



Loretto Earth Network News

LAND COMMUNITY

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Regenerate the Soils THEN Practice Sustainable Agriculture

Before we can legitimately talk about sustainable agriculture, we must practice regenerative agriculture. Current industrial practices are not healthy for us or for Earth and should not be continued. In early December 2018, your editor attended the 2018 Soil Revolution Conference in Boulder, www.soilrev.org, where national experts promoted the following five practices:

First, Minimize Disturbance.

Mechanical, chemical and physical disturbances destroy soil structure. What we want is soil with the texture of black cottage cheese, which “livestock beneath the ground” need privacy to create!

Second, Energize with Diversity.

Mimic nature by promoting biodiversity. Avoid monoculture farming. Lots of diversity can bring up 25-30 earthworms per shovelfull! Fields yield more profit per acre when crops are stacked. Attend to diversity in livestock too; each brings different gifts.

Third, Provide Soil Armor.

Keep the soil covered at all times to protect the ecosystem and the life that inhabits this invaluable resource. Plant cover crops off-season that add nutrients to the soil. Avoid sunburn and dry-out. Work all five steps to create a synergy.

Fourth, Maximize Living Roots.

The deeper the roots, the better. Leave them in the soil. The interaction between root fibers and micro-

organisms feeds the soil, sequesters carbon, enhances soil moisture and the entire living matrix.

Fifth, Integrate Animals.

Nature doesn't function without animals. Ruminants and grasses co-



evolved. Properly-managed grazing stimulates plants to pump more carbon into the soil. Smaller animals like chickens and rabbits help too. And do not ignore the tiny livestock under the ground; they are essential!

At the conference, David R. Montgomery spoke eloquently of his journey as a geologist learning from his biologist wife Anne Biklé the difference between dirt and living soil. *The Guardian* online hosts their dramatic personal story as “The scientists whose garden unlocked the secret to good health.” More detail is in his book, *The Hidden Half of Nature*.

Other sources (beyond the conference) include “Ethan Roland – Carbon Farming” on You Tube. At about marker 9:30, view how Keyline Farming, especially enhanced by inoculating the soil with compost

tea, can add a full twelve inches of living topsoil in only 3-4 years – sequestering up to 50 tons of carbon per acre per year. At about 22:00, he describes Restoration Agriculture, pioneered by Mark Shepard.

Replacing corn crops with equally-nourishing chestnut crops (and soybeans with hazel nuts) provides the same or better level of nutrition to humans and animals, while avoiding annual soil disruption and supporting livestock or annual food crops on the same field as the nut trees.

Restoring Earth's atmosphere at 350 ppm requires us to remove more than 250 billion tons of carbon from the atmosphere. Communities of Life beneath the soil are ready and eager to do their job, if only our agricultural system will let them. With their help, CO₂ is turned into sugars which then become humic acid, a stable molecule that stores carbon undisturbed for 500 years. Roland maintains that agriculture could absorb 320 billion tons of carbon worldwide.

We are lucky at Loretto Motherhouse that our farmer brings a knowledge of soil communities and a deep relationship with the land to combine various methods into a synergistic, life-affirming, carbon-sequestering and regenerative agricultural practice. This is our potential as children of Earth who have the capacity to observe, listen, and learn from the story of Life on this planet, what humans need for our sustenance, health and survival.



Editor's Note:

Libby Comeaux CoL

of practice to navigate these times. (Recommended: Franciscan Richard Rohr's work at www.cac.org.) Being anchored in a nondual vastness like the sea is best learned in the physical presence of an elder already rooted deeply in the Earth. What lost opportunities we can regret!

The drumbeat of the American Indian Movement is rhythmic like the rolling of the tide, like the heartbeat of Mother Earth. *Laudato Sí* calls us to listen and learn from the peoples who have centered in that connection over the millennia before our founding fathers arrived and began their great experiment on this land – an experiment whose fatal flaws we must now correct.

Buckminster Fuller's work described the trim tab on the rudder of a large vessel. While the large rudder is well known for steering the ship, less known is the role of the mini-rudder installed on the large one. Only a slight movement of the tiny trim tab can change the direction of the giant ocean-going vessel, even in rough seas. What is our trim tab?

