

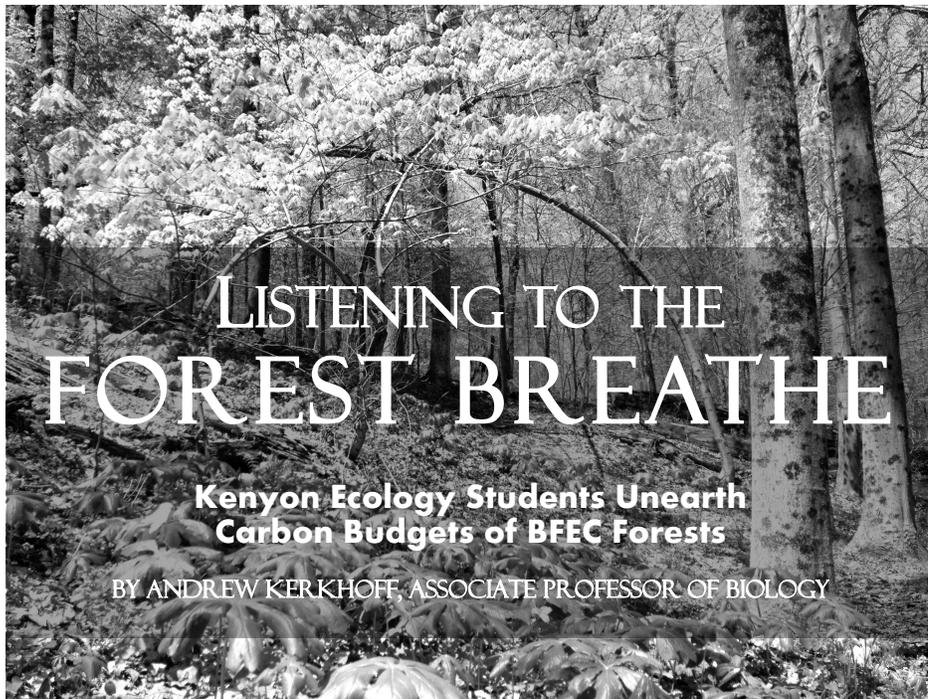
Brown Family Environmental Center

at Kenyon College

Field Notes



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LISTENING TO THE FOREST BREATHE

Kenyon Ecology Students Unearth Carbon Budgets of BFEC Forests

BY ANDREW KERKHOFF, ASSOCIATE PROFESSOR OF BIOLOGY

This article is the first of an occasional series in which we will highlight Kenyon faculty and student research at the BFEC, and what it tells us about our natural world.

Everyone knows that old saying about “missing the forest for the trees,” and really, from the point of view of a tree-hugger like myself, that is really understandable – trees are really beautiful living things! We learn from a young age that trees are critically important to life on Earth as we know it.

In their leaves, trees use sunlight to convert atmospheric carbon dioxide into food, releasing in the process the oxygen that is absolutely essential to animals like us. They literally use light to spin air into sugar! And in the process they give us the air we

breathe. It seems too good to be true – a child’s dream, indeed.

But a forest is more than simply a collection of trees. Birds, bats, moths, and innumerable smaller insects flit through the canopy. Squirrels, foxes, and deer lurk, cavort, hide, and stalk among the trunks, while woodmice and beetles dodge and clamber among the ferns, forbs, and leaf litter of the forest floor. The forest even extends out of sight belowground, where networks of fungal hyphae lace the soil, joining the roots of all the trees into one highly-connected, pulsating “wood wide web.” When you walk in a forest, you are truly immersed, buoyed by the ground between the soaring branches above your head and the burrowing roots beneath your feet.

This sense of immersion, of being totally enveloped, make forests my favorite place to walk on the BFEC: from the multilayered collection of oaks, cherries, elms, ashes, and hornbeams of the Fern Trail, to the quiet, shady cathedral of the pine plantation, and even the stand of optimistic young sycamores slowly reclaiming the old field along the River Trail. All of them are beautiful, but even though they are all forests, they are strikingly different.

