rockefeller Farms, which raises organic produce as well as cows, sheep, and chickens, includes 62 acres of forest and wetlands. Both farms use border plantings along fields that serve as wildlife habitat, attractants for beneficial insects, and runoff control. A 100-acre pristine woodland, the Cox Protectorate, is near the Rockefeller Farms. In 2010-11, a Farms Task Force reviewed the history and land-use capacity of COA's remote properties and developed a set of goals. A top priority was to increase support for student educational connections. All three sites are currently used for independent and group studies, senior thesis projects, and research on the Northeast Creek watershed.



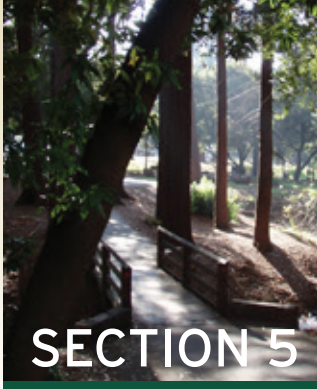
Aerial view of the Beech Hill Farm, owned by College of the Atlantic.
Photo: College of the Atlantic, 2014

COA also owns 12 acres of the 220-acre Great Duck Island, which it shares with The Nature Conservancy and the State of Maine. The college property, named the Alice Eno Field Research Station, hosts teams of students and faculty who study the island's nesting colonies of Leach's storm petrels, black guillemots, black-backed gulls, and other seabirds and raptors. The college also owns Mount Desert Rock, located 25 miles offshore, which is a fully operational marine mammal research station where students carry out research projects involving humpback and northern right whales, harbor seals, white-sided dolphins, and other species. And in the literal backyard of the Bar Harbor campus itself, Acadia National Park's 30,000 acres offer further opportunities for recreation and outdoor study. Among other projects, students helped with the reintroduction of peregrine falcons to the park 30 years ago and with surveys of Acadia's birds and other wildlife.



In the U.S., harbor seals are found along the coasts of the north Atlantic and Pacific Oceans.
Photo: Sequoia Hughes

"The College of the Atlantic was recently ranked as having one of the top 20 Best College Farms in the U.S. The criteria used to determine this include sustainability, integration with the main campus, the number of courses taught at the farm, students' use of the farms, and integration with the community." – Darron Collins, COA President (and 1992 COA graduate)



SECTION 5

Campus Policy & Planning with Wildlife and Climate in Mind

Although it may seem obvious, it is important to ensure that college and university natural areas, tree canopies, and other places for wildlife are secured and protected for future generations. If the campus wild is a valued part of the student experience—important both for education and campus ambiance—then advocates for “the wild” should always have a seat at the planning table.

Whether public or private, schools generally retain the right to develop their land as they choose, sometimes resulting in campus expansion at the cost of once-wild acres. Establishing formal policies for preservation, and making sure campus green places become visible and valued campus assets, can help guarantee the long-term protection and survival of those places. Protection can be achieved through a variety of mechanisms, including campus master plans, conservation easements, LEED requirements, and state protection programs.

The **University of Nevada Las Vegas**¹⁰⁵ (NV), featured above in Section 1, has a campus policy stipulating that all new landscaping around buildings be xeriscape, much of which includes native species. **Duke University’s**¹⁰⁶ (NC) Master Plan calls for strategies to maintain its “University in the Forest,” such as preserving campus natural areas and limiting construction in such areas, and using infill development to preserve open space.

At the **University of Arizona**¹⁰⁷ (AZ), a comprehensive set of Guiding Principles helps protect its Arboretum, a campus-wide collection of trees and shrubs. One guideline makes the Office of Campus and Facilities Planning responsible for preserving and supporting the care of campus trees, ensuring their continued use as an educational resource. And a policy at the **University of Cincinnati**¹⁰⁸ (OH) requires that all new construction—and renovations, when possible—be built to LEED Silver requirements or higher. Wildlife-friendly landscaping and features are often part of projects with high environmental standards.

FEATURED CAMPUSES

Franklin Pierce University¹⁰⁹ (NH)

Most of the main campus of Franklin Pierce University is a mosaic of natural forests and wetlands, including the shoreline along Pearly Pond. Of the campus total of 1,200 acres, 1,000 are undeveloped and used extensively for education, research, and recreation. Selective logging is permitted in designated areas. As noted on its website, FPU is one of only a few colleges and universities to place permanent, legal restrictions on a portion of the undeveloped land within its campus borders. In 2005, a 46-acre parcel of wetlands and upland forest was protected with a conservation easement, held by the Monadnock Conservancy Land Trust, creating a wildlife corridor linking Pool Pond and Pearly Pond.



View of the scrub-shrub wetland in the conservation easement at Franklin Pierce University.
Photo: Catherine Coning

Conservation Easement

This voluntary legal instrument, formed between a landowner and a government or nonprofit organization, permanently restricts certain kinds of development on a parcel of land. Conservation easements are written to promote specific conservation objectives for water, wildlife, and ecological communities while limiting or precluding roads, buildings, traditional agriculture, and other non-compatible uses. Once an easement is signed, its restrictions apply to current and future owners of the land.