As I write this on the morning halfway between the Winter Solstice and Spring Equinox when you have this issue in your hands, I read that it is Groundhog Day. Today, Boulder Rights of Nature (BRON) is hosting a conference on the rights of prairie dogs to live, have habitat, and fulfill their role in the ongoing evolutionary process – Thomas Berry's three suggested rights of Nature. I continue to find hope that mainstream U.S. culture will embrace a trim tab like the Rights of Nature to turn away from the unfortunate and unforgiving legacy of the 15th century papal bulls in our constitution and national behavior. To learn more about Rights of Nature,

follow www.celdf.org and www.bron.org – and about the papal bulls, www.doctrineofdiscovery.org

Unfortunately, our current pattern of governance drives the ship of state into a monstrous sandbar. We could visualize that sandbar as formed by the two-thirds of the planet's topsoil that ill-informed agricultural practices have driven off the continents into the sea.

Vastly diverse communities in themselves, healthy soils are home to tiny creatures whose combined mass is greater than the mass of all animal life on Earth. Chemical-intensive tillage practices began before humans knew the role of millions of tiny farmers under the ground. Instead of killing them, we need to feed them! Their role is to communicate with the roots of plants, bartering nutrients from rocks for sugars and lipids, together making up what the Bible calls "the fat of the land." You can experience that fat yourself, if you are lucky to be near enough to healthy soil to scoop up its black-cottage-cheese texture full of earthworms.

Healthy soil absorbs and cycles carbon as well as water and protects the farmer (and our bodies) from unhealthy chemicals. So much more to learn! Enjoy this issue and follow the trail to further research.

Loretto Earth Network News

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Loretto Community

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Under the Wolf Moon in the third week of January, I walked a 7-circuit labyrinth with gentle people who drew it in the sand on Galveston Island. This last night of my annual sibling migration, I mused on the tradition of making pilgrimage by walking the labyrinth at Chartres Cathedral.

The sound of the waves masked the traffic on the sea wall above. Practicing modesty of the eyes, I ignored oil tankers and rigs filling one side of the horizon, the neon lights of the nearby amusement park on the other. In the middle was the vastness of that dark, open sea. I let the sounds of our Southern Ocean wash over me.

It took longer than usual to be willing to walk out of that center into my return. On the drive back, how curious to notice the stately white-domed church on Christopher Columbus Boulevard (and further on, a billboard advertising the Turn-Around Church). The new cathedral in downtown Houston features a floor-to-ceiling stained-glass Jesus. He has blue eyes, fair skin, and a golden sheen to his light-brown hair.

It is not surprising that Catholic-schooled youth immersed in a day of advocacy fumble awkwardly. Marches can generate a fervor of righteousness that by its very nature can backfire. It takes a mature spirituality born of years

Together Resilient:
Building Community in the Age of Climate Disruption
By Ma'ikwe Ludwig (Chelsea Green Publishing, 2017).

Book Review by Lisa Reynolds, CoL

“The challenges presented to us by the triple crises of climate disruption, resource scarcity, and economic insecurity have different solutions for different populations in the world. Our goal should be a sustainable and lower-carbon, socially-equitable, high quality of life for everyone...” So begins the first chapter of **Together Resilient: Building Community in the Age of Climate Disruption**. While Ludwig’s main approach is advocating for the creation of intentional / sustainable communities, there is invaluable information, founded on experience and clear analysis, that is offered to anyone interested in social justice.

To bring about the change needed, Ludwig describes how the increasingly complex world of our culture must be addressed from a systems perspective rather than the “siloeed” approach with which we are familiar. “... you can’t just solve many of our ecological problems directly or in isolation from a whole system that surrounds them. While the ecological realities are the most obvious, most tangible manifestation of the crisis, they are actually the end game of a whole series of causal pieces, and not where things start.”

Ludwig proposes addressing four essential areas in order to bring about the needed systemic change:

Worldview: It is the most fundamental paradigm of how we see the world and ourselves. It can be secular or spiritual, but without it being consciously addressed, it can drive motives and assumptions, clouding the realm of possibilities and limiting the perspectives underlying individual and collective actions. At its best, it can provide the vision and spiritual or philosophical ground needed for

creating a more just and sustainable world.