Divergent Forests

In late summer, the sycamore grove is sunny and crowded. Uniformly straight and slender trunks of characteristically flaking green grey bark rise out of a head-high crop of wingstem, all scabrous leaves and yellow, daisy-like flowers. Wingstem is usually a prairie plant – you can find it in the BFEC wildlife garden and along roadsides as well – and it only grows in the sycamore forest because the young trees still let abundant sunlight through to the forest floor. As the trees grow and the canopy deepens, wingstem plants will slowly be pushed to the edges of the stand, to be replaced by other, more shade-tolerant species. This is a “successional” forest, recolonizing a narrow spit of land between the Kokosing River and the Kokosing Gap Trail. After many years of row crop agriculture, the plot was removed from cultivation by the BFEC in 1994.

The pine plantation came into being just a few years before that. In honor of Earth Day in 1990, Kenyon faculty, students, and community members planted 1,000 white pine seedlings on the hilltop above the BFEC

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“... carbon sequestration through reforestation and the conservation of existing forests represents one of the most powerful tools humans have for mitigating our climate impacts”



Kenyon students Toni Miller 15', Heather Fantry 16', and Gwendolyn Lloyd 16' collect data in the pine forest. Photo courtesy of Toby SantaMaria.

farmhouse. Over the past 25 years, the plantation has slowly thrown the former pastureland into deep shade. The seedlings were planted only 10 or 15 feet apart, and as the pines grew, their crowns spread to close the gaps between the trees.

When I came to Kenyon in 2005, the pine plantation was still a largely impenetrable coniferous thicket, punctuated with rambling vines of poison ivy. But as the trees grew taller, adding layered whorls of limbs and needles, the trees actually shaded out not just the ground vegetation, but their own lower branches. The boughs, most now more than a foot in diameter, are studded with skeletal and broken ghosts of their old crowns. The ground beneath the trees is a spongy bed of fallen needles; smaller plants only grow near the edge of the plantation and in the small gaps where individual trees succumbed, whether to disease or deer browsing. The resulting gallery, with row upon row of pillar-like pines extending in all directions, is so architectural that it is clearly a human construction, but it is still somehow a forest.

The pillars of the pine plantation, while impres-

sive, are dwarfed by the tallest oaks and beeches of the forest along the Fern Trail. These rocky, steep slopes were never useful for pasture or crops, so the forest likely long served as a woodlot, with select trees being logged out for timber or firewood. As a result, the forest has developed a complex, layered canopy of multiple species and varied stature.

The greatest contrast with the pine forest and the sycamore grove is how open this more mature forest seems (pictured below). The leaves rustle in the wind far above the hillside, and the height of the trees is matched with a much wider spacing between their trunks. The exception is in gaps created when one of the big trees

dies and falls. There, younger trees crowd around the fallen log, racing each other upwards to fill the hole in the canopy. Other small species like hornbeams, ironwoods, and dogwoods don't bother with such competitive jostling. Instead, they are adapted to thrive in the partial shade of the mid-story, capturing the light that passes through the sieve of the upper canopy.

The forest floor is as varied as the canopy above. Trillium and other wildflowers coexist with a collection of tree seedlings, ferns, and shrubs. Many of the largest oaks exceed three feet in diameter, and have likely been here for nearly two centuries. The largest may have been here when Philander Chase himself wandered across these hills, seeking a site for his college.

An Atmospheric Bank

The woodlots, plantation, and successional forests of the BFEC are representative of the forests in rural landscapes across eastern North America more generally. Instead of the largely unbroken expanse of forested land that greeted the earliest European colonists, our modern landscape is a patchy mosaic of different



Elementary school students on a field trip explore the BFEC's fern trail, which winds through a mature forest with an open under-story.

forest types, nestled among our fields and villages, our towns, suburbs, and cities. Mirroring patterns across much of the US, Ohio's forests have been reduced by more than 2/3 over the past two centuries, but the remaining patches (and potentially the new plantations and successional areas) still provide valuable ecosystem services, including the provision of wildlife habitat, the filtration of surface and subsurface run-off, erosion control, and carbon sequestration.

Given the reality of climate change caused by human greenhouse gas emissions, the exchange of carbon dioxide between forests and the atmosphere is particularly important. As mentioned above, every living tree takes up carbon dioxide, the most important greenhouse gas. Some of that carbon becomes part of the tree, locked away in the complex molecules that make up the wood and leaves of its body, its flowers and seeds. Even when parts of the tree die (remember all of those needles and dead branches in the pine plantation, or the leaf litter and fallen trees of the Fern Trail forest) much of the carbon remains in the litter and soil. The carbon that is bound up in the trunks, leaves, and soil of the forest is *sequestered*. It is kept out of the atmosphere, at least for a time.