The protected area at Franklin Pierce not only connects two lakes, but also encompasses a headwater stream corridor surrounded by several types of wetlands, as well as upland forests of hemlock and mixed hardwoods dominated by sugar maple, yellow birch, and red oak. Native understory plants include wild sarsaparilla, wintergreen, and partridgeberry. Despite their close proximity to athletic fields and residence halls, these ecosystems support abundant wildlife, with recent sightings of moose, white-tailed deer, black bears, fishers, pileated woodpeckers, yellow warblers, spotted salamanders, and others, as documented by tracking, camera traps, and direct observation.

“The campus is our outdoor learning laboratory, and not only is it stunningly beautiful, it is chock full of wildlife. We use it to stimulate students’ abilities to ask good ecological questions and to conduct long-term research on important topics related to conservation of biodiversity, climate change, and water quality. What is particularly special about the place is the quintessential New England look of it—old farming roads and stone walls winding through sugar maple forest, pockets of wet meadows and streams dotting the landscape. Just walking through the area is a treat for the senses.”

— Catherine Owen Koning, Professor of Environmental Science

FPU’s wild places are used extensively for student independent research, as well as for field laboratory portions of courses including Wetland Ecology, Forest Ecology, Ecosystem and Wildlife Conservation, and Place, Community, and American Culture. These labs teach skills in wetland hydrology, water quality management, carbon sequestration analysis, exotic species control, aquatic invertebrates as water quality indicators, and many other topics.



Yellow warblers are one of the more colorful of the neotropical migrants to return each spring.
Photo: Kathy Rowland

Currently, FPU faculty are working with the university administration to explore placing a similar conservation easement on a 350-acre parcel of land on nearby FPU property in the town of Rindge. This site would be earmarked for more outdoor “learning laboratory” experiences that have been so valuable on the first conservation easement. The main campus has also benefited from recent efforts to improve wildlife habitat in areas directly adjacent to the developed parts of campus—removing turf grass and invasives, and planting native shrubs and other plants to attract insect pollinators, birds, and other wildlife.

“For our classes, we go out into the wetlands, learn their ecology, identify plants, learn the chemistry of the wetlands. There’s plenty of time to spend outside, which is ideal. It’s hands-on learning and it’s more interesting.”

— Patrick Freeman, Environmental Studies major

Butte College¹¹⁰ (CA)

When Butte College was established in 1973, its Board of Trustees designated the entire 928-acre campus a Wildlife Refuge. Currently, the developed parts of campus occupy 207 of those acres, including an 85-acre farm. Butte lies in the dry foothills just east of the Sacramento Valley, where the refuge serves as an outdoor laboratory for degree programs in agriculture, natural resources management, environmental studies, biology, and other fields.

All wildlife is protected on campus. No hunting is allowed, though certain species may be relocated; for example, rattlesnakes can be moved away from populated areas. The refuge harbors healthy numbers of deer, turkeys, mountain lions, California quail, golden eagles, several bat species, and Swainson's hawks, a species listed as threatened in California.

The college's Land Use Committee plays a key role overseeing the refuge. With a dozen faculty, staff, and student members, the committee addresses issues and ideas related to campus land management. A recent topic was removal of turf grass areas, to be replaced with native plants—a step that would decrease water use and attract even more wildlife to campus.

A recent demonstration of how Butte College protects its wild landscapes was when the college modified a proposal for an array of solar electric panels. The original plan was to put the array on wild land, which would have required cutting down mature blue oak trees (*Quercus douglasii*) and disturbing wildlife and other native plants. Faculty and staff came together to propose a better solution: mount the arrays on existing buildings and parking lot structures. The modified proposal was accepted by the college president and trustees, and the solar array now provides both electricity and shade to parked cars, an added benefit.

The wildlife refuge provides many opportunities for learning. Guided by faculty, students have been assisting facilities staff use GIS (Geographic Information System) technology to map Butte's natural landscapes and buildings. Not only do students get to apply skills they are learning in class, but the project also is helping achieve the goal of mapping the campus. Another effort is the Wood Duck Box program, which increases nesting sites for wood ducks at ponds and riparian habitats in the refuge. Students participate in all phases of the project, including cleaning the nest boxes in winter, counting hatchlings, and assisting staff from the California Department of Fish and Wildlife to put leg bands on the birds. Annually, wood ducks on campus have fledged an average of 300 ducklings.



Students install a nest box for wood ducks near a pond at Butte College.
Photo: Butte College

Facilities Director Ken Albright is committed to connecting facilities management activities to the classroom. “Although working with students takes a little extra time,” he observed, “if you divide projects into smaller bites that are doable in a semester, you will have better success. Students become empowered and are more likely to stay engaged.”