Social: It determines how we make decisions, how we resolve conflicts, how we personally interact and how we define cultural norms around race, class and gender. It includes the institutions we put in place to support our values. It can support or inhibit individuals’ abilities to function with a level of self-honesty, humility and compassion.

Economic: How we make, distribute and consume goods and services to meet our needs is not only a prevalent influence in our culture and the often-oppressive systems it supports, it is a fundamental component of our current exploitative view and treatment of the environment.

Ecological: This is the most visible of the four dimensions. It is less an intended outcome than a consequence of our often-unexamined worldview, social structures and economic system.

Without treating these four areas together, we run into roadblocks in attempting to make the radical change needed for a just and sustainable world. A community’s failure to succeed in this effort, according to Ludwig, is often due to “a breakdown in conflict resolution skills, lack of facilitation skills to keep decision-making moving along in a solid way, or a general lack of understanding of the immense cultural shift they are taking on in moving from a competitive to a cooperative framework.” I personally find this comprehensive approach valuable for us in Loretto as we explore how to move into our future as a community based in faith and committed to justice.

TOGETHER
Resilient
— Building Community —
in the Age of Climate Disruption



MA'IKWE LUDWIG

Ludwig’s experience in community, sensitivity to and respect of individuals and their diversity, and her thorough understanding of current social and political dynamics tempers what could have been an ideological diatribe of our current situation and a means to change it. Instead, it is a thoughtful and workable approach that is sorely needed at this time. One of the final chapters even provides some specific and practical political suggestions for an activist approach.

I found **Together Resilient: Building Community in the Age of Climate Disruption** to be one of the most comprehensive examinations of the inter-related components of our current system - a system devastating the ecology of the planet and contributing to increasing violence, injustice and destruction. It offers clear and down-to-earth suggestions for ways to create something better. The book is filled with examples from the author’s more than 25 years of experience in intentional communities. It combines thorough research with philosophical and creative approaches that offer specific means of creating an alternative to the crisis in which we find ourselves. This book is for anyone who cares about the *how* of becoming a community that attempts to model and inspire a way of life that advocates for peace and justice.

Dirt to Soil: One Family's Journey into Regenerative Agriculture

By Gabe Brown (Chelsea Green Publishing, 2018)

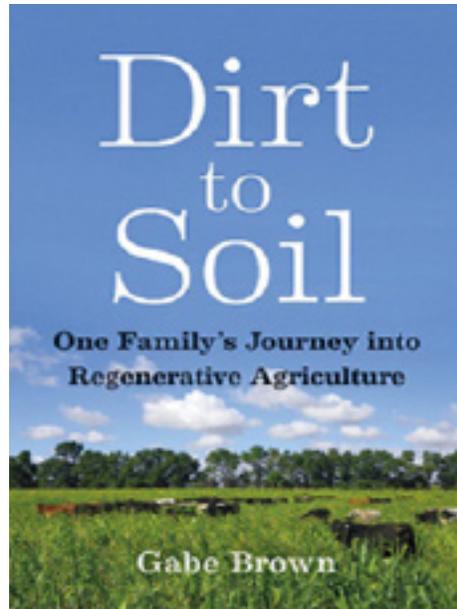
Book Review by Susan Classen, CoL

Picture this exchange. I'm at a Motherhouse Farm and Land Management Committee meeting when I mention that I was so excited about reading *Dirt to Soil* that I read it straight through while I was on vacation in Florida. After a brief pause, one of the committee members quipped, "You must be hard up!" By the end of this review, I hope you, too, are excited to read it!

Dirt to Soil is easy to read and understand. Gabe Brown takes his readers on a personal journey starting with his own difficult entry into farming when he and his wife, Shelly, lost their crops four years in a row due to weather-related disasters. On the brink of financial ruin and unable to till, plant or harvest, he discovered his land's ability to regenerate life. The book documents his personal experience along with the science of regenerative agriculture, which he learned from diligent personal study and a wide-range of experts.

Many farmers struggling to stay solvent will see themselves in Gabe's story because conventional wisdom pushes farmers to plant more in order to earn more. But Gabe discovered from experience that planting more simply increased the cost of buying fertilizer and chemicals, so he still didn't earn a profit. He now teaches that the goal isn't to increase the *yield* per acre but to increase the *profitability* per acre. How? By decreasing the use of fertilizer and chemicals, which are not only expensive, but also interfere with the natural cycles of life.