Globally, forest carbon sequestration strongly influences the overall cycling of carbon between the Earth surface and the atmosphere, and deforestation is itself a significant component of how humans cause climate change. Likewise, carbon sequestration through reforestation and the conservation of existing forests represents one of the most powerful tools humans have for mitigating our climate impacts.

Just as the amount of money in your checking account is determined by your income and your expenses, the amount of carbon sequestered by a forest (the standing stock of carbon in the leaves, trunks, soil, etc.) represents the balance of carbon inputs (the total CO₂ taken up by the leaves) and carbon outputs (the total

CO₂ released through respiration by all of the plants, animals, fungi, and microbes). Together, these stocks, inputs, and outputs are known as the *carbon budget* of the forest.

In my Ecology Laboratory class, my students and I study how the differences we so readily observe when walking through the BFEC forests influence their carbon budgets. Using protocols developed by the USGS Forest Service and other foresters and ecosystem scientists, we quantitatively estimate all of the major components of the carbon budget.



Student Gwendolyn Lloyd '16, and Professor Drew Kerkhoff check leaf traps to gather carbon budget data.

The methods are time consuming and range from primitive (cutting, drying and weighing vegetation) to positively high-tech (using tree ring records and statistical models to estimate tree growth). But over the course of the semester, the students build up a scientific picture of the forest carbon budgets that is comparable to those used by natural resource managers, ecosystem scientists, and biogeochemists.

Surveys Say.....

So what do we find out about those three BFEC forests that we were walking through earlier? Not surprisingly, the trees themselves make up a huge fraction of the carbon stock

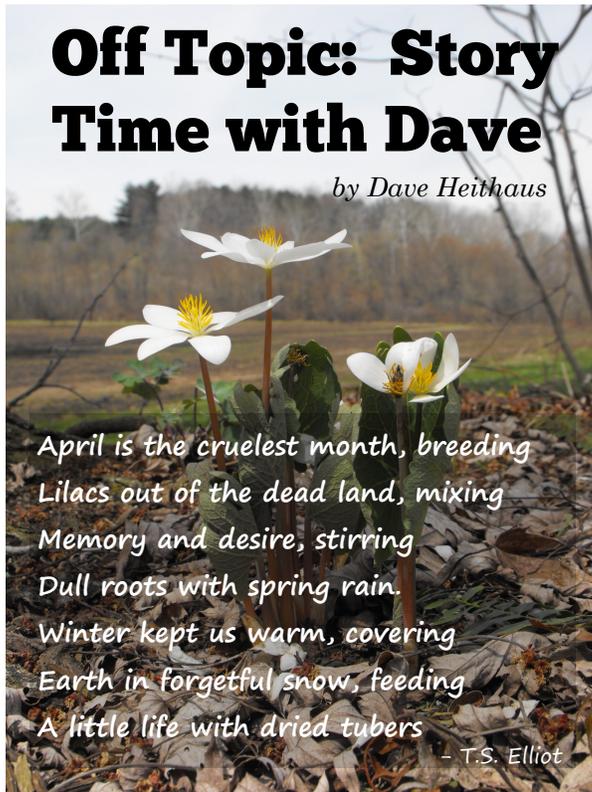
of any forest, and large, old trees like those oaks along the Fern Trail represent particularly large stocks of sequestered carbon. What the students are always a bit more shocked to realize is that the soil beneath our feet also represents a very large carbon stock. For example, in the sycamore grove, just the top 10 cm of soil contains almost as much carbon as all the trees, shrubs, and herbaceous vegetation visible above ground – and the floodplain soils of that area are in fact much deeper.

Finally, we find that despite the striking differences we see when walking through them, the three forests are actually fairly similar in terms of their rate of carbon uptake. The huge trees of the Fern Trail are proportionally productive, but what the sycamores currently lack in size, they largely make up for in numbers. There are certainly differences in carbon uptake between the forests (for their size, the pines grow a bit more slowly than the broadleaves for example), but all of them take up significant amounts of carbon. Thus, keeping our few remaining older forests intact, and letting our young forests mature is a significant investment in carbon sequestration.