University of California, Berkeley¹¹¹ (CA)

In 2009, the University of California, Berkeley (UCB), created its first Campus Sustainability Plan which “defines a vision of long term sustainability and describes steps being taken to achieve the vision.” The plan, which was updated in 2013, guides work on campus to ensure continuous improvement to the campus relationship with the environment. UCB's Landscape Master Plan, a separate document, is integrated into the sustainability plan and focuses on management of the university's landscape with an emphasis on supporting the educational mission.

Included in the Campus Sustainability Plan is a set of sustainability goals in nine broad categories, with Land Use among them. The Land Use goal is straightforward: “Plan every new project to serve as a model of resource conservation and environmental stewardship.” There are several strategies to address that goal, two of which relate directly to wildlife. One strategy is to “revise and implement the Strawberry Creek Management Plan.” Strawberry Creek provides an east-west greenway and wildlife corridor across the campus. The other is to “manage UCB's natural preserves based on ecological



Grinnell Natural Area along Strawberry Creek on the University of California, Berkeley campus.
Photo: UC Berkeley

principles, including replacing invasive exotic plants with native plants ... and preserving and enhancing their habitat value.” The creek runs through three designated campus wild places, the Grinnell, Goodspeed, and Wickson Natural Areas.

Decades ago, in response to the degraded state of Strawberry Creek on campus, a UCB graduate student, Robert Charbonneau, proposed and undertook a comprehensive study of the creek. The resulting 1987 *Strawberry Creek Management Plan* guided systematic clean-up efforts, water quality improvements, and elimination of invasive plants. Within a few years, populations of native fish were reestablished in the creek, including the three-spined stickleback, Sacramento sucker, and California roach minnow. The plan continues to guide work today through the Strawberry Creek Restoration Program, operating with volunteer labor and donated funds. Among other efforts, students built a native plant nursery in 2011 to propagate species to be planted in the riparian corridor. The program also provides hands-on training in restoration for students at the university and local schools.

Saint John's University¹¹² (MN)

The main campus of Saint John's University (SJU) occupies a small portion (80 acres) of the 2,700 acres that surrounds it. The land—made up of woods, wetlands, several ponds and lakes, and a restored prairie—is owned by Saint John's Abbey and was designated the Saint John's Abbey Arboretum in 1997. The arboretum serves as a valuable living laboratory for SJU students for hands-on learning and research experiences in sustainable forestry, prairie restoration, sustainable land use, and more.

The Abbey Arboretum is located in Minnesota's ecological transition zone between the tallgrass prairies to the south and west and the hardwood forests to the northeast, and thus is home to a great variety of native flora and fauna. Online lists of animal species recorded on the property include common wood nymph and white admiral butterflies, green-winged teal, northern shrike, plains pocket gopher, northern flying squirrel, beaver, short-tailed weasel, porcupine, white-tailed jackrabbit, blue-spotted salamander, Cope's gray tree frog, red-bellied snake, western painted turtle, and prairie skink.

To guide preservation and maintenance of these rich natural areas, Saint John's has a number of policies in place. The Lands and Trails Policy lists activities not allowed within the arboretum, such as harvesting plants, animals, and fungi, and operating off-road vehicles. The Invasive Species Policy protects against introduction of invasive plants and animals. It requires that all plantings within the prairie, for example, occur under the direction of the Abbey Land Manager, and that no firewood be brought from off-campus sources, which might contain fungus or invasive insects harmful to the forest. The Lakes and Waters Policy stipulates rules for fishing and requires removal of any visible aquatic plants and animals (mussels, snails, worms, etc.) from boats or trailers before entering and after leaving water access points. In addition, the arboretum has posted land stewardship methods and guidelines to direct long-term management efforts of its varied habitats. Controlled prairie and woodland burns in fall and spring, for instance, are used periodically to help control woody and invasive species and to encourage native plants, insects, and wildlife.

Butler University¹¹³ (IN)

Wildlife-friendly landscaping practices at Butler University in Indianapolis include the Butler Prairie, which was established in 1987 and serves as an outdoor laboratory for ecology classes. More recent projects include two rain gardens on campus that have been planted with native species. To guide landscape management decisions, staff at the university implemented a Sustainable Landscape Plan.

Butler was recognized by the Indiana Wildlife Federation (IWF), an affiliate of the National Wildlife Federation, for sustainable landscaping. The IWF sponsors a voluntary program—Landscaping the Sustainable Campus (LSC)—whose aim is to encourage greater conservation-minded landscape practices. Specifically, the LSC program promotes campus plans that are designed to manage surface runoff,

reduce excessive nutrient pollution, and add quality habitat space for wildlife on university and college properties in Indiana. Emphasis is placed in five areas: sustainable lawn maintenance and landscaping, pesticide/herbicide use reduction, invasive species eradication, native plant species selection, and water conservation. Efforts to engage students in the planning and practice of sustaining natural resources and conservation are strongly encouraged.