His book untangles the threads of our dependence on chemical inputs and then weaves together the coherent whole of natural ecosystem cycles. Here is an example of the downward



spiral of our dependence. Loss of biodiversity leads to less nutrients which leads to an increase in the use of synthetic fertilizer. Increased use of synthetic fertilizer leads to more weeds (weeds are high nitrogen users) which, in turn, leads to increased use of herbicides. Herbicides have a negative impact on plants by binding certain nutrients that are essential for warding off disease. A lack of those nutrients makes the plant more susceptible to fungal disease which leads to increased use of fungicides. Whew! Enough? Gabe isn't quite finished. A lack of nutrients also leads to increased pests which results in an increased use of pesticide.

Fortunately, the fact that everything is connected also results in the possibility of positive upward cycles. Let's take organic matter in the soil as an example. Increased organic matter improves soil biology which increases the nutrients available to the plants which increases plant health and decreases the need for chemical inputs. Gabe calculates that for every 1 percent increase in

organic matter, farmers save about \$750 per acre which they would have spent on fertilizer. Increased organic matter also improves water infiltration and decreases erosion since every 1 percent increase in organic matter results in an increased water storage capacity of between 17,000 and 25,000 gallons of water per acre.

The five principles of regenerative agriculture are applicable on any scale from a backyard garden to a large farming operation, and they produce visible results within the first three years. Together, they significantly increase the capacity of the soil to sequester carbon.

Many of us reading this review have heard over and over again that meat, particularly beef, contributes significantly to climate change. It's eye-opening to read Gabe Brown's perspective that it isn't cattle that are the problem but the way we manage them.

I will close with these words from the Rodale Institute regarding carbon emissions and regenerative agriculture.

Simply put, recent data from farming systems and pasture trials around the globe show that we could sequester more than **100% of current annual CO2 emissions** with a switch to widely available and inexpensive organic management practices, which we term "regenerative organic agriculture." (<https://rodaleinstitute.org/wp-content/uploads/rodale-white-paper.pdf>)

I enjoyed reading the book on vacation because I felt inspired and energized as my understanding of farming as mission broadened. As we become more effective in applying the principles of regenerative agriculture, we are not only improving the soil and increasing the farm profitability, but also fighting climate change.

Soils Can Save US

Interview

Elizabeth Black, like many of us, found Al Gore's movie, "An Inconvenient Truth", disturbing and motivating. Not one to sit idly by, she has since grown and given away more than 5,000 seedling trees for Boulder, Colorado. When she heard about carbon sequestration through improving soil health, she found a new mission.

Now she facilitates the Citizen Science Soil Health Project, supported by Boulder County and the local Farmers Market. The 10-year Project will coordinate and document participants' steps to improve soil health. The goal: help participants get their soil in the best shape possible, so it can withstand the droughts and floods ahead and help draw down atmospheric CO₂. As soil health improves, there is more microbial life, and thus more sequestration of carbon into the soil.

Participants include conventional and organic farmers, ranchers, turf and park managers, foresters, grassland managers, and large truck-gardeners. They agree to attend short orientation classes, so the data is systematically gathered and reported, and attend annual meetings to surface questions and share learning. The program is non-competitive.

Your editor asked Elizabeth what she is learning. She replied that there is a hunger among potential donors and participants to do something positive about climate change and take action. It has been relatively easy to raise money and find participants. Most farmers have heard something about soil health and want to improve their soil health. They get hung up on what the next step is. The Project gives them the next step, and so they are often eager to jump on it.

Can the Project share its methods if other communities want to replicate it? Sometime next winter, they will begin posting to the Longmont Conservation District's website, where folks elsewhere can copy it. In the meantime, explore "Soil Health Benchmark Study" under Soil Institute/ Farm Based Research on www.pasafarming.org. The Haney and PLFA tests they use are from Ward Labs. Go to www.wardlab.com and click on Soil Health Services for more information.



Why not just encourage the use of compost? And how does an increase in microbial life foster carbon sequestration? The rest of this article quotes Elizabeth's own words in the Boulder Daily Camera on December 17, 2015.