By learning to do all of this careful carbon accounting, the Ecology Lab students are contributing to a project with implications well beyond a Kenyon course, and beyond the boundaries of the BFEC itself. Our results provide concrete data to inform future discussions of sustainability at Kenyon, and they contribute to a growing body of knowledge about how diverse forest types contribute to the carbon balance of terrestrial ecosystems more generally. One recent graduate was even able to put our same methods to use in helping to develop a sustainable forestry initiative in rural India. Bringing authentic research into undergraduate courses helps students to understand the process of science, and the forests of the BFEC provide a beautiful and inspiring setting for (literally) getting our hands dirty and trying to figure out how the natural world actually works.

Off Topic: Story Time with Dave

by Dave Heithaus



*April is the cruelest month, breeding
Lilacs out of the dead land, mixing
Memory and desire, stirring
Dull roots with spring rain.
Winter kept us warm, covering
Earth in forgetful snow, feeding
A little life with dried tubers*

- T.S. Elliot

Old T.S. must have missed the pleasure of a February in Gambier. April is the cruelest month? Really? That ... that is just absurd. And dried tubers don't exactly qualify as banquet fare.

I don't give one hot drop of monkey sweat what TS Elliot says; April is not the cruelest month. February is. They don't string pretty lights up in the trees in April out of fear that seasonal depression will lead to a spike in the suicide rate. They do that in FEBRUARY. The original cruelest month. Why do you think it got cut to 28 days? Because everyone loves it so much?

Here are 28 reasons why February is the cruelest month: February 1st, February 2nd, February 3rd, February 4th, February 5th... you see where this is going.

Now that we've gotten that and winter out of the way, let's focus on spring and the future. And by the future I mean the past. Believe it or not, the preserve is about to celebrate its twentieth birthday and we have some big party plans on the horizon. Who doesn't like a birth-

day? It's the one day that a person can get away with pretty much whatever they want inside the boundaries of law and decency. We intend to capitalize on that...

How did we survive to twenty you ask? In all honesty and like many others turning the corner into adulthood, we did it through the generosity of others. Without the support of the college, our members, donors and volunteers we'd be 2.75 people sitting in an overgrown field very cold and very hungry and very frightened of the banjo music echoing from the darkest hollows.

When the center began as the Kenyon Environmental Center, it was land with potential. Twenty years down the line, with mountainous piles of support, we've been able to realize some of that potential. Here are some....

... highlights and perspectives on twenty years of being a thing:

- Over 10,000 trees of at least 50 species have been planted at the BFEC. That's what we call diversified carbon sequestration.
- Over 16,000 elementary school students have attended field trips at the BFEC. We like to think that at least six of them went on to save some small part of the world.
- If you attended our first season of elementary school field trips you are now old enough to indulge in any of the federally age-restricted vices or run for a seat in Congress... which may be redundant.
- Since our inception, the McRib has risen and fallen, risen and fallen, risen and fallen... only to rise again. And then fall. I think maybe twenty times. Except in

Germany. It stayed on the menu there.

- Almost 1,000 bluebirds have fledged from BFEC nesting boxes under the watchful eyes of our volunteer monitors.
- 1995 saw the Kenyon community slogging through the underbrush if they fancied a stroll in the woods. Today over 8 miles of trail give visitors safe access to the vast majority of the preserve.
- Two State Scenic Rivers have been designated in Knox County since the days of the "Kenyon Environmental Center": our beloved Kokosing in 1997 followed by the pretty okay Mohican in 2006.
- In 1995, the president of the college was famed marksman* and judo grand master*, Phillip Jordan. Today the president of the college is legendary bullfighter* and mixed martial arts champion* Sean Decatur. *[ed. rumor, please fact check before publication]
- Nearly 58 acres of the original preserve have been restored to historically natural woodland and prairie.
- Tens of thousands of people have participated in BFEC programs and events like the Harvest Festival, Earth Day Festival, Family Adventure Days and the Natural History Series.
- In 1995, the Kenyon Men's swim team was already 15 national titles deep in what would become a 31 year run. By publication time, we should know if that list has been added to. Go Lords and Ladies!

We are proud to have been able to tap some of the potential held within the boundaries of the preserve. In no way do we believe that it is tapped out though! What the next twenty years will hold depends slightly on whether or not my Powerball numbers come up but, regardless, it should be exciting.