On the strength of its record, Butler achieved the Conservation Champion Gold Level certification through the LSC program. To reach this status, the university created a timeline and plan detailing current campus practices, long-range goals, and incorporation of new projects and sustainable practices on campus. Other campuses recognized through the LSC program in Indiana are **Purdue University (IN)** and **Indiana State University (IN)**.

5A LEED DESIGN STANDARDS LEAD TO WILDLIFE-FRIENDLY BUILDINGS

by Dagmar Epsten¹¹⁴

A prominent leader in technological change, the academic community has rapidly embraced sustainable design in its buildings and landscapes. Colleges and universities have long recognized the importance of a physical environment that promotes long-term human and environmental health. Thus, campuses nationwide are adopting an increasingly accepted set of standards and green building certification program in the construction industry, the LEED¹¹⁵ (Leadership in Energy and Environmental Design) rating systems. Developed in 1999 by the U.S. Green Building Council, LEED promotes sustainable design, construction, and operations in the built environment.

LEED standards cover various building types, interiors, campuses, and even entire neighborhoods. (*See box for LEED rating systems and a guidance document commonly used for a campus.*) Building projects have to document compliance with mandatory prerequisites, and projects can earn optional credits or points from among several credit categories, including water efficiency, energy and atmosphere, and

sustainable sites. LEED Platinum, Gold, Silver, or Certified status is awarded based on the total number of points achieved, with Platinum as the highest rating. Some point-worthy features of construction projects help protect wildlife, preserve trees, and make waterways healthier.

While LEED is focused primarily on buildings, it also encourages design features that favor resident and migratory wildlife. For example, it rewards innovative solutions for managing storm and surface water, for maximizing open space and green roofs, and for including trees and landscaping that provide shade and shelter. And indirectly, LEED supports wildlife on a much larger scale. Better energy performance, for example, reduces the greenhouse gases that contribute to climate change, which affects wildlife globally. The campus examples below highlight LEED-inspired elements of building projects that promote green space and wildlife habitat. They also call attention to the systemic interaction between the built environment and natural environment.

LEED Rating System¹¹⁶

- **LEED for Building Design and Construction**

Covers the development of a new green building or renovation of an existing building to ensure a holistic green structure. Includes the Master Site approach to prerequisites/credits for a campus or a partial campus site.

- **LEED for Building Operations and Maintenance**

Assesses the ongoing process—through prescriptive and performance strategies—of providing operational benefits throughout the life of the building. Includes the Master Site approach to prerequisites/credits for a campus or a partial campus site.

- **LEED for Neighborhood Development**

Assesses the creation of a neighborhood that combines environmental and social benefits to foster community with open spaces, access to parks, and community gardens. The campus or partial campus site would need to meet LEED criteria for a neighborhood.

- **LEED Campus Guidance for Projects on a Shared Site**

This guidance document is for projects on a shared site under the control of a single entity; for example, a corporate or educational campus, government installation, or commercial development. Can be used in conjunction with LEED for Building Design and Construction, or LEED for Building Operations and Maintenance.

Wildlife and LEED® v4 Rating System most applicable for campus developments:

		BD+C NC	BD+C Schools	HOMES Multi-Family Midrise	ID+C CI	O+M EB	O+M Schools	ND
	BD+C Building Design & Construction, including Campus Approach							
	NC New Construction and Major Renovation							
	Schools							
	HOMES Multi-Family Midrise (for Dormitories and Apartments)							
	ID+C Interior Design & Construction: CI Commercial Interiors							
	O+M Building Operation & Maintenance, including Campus approach:							
	EB Existing Buildings							
	Schools							
	ND: Neighborhood Development Plan and Neighborhood Development							
General, no category	<i>Integrative Process</i>	X	X	X	X			
LEED CATEGORY	Location and Transportation (LT)/ ND: Smart Location and Linkage (SSL)							
	LEED for Neighborhood Development Location	X	X	X	X			
	ND Smart Location							X
	ND Imperiled Species and Ecologic Communities Conservation							X
	ND Wetland and Water Body Conservaton							X
	ND Agricultural Land Conservation							X
	ND Floodplain Avoidance			X				X
	ND Preferred Locations							X
	ND Brownfield Remediation							X
	ND <i>Access to Quality Transit/HOMES: Access to Transit</i>	X	X	X	X			X
	ND <i>Bicycle Facilities</i>	X	X		X			X
	ND <i>Housing and Jobs Proximity</i>							X
	ND Steep Slope Protection							X
	ND Site Design for Habitat or Wetland and Water Body Conservation							X
	ND Restoration of Habitat or Wetlands and Water Bodies							X
	ND Long-Term Conservation Management of Habitat or Wetlands and Water Bodies							X
	Sensitive Land Protection	X	X					
	High-Priority Site	X	X					
	Surrounding Density and Diverse Uses	X	X		X			
	Reduced Parking Footprint	X	X		X			
	<i>Green Vehicles</i>	X	X					
	Site Selection			X				
	Compact Development			X				
	<i>Community Resources</i>			X				
	<i>Alternative Transportation</i>					X	X	
LEED CATEGORY	ND: Neighborhood Pattern & Design (NPD)							
	ND <i>(Various credits encouraging density, mixed use, and alternative transportation.)</i>							X
	ND Local Food Production							X
	ND Tree-Lined and Shaded Streets							X