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Earth Day Festival & food: a perfect pair

The BFEC and community partners (Knox County Health Department, Knox County Park District, and the Knox County office of OSU Extension) are cooking up the 9th annual Earth Day Festival on Sunday, April 19th. The event features diverse offerings to inspire and support healthy living for ourselves and our world (see details p.6)

Organizers are striving to take this mission a step further this year by connecting visitors with resources that will extend beyond the one-day event. Our “Grow - Eat - Compost - Repeat!” demo series will give people real knowledge (and potted vegetable seeds) to take home.



AVI Fresh, which partners with Kenyon College to source and prepare 40% of the college's food needs through local sources, will present a cooking demo featuring seasonal produce at 1pm. With recipe in-hand, visitors can then give it a try after potting-up (and growing) seeds of the featured veggies with OSU Extension Master Gardener volunteers, as well as catch a container gardening demo at noon. Master Gardener volunteers will also share composting know-how with a 11am demo.

While food may seem like a far cry from the BFEC's mission, purchasing local, in-season food leads to cleaner air by conserving transportation energy, plus builds a stronger community and economy. Composting food scraps is also a great step to take at home to limit green house gases and the growth of landfills. For additional opportunities to shop local, learn and connect, visit kenyon.edu/earthday.

Get your free milkweed seeds!



One year ago, we reported the disheartening news that the monarch butterfly population was in alarming decline. During the winter of 13-14, monitors reported the smallest population on record, down by over 90%.

Monarchs are well known because of their one-time abundance, plus the awe-inspiring story of their annual 2,000 mile migration to the Sierra Madre Mountains in central Mexico. Once they arrive, they huddle together on fir trees, covering every inch of trunk and leaf. At a high point, recorded in 95-96, their masses covered 21 hectares (or about 52 acres) of forest. The area fell to just .67 hectares in 13-14. Though it bounced back to 1.13 hectares over this past winter, the bounce was not nearly high enough to ensure the survival of the species.

The decline is due to multiple factors, including logging in their wintering habitat and unfavorable weather patterns. But the biggest emerging issues is habitat loss in the U.S. Monarchs require milkweed plants for survival, since it is the “host plant” on which they lay eggs. While milkweed was once abundant among agricultural fields, widespread pesticide use and reduced field margins has led to a large loss of the plant they can't do without.

If you have a sunny patch of yard, you can help. For the second year, the BFEC will be giving away free common milkweed (*Asclepias syriaca*) seeds at the Earth Day Festival on April 19th. Attract monarchs to your yard and enjoy the incredibly fragrant milkweed flowers. See more information about sourcing and growing milkweed at bfec.kenyon.edu.

Calendar of Events

*All events are free, open to the public, and start from the BFEC Resource Center unless stated otherwise.
9781 Laymon Road, Gambier Ohio | 740-427-5050 | dohertyh@kenyon.edu | bfec.kenyon.edu*

Bald Eagles Along the Kokosing - Saturday, April 4th, 1:00 - 4:30pm. Join us to learn about our national emblem, starting indoors with former Metro Parks Chief Naturalist Gary Moore, and volunteer eagle nest monitor Brad Perkins. We'll then car pool 2 miles to a nesting site along the Kokosing where (with luck) we'll view Eagles that may be feeding young. All ages welcome. Co-sponsored by the Knox County Park District.

Spring Wild Edibles Hike - Saturday, April 26th, 1:00pm. Miller Observatory Trailhead. Join local self-sufficiency enthusiast Shawn Dailey for a hike to identify wild edible plants. The tour will start at the Miller Observatory and cover 2.5 miles of hilly terrain, followed by a wild-foods tasting. Bring water, hiking footwear, and an adventurous spirit. *From downtown Mt. Vernon, travel 4 miles east on S.R. 229. Just before reaching Laymon Road, turn left on access road marked with observatory sign.*

Wildflower Hike - Saturday, May 2nd, 1pm
Take a 1.5 mile hike on the Fern Trail to enjoy spring woodland wildflowers, as they take advantage of the strong spring sun before leaves emerge. See mayapple, trillium, dogwood, and more.

Breakfast with the Birds - Saturday, May 23rd, 9am. Enjoy coffee and donuts before taking a leisurely walk to see some of the seventy-eight bird species that nest at the BFEC. Binoculars and field guides will be available.

Pond Exploration - Saturday, June 6th, 1-3pm
The BFEC ponds are busy with tadpoles and insects swimming, frogs perched in the shallows, red-winged blackbirds nesting, and dragonflies zooming overhead. Drop-in, grab a net and explore this mini-ecosystem of scurrying underwater creatures.