Wildlife and LEED® v4 Rating System most applicable for campus development:		BD+C NC	BD+C Schools	HOMES Multi-Family Midrise	ID+C CI	O+M EB	O+M Schools	ND
BD+C Building Design & Construction, including Campus Approach								
NC New Construction and Major Renovation								
Schools								
HOMES Multi-Family Midrise (for Dormitories and Apartments)								
ID+C Interior Design & Construction: CI Commercial Interiors								
O+M Building Operation & Maintenance, including Campus approach:								
EB Existing Buildings								
Schools								
ND: Neighborhood Development Plan and Neighborhood Development								
LEED CATEGORY	Sustainable Sites (SS)/ ND: selected credits from Green Infrastructure & Buildings (GIB)							
	Construction Activity Pollution Prevention	X	X	X				X
	<i>Environmental Site Assessment</i>		X					
	Site Assessment	X	X					
	Site Development: Protect or Restore Habitat	X	X			X	X	
	Open Space	X	X					
	Rainwater Management	X	X	X		X	X	X
	Heat Island Reduction	X	X	X		X	X	X
	Light Pollution Reduction	X	X			X	X	X
	Site Master Plan		X					
	<i>Joint Use of Facilities</i>	X	X				X	
	No Invasive Plants			X				
	Nontoxic Pest Control			X/X				
	<i>Site Management Policy</i>					X	X	
	Site Management					X	X	
	<i>Site Improvement Plan</i>					X	X	
	Minimized Site Disturbance							X
LEED CATEGORY	Water Efficiency (WE)/ ND: Green Infrastructure & Buildings (GIB)							
	Various credits re. water efficiency. Issues relate to wildlife include human water use affecting natural water cycles and requiring energy, see also Energy & Atmosphere. Credits include							
	Outdoor Water Use Reduction/ HOMES: Outdoor Water Use	X/X		X		X	X	X
	Wastewater Management							X
LEED CATEGORY	Energy & Atmosphere/ ND: Green Infrastructure & Buildings (GIB)							
	Various prerequisites/ credits that address energy performance and renewable energy.							
	Major issues directly related to wildlife include the effects of atmospheric pollution (through CO₂, greenhouse gases, and other pollutants) and fossil fuel extraction on global climate and wildlife habitats.	X	X	X		X	X	X
LEED CATEGORY	Materials & Resources (ME)/ ND: Green Infrastructure & Buildings (GIB)							
	Various prerequisites/ credits that address the entire life-cycle of materials, including during the building's life-cycle. Major issues directly related to wildlife include the sourcing of raw materials.	X	X	X		X	X	X
LEED CATEGORY	Indoor Environmental Quality/ ND: Green Infrastructure & Buildings (GIB)							
	<i>Various prerequisites/ credits that address healthy indoor environments. Issues related to wildlife include low-emitting materials which tend to create less environmental pollution during manufacturing, daylighting which saves energy, and views which can allow for appreciation of wildlife.</i>	X	X	X		X	X	X
LEED CATEGORY	Innovation (IN)							
	Various credits for exemplary performance or that can innovative or be selected from a list of current pilot credits, which as of 3-15-2014 include:	X	X	X		X	X	X
	Bird collision deterrence	X	X	X		X	X	X
	Local food production (ND: NPD credit, see above)	X	X	X		X	X	
LEED CATEGORY	Regional Priority (RP)							
	<i>(Extra points for achieved credits according to zip code)</i>	X	X	X		X	X	X

LEGEND

X = LEED prerequisite (mandatory) X = LEED credit (optional)

Water-related design

Greenspace-related design (may include water)

Other location/site/building decision that may help wildlife, may include policies

Other process/policy that may help wildlife

Bold = major direct impact on wildlife

Roman (non-bold, non-italic) = some impact on wildlife

Italics = minor, indirect impact on wildlife

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The LEED Platinum-certified G. Wayne Clough Undergraduate Learning Commons at the Georgia Institute of Technology.
Photo: Georgia Institute of Technology

FEATURED CAMPUSES

Georgia Institute of Technology¹⁷ (GA)

In its *2004 Campus Master Plan Update*, Atlanta-based Georgia Tech established sustainability as one of three directives essential to the future of its 400-acre campus. LEED provides an important strategy to make progress toward this goal. As of May 2013, Georgia Tech had 15 LEED-certified buildings: 2 Platinum, 11 Gold, 1 Silver, and 1 Certified. Other buildings await certification or are using LEED standards as a guide.

Among the certified is the LEED Platinum G. Wayne Clough Undergraduate Learning Commons. This 220,000 square-foot building, built in 2011, has wildlife-related LEED features, including an 18,000-square foot rooftop garden and a stormwater collection system. The green roof, which reduces the urban “heat island effect” (a phenomenon in which dense, paved areas warm up to 6°F more than nearby green spaces or forested areas), contributed LEED points for stormwater management, habitat, and open space creation. Next to the Clough building, and contributing to those same LEED points, is the newly-created Tech Green. Buried below is a 1.4 million gallon cistern that collects stormwater and air conditioning condensate, which is used for watering the Tech Green and the Clough building’s rooftop vegetation, as well as to flush Clough’s toilets.

The landscape around the building was planted with 39 native species, including trees, which provide shelter and food for insects, birds and other wildlife. According to Howard Wertheimer, Georgia Tech’s director of capital planning, trees are considered critical to the campus master plan. A group of faculty, staff and students monitors and promotes the health of the 5,000 trees on campus, many of which surround the LEED buildings and contribute to LEED points.

Emory University¹⁸ (GA)

Also located in Atlanta, Emory University is a recognized national leader for LEED-certified buildings, with 25 on its campus and more in progress. Many of these certifications were earned from upgrades to existing buildings. Beginning in 2001, a campus policy requires that all new construction and major renovations must achieve LEED Silver certification or higher. In addition, any building project must conform to Emory’s Land Use Plan, which requires 50% of the university’s 700-acre campus to remain as undeveloped open space. Currently, the university is maintaining 54% of its campus as protected greenspace. The plan also pledges no net loss of forest canopy. Any trees removed due to construction must be replaced.

The story of Emory’s green buildings includes a wildlife challenge that reshaped the university’s design standards. The LEED-Certified Math and Science Center, completed in 2002 as an early campus LEED project, has a three-story system of reflective glass walls facing the adjacent Harwood Forest. The walls proved deadly to migrating birds. The birds could not tell that the trees and sky they saw in the glass walls were reflections. As a result, large numbers of birds collided with the building. Reconstruction was considered but proved prohibitively expensive. Instead, campus managers opted to erect protective bird netting over the glass during fall migration.

The design of all new campus buildings now addresses this concern by using small panes of glass and avoiding reflective glass coatings, according to John Wegner, senior lecturer in Emory’s Department of Environmental Studies. He mentioned Cornell University’s pioneering designs with downward-tilted glass that reduce the reflective effect, which also has proven to be an effective strategy. LEED now offers an Innovation Point for Bird Collision Deterrence, thanks to awareness raised by early pioneers such as Emory.



The Math and Science Center at Emory University.
Photo: Kay Hinton, Emory University

Wegner also said, “As we have added more buildings on campus, we have not noted any decline in wildlife.” Emory’s commitment to sustainability and its many LEED-certified buildings—with their collective achievement of LEED credits that encourage open space, habitat restoration, and stormwater management—contributed greatly to this outcome.

Oberlin College¹¹⁹ (OH)

Oberlin’s 14,000-square-foot Adam Joseph Lewis Center for Environmental Studies (AJLC) was designed in the 1990s, just as the U.S. Green Building Council was finalizing its first LEED standards. The structure was completed in January 2000. From 1993 to 1998, Oberlin students were integral to the building’s design process.

AJLC was conceived as an “integrated building-landscape system” with green spaces that would be modeled after natural ecosystems. Although the building’s 1.5-acre lot is not expansive, many wildlife opportunities have been created by incorporating a pond and restored wetland area into the building’s water cycles, which includes wastewater treatment. Facilities manager Sean Hayes, who oversees operation of the 14,000-square-foot building and its grounds, points to a loud chorus of frogs each spring as testament to the success of this effort.

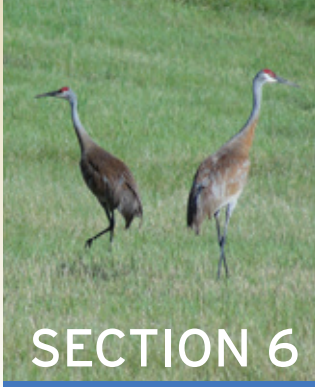
An organic permaculture garden with fruit trees and vegetable beds on the site demonstrates that urban agriculture can also provide wildlife areas. Hayes notes that the orchard, with its 50 pear and apple trees, regularly attracts raccoons, opossums, rabbits, and many birds. The land around the

pond, wetland, and garden has been landscaped with more than 50 indigenous Ohio plant species, which help attract both resident and migrating birds. Species regularly spotted around AJLC include cardinals, robins, blue jays, crows, and finches. Rainwater is captured in a 10,000-gallon cistern and then slowly released to the pond and wetlands.