CELEBRATE EARTH DAY! **Sunday, April 19th - Kenyon Athletic Center**

EARTH DAY CHALLENGE Half Marathon & 4 Mile Run/Walk
Participants of all abilities are invited to walk, run or a little of both for a half marathon or 4 miler. Race begins at 8am, then stay to enjoy post-race amenities and the Earth Day Festival. Find more info and registration at premieraces.com.

EARTH DAY FESTIVAL: Healthy People ~ Healthy World

Keep yourself and the planet healthy - two goals that go hand-in-hand! Enjoy this FREE event from 10am - 2pm with exhibits, vendors, kids' activities, farm marketers, demos on cooking, gardening, and composting, live music & more. The Festival uniquely brings together the best in local resources. Celebrate Earth Day by shopping green and connecting with groups that support healthy living for ourselves and our world. More information at kenyon.edu/earthday



Have fun while connecting with and learning about nature, with hiking, creeking, games, crafts, and more.

For 5-7 year old children: Two sessions will be offered starting on June 22 & June 29 in partnership with the Science Play-Space Initiative. Camp runs 9am to noon, Monday through Friday. Look for online registration coming soon to spispot.org.

For 8-11 year old children: One session will be offered on Wednesday, August 5 through Friday, August 7, 9am - 4pm. Registration will open in May; contact Heather Doherty at 427-5052.



Thank You to...

Our Members *January - March*

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Eben Crawford
Linda & Charles Findlay

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Our Donors

After Kenyon Society; Bench donation in memory of Andrew Bobick '00;

Our Volunteers

In the office and on the trails: Paula Barone, Shirley Hughes

Christmas Bird Counters, some of whom braved the cold for hours for the sake of our feathered friends: Karen Bagne, Chris Bowman & Susan Ramser, Don Comis, Gary Cowell, Chris & Kathy Gillen, Howard Gratz, Joan & Bill Heiser, Pat & Ray Heithaus, Debbie Hurlbert & Jon Menard, Brad Imhoff,

Vicki Lambert, Ann Laudeman, Usher Levering, Danielle McCament, Linda & Peter Michaels, Carson Miller, Kimmie Murphy & Bruce Hardy, Ben Nickley, Jim and Isabella Quinlivan, Fran Rodstrom, Erin Salva, Opal & Gene Sheperd, Debbie Shepherd-Gregg, Timothy & Leslie Shutt, Audrey Spearman, Lori Tottman, Pat Tuttle, and Susan Walker. Special thanks to the Birding FAN Club!

...Continued from page 4

At the end of the day, the people, places and programs at the BFEC are here to engage as many as possible with the wonders of the natural world. We will strive to find new and creative ways to do so in 2015 and every year after... until the sun explodes. Then we'll set up something new in another solar system. 

**Are YOU
a member?**

Now is the time to join the BFEC for 2015!

There are many reasons to become a member of the BFEC, including the satisfaction of knowing you're a part of critical education and conservation programs. Receive preferred access to popular workshops, a hard copy of our newsletters, and 10% discount on bird seed. Thank you for your support!

Membership level: Student ___ \$20 Individual ___ \$35
Family ___ \$50 Friend ___ \$100 Patron ___ \$250
Benefactor ___ \$1000 +

Amount enclosed: _____

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Brown Family Environmental Center at Kenyon College

9781 Laymon Road, Gambier, Ohio 43022 ~ (740) 427-5050 ~ <http://bfec.kenyon.edu>



Our Mission

The BFEC at Kenyon College exists to engage Central Ohioans of all ages with nature, and to support the goals of Kenyon College by conserving the natural diversity of the Kokosing River valley and providing opportunities for education and research.

Director of Facilities

David Heithaus

Director of Programming

Heather Doherty

Facility & Program Assistant

Jill Kerkhoff

Upcoming Events



Earth Day Festival

Sunday, April 19th | Kenyon Athletic Center | 10am - 2pm

- * Earth Day Challenge 1/2 Marathon & 4 Miler *at 8am* *
- * Over 90 Exhibitors * Live Music by the Rain Crows *
- * Local Artisans * Farmers Market & Live Farm Animals *
- * Kids' Activity Zone * Free Health Screenings *
- * Cooking, Gardening & Composting Demos *

kenyon.edu/earthday

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P.O. Box 508, Gambier, Ohio 43022