Both wastewater treatment and a native landscape with stormwater irrigation contribute LEED points to a building. Although never officially certified, AJLC incorporates many aspects of LEED and is widely recognized as an early sustainable showcase building that inspired campus projects throughout the U.S. In 2006, Oberlin adopted a policy calling for all new buildings to conform to LEED Silver design standards or higher. It now boasts five LEED-certified buildings on a campus that serves a student population of 3,000.



The innovative Adam Joseph Lewis Center at Oberlin College.
Photo: Jennifer Manna



SECTION 6

Toward a Wilder Campus Future

In the previous pages, *The Campus Wild* features dozens of ways that students, faculty, and staff at the nation's colleges and universities are taking action to protect wildlife and habitat on campus. It showcases innovative examples from all 50 states, plus D.C. This groundbreaking guide not only highlights the different ways this is happening, such as by landscaping with native plants, managing natural areas, planting trees, using stormwater to recharge groundwater, and studying distant campus-owned wild lands, it also spotlights how green spaces on campus are being used for valuable learning opportunities for students. It shows the many ways students are experiencing—and leading—hands-on activities to improve their schools and better understand how outdoor environments are important to the health of both people and wildlife. The featured campuses are leaders in the higher education community and in their local communities, and serve as role models for educational institutions across the country.

More than 70 years ago, wildlife ecologist Aldo Leopold¹²¹ envisioned how colleges and universities could serve as training grounds for all students to learn “land ecology,” using the campus lands around them. He proposed an “all-campus

teaching effort with vital local facts and questions.” Lamenting how academic disciplines focus too narrowly on their own limited worlds, he said, “All the sciences and arts are taught as if they were separate. They are separate only in the classroom. Step out on the campus and they are immediately fused.” Furthering this idea, he added, “The objective is to teach the student to see the land, to understand what he sees, and enjoy what he understands.”

This, then, is our challenge: to turn the attention of an increasing number of students toward the “wild” during their precious few years on campus. It is a critical time to win both their minds and their hearts. Nothing generates connection to a place better than opportunities to study it, help care for it, and to learn the names of the plants and animals that live there. The possibilities for learning are endless, no matter what the major or academic discipline. And once students learn to care for a place, they are more likely to care for other places throughout their lives and careers. Connecting to “The Campus Wild” could well lead to a lifelong love affair with nature and wildlife, no matter where a student's path may lead.

Kansas State University Rain Garden
Photo: Lee R. Skabelund



Appendix

A. Resources for “The Campus Wild”

The following resources are just a sample of the many online and print publications that can assist colleges and universities with their Campus Wild projects and planning. Most come from the National Wildlife Federation, for readers not familiar with NWF’s broad range of offerings. A number of other resources are included that cover important topics and organizations.

FEATURED RESOURCE

NWF’s Campus Sustainability Case Studies Database¹²⁰

The Campus Sustainability Case Studies Database, sponsored by NWF’s Campus Ecology program, features nearly 800 case studies from nearly one-quarter of all colleges and universities in the U.S. It covers 17 campus environmental and sustainability categories including habitat, farming and gardening, energy, transportation, green jobs training, dining services, and more. Each case study features project goals, accomplishments, challenges, financing, educational outreach strategies, and campus contacts. The database features all types of higher education institutions—large and small, public and private—and includes a clickable map to link to locate specific campuses. The NWF case studies resource gives campuses the opportunity to showcase their accomplishments—along with other schools across the country—and offer inspiration and models for campuses that are developing and launching their own sustainability initiatives. This national resource documents the sustainability movement in U.S. higher education as it has transformed curricula, campus operations, and communities in ways that prepare the next generation of leaders in wildlife conservation and many more career paths.

National Wildlife Federation – Websites and Publication

[Campus Environment 2008: A National Report on Sustainability in Higher Education](http://www.nwf.org/Campus-Ecology/Resources/Reports/Campus-Report-Card.aspx),
<http://www.nwf.org/Campus-Ecology/Resources/Reports/Campus-Report-Card.aspx>

[Campus Sustainability Case Studies](#)
NWF’s Campus Ecology program

[Changing Course: Why protecting floodplains is good for people and wildlife](#)
Dan Siemann, 2013

[Clean Water Grows: Six Successful Cover Crop Outreach Efforts](#)
Lara Bryant, 2013

[Climate Change and the Next Generation of Wildlife](#)
Felice Stadler, 2014

[Climate Change Effects & Adaptation Approaches for Terrestrial Ecosystems](#)
Patricia Tillmann, 2014

[Ecodemia: Campus Stewardship at the Turn of the 21st Century by Julian Keniry, 1995](#) –
<http://www.nwf.org/Campus-Ecology/Resources/Reports/Ecodemia.aspx>

[Five Questions: Getting More Out of an Urban Garden Than Vegetables](#)
NWF, 2009

[Forestry Bioenergy in the Southeast United States: Implications for Wildlife Habitat and Biodiversity](#)
Jason M. Evans and others, 2013

[Generation E: Students Leading for a Sustainable, Clean Energy Future](#)
Christina Erickson and David J. Eagan, 2009

[Going Native: Rooting Campus Landscape Planning in Low-Energy Native Plants](#)
NWF, 2009

[Green Roofs Yield Climate and Habitat Benefits on Campus](#)
Julian Keniry, 2005

[Guide to Climate Action Planning: Pathways to a Low-Carbon Campus](#)
David J. Eagan, Terry Calhoun, Justin Schott and Praween Dayananda, 2008

[Higher Education in a Warming World: The Business Case for Climate Leadership on Campus](#)

David J. Eagan, Julian Keniry, Justin Schott and others, 2008

[Mascot Madness: How Climate Change is Hurting School Spirit](#)
Doug Inkley, 2014

[Natural Defenses from Hurricanes and Floods: Protecting America's Communities and Ecosystems in an Era of Extreme Weather](#)

Patty Glick, John Kostyack, James Pittman, Tania Briceno and Nora Wahlund, 2014

[Restoring the Gulf of Mexico for People and Wildlife: Recommended Projects and Priorities](#)

Ryan Fikes, 2014

[Shifting Skies: Migratory Birds in a Warming World](#)

Doug Inkley, 2013

[Student Sustainability Educators: A Guide to Creating and Maintaining an Eco-Rep Program on Your Campus](#)

Christina Erickson, 2012

[Swimming Upstream: Freshwater Fish in a Warming World](#)

Doug Inkley, 2013

[The Growing Business of Cover Crops](#)

P.A. White, 2014

[Ticked Off: America's Outdoor Experience and Climate Change](#)

Doug Inkley, 2014

[Wildlife in a Warming World: Confronting the Climate Crisis](#)

Amanda Staudt, Corey Shott, Doug Inkley and Isabel Ricker, 2013

Other Resources

[AASHE: How To Guide to Promoting Campus Sustainable Landscapes](#)

Judy Walton and Mary Sweeney, 2013

[Landscaping the Sustainable Campus: Resources and Tips for Campuses](#)

Indiana Wildlife Federation

[Roadmap to a Green Campus](#)

U.S. Green Building Council, 2010

[Tree Campus USA Standards](#)

Arbor Day Foundation

[USDA PLANTS Database](#)

The PLANTS Database provides standardized information about native and introduced vascular plants, mosses and lichens of the U.S. and its territories.

Ithaca College

Photo: David J. Eagan

Appendix

B. Schools featured in *The Campus Wild* by State

Alabama	Auburn University University of West Alabama
Alaska	University of Alaska Fairbanks
Arizona	University of Arizona
Arkansas	Harding University
California	Butte College University of California, Berkeley University of California, Los Angeles University of California, Santa Barbara University of California, San Diego
Colorado	Naropa University
Connecticut	Central Connecticut State University
Washington, D.C.	American University
Delaware	University of Delaware
Florida	University of South Florida
Georgia	Agnes Scott College Emory University Georgia Institute of Technology Georgia Southern University
Hawaii	University of Hawaii Manoa
Idaho	University of Idaho
Illinois	Eastern Illinois University Roosevelt University University of Illinois at Chicago
Indiana	Butler University Indiana State University Indiana University Purdue University
Iowa	Luther College
Kansas	Kansas State University
Kentucky	Western Kentucky University
Louisiana	University of Louisiana at Lafayette
Maine	College of the Atlantic
Maryland	Towson University
Massachusetts	Harvard University
Michigan	Michigan State University University of Michigan Western Michigan University
Minnesota	Saint John's University University of Minnesota, Crookston
Missouri	Washington University in St. Louis
Mississippi	Delta State University
Montana	University of Montana

Nebraska	Doane College Nebraska Wesleyan University
Nevada	University of Nevada, Las Vegas
New Hampshire	Franklin Pierce University
New Jersey	Raritan Valley Community College
New Mexico	University of New Mexico
New York	Cornell University Fordham University Ithaca College SUNY Rockland Community College
North Carolina	Duke University Warren Wilson College
North Dakota	United Tribes Technical College
Ohio	Oberlin College The Ohio State University University of Cincinnati
Oklahoma	University of Oklahoma
Oregon	Oregon State University Portland State University
Pennsylvania	Allegheny College California University of Pennsylvania Lafayette College Northampton Community College Pennsylvania State University Wilkes University
Rhode Island	University of Rhode Island
South Carolina	Furman University Spartanburg Community College
South Dakota	Black Hills State University
Tennessee	University of Memphis
Texas	Texas A&M University Texas Southern University University of Texas, Austin
Utah	University of Utah Utah State University
Vermont	Green Mountain College
Virginia	Randolph College
Washington	The Evergreen State College Seattle University
West Virginia	West Virginia University
Wisconsin	College of Menominee Nation University of Wisconsin-Madison
Wyoming	University of Wyoming

Endnotes

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