"Manure or compost isn't the only way to put extra carbon into our soils. We can also use the symbiotic relationship between soil microbes and plants to do the work for us. Remember learning about photosynthesis, where plants take sunlight and CO₂ from the air and make oxygen and carbon-sugars, which they use to grow? But you probably didn't learn that down below the soil line, plants leak carbon-sugars out through their roots, to

attract and feed soil microbes, which in return supply plants with broken down minerals (N-P-K) which plants also need to grow. Then, as the soil-microbes eat each other, the plants' original carbon-sugars pass from one soil-microbe to another. Each time the carbon-sugar is eaten by another microbe, it becomes more concentrated, until it eventually forms humus: rich, black, insoluble sequestered carbon.

A teaspoon of healthy soil holds one billion bacteria, yards of fungal filaments, and thousands of protozoa. We can harness our jillions of soil microbes to make even more humus and sequester even more carbon for us. Practices to keep our soil microbes sequestering carbon at top speed include cover crop cocktails, conservation crop rotation, no-till farming, mob grazing, composted green waste or biochar applications, fungal soil inoculations using no-turn composting, and more.

How much CO₂ can our jillions of soil microbes actually sequester? For two years, New Mexico State University molecular biologist David C. Johnson measured carbon sequestration on test plots with cover-crops. His soil organic matter increased 67 percent and soil water-holding capacity jumped over 30 percent. Reporting to Sandia National Labs, he states, "The rates of biomass production we are currently observing in this system have the capability to capture enough CO₂ (50 tons CO₂/acre) to offset all anthropogenic CO₂ emissions on

11 percent of world cropland. Twice this amount of land is fallow at any time worldwide." So those itty-bitty microbes could potentially sequester *all* of the CO₂ we produce!"

Elizabeth Black lives on a teeny farm with her husband Chris, where she paints western landscapes and grows Christmas trees and vegetables. A 35-year Boulder resident, she started community organizing in the 1990's to clean up well water. Now she moves about her community growing hope. www.ElizabethBlackArt.com

Excerpts of Sermon by Paula Palmer

Paint Branch UU Church Sermon Adelphi, MD, November 4, 2018

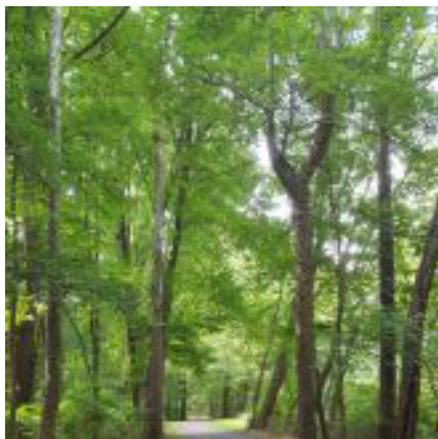
One thing I've learned from living and working with Native peoples is to be attentive to place – to the earth beneath our feet, to all the living beings that surround us, and to the humans whose stories are embedded in the land. That's why we began today's service by acknowledging the Piscataway people – their history on this land and their continuing presence here today. Native peoples are asking churches and civic organizations around the country to open our services and meetings with acknowledgments like this. It's a way for us to recognize the Native peoples who live here today and remember those whose ancestors lived and died here – right here. We can connect with them through the land.

I travel around the country as a Quaker minister, offering workshops like the one I facilitated here a few years ago. I ask people to think about our country's history of genocide and colonization – which we don't think about very much, and our schools don't teach very much, and our government never acknowledges. I ask people to think about what happened here, and then think about the Native people in our own communities today, and consider what we might do to develop relationships now, based on truth and respect and justice and our shared humanity. So many people say, but I don't know any Native Americans. This might be true, or it might not be – Native people are not always recognizable in stereotypic ways. But what is true is that many of us don't feel any connection with Indigenous peoples. So it's kind of hard for us to imagine what it would mean to work toward "right relationship" with them.

I think the land is our connective tissue. Most of us are connected to land somewhere – the land where we

live today, the land of our ancestors, the land where we were born, the land where we vacation, the land we love for whatever reason. All the land we know and love was known and loved first by Indigenous Peoples. And Indigenous Peoples say the land remembers.

If the land we love could tell us what it remembers, what would it say?



When I asked myself this question, I started by thinking about the land where my German ancestors settled in the 1840s. They bought land in Michigan Territory and founded a German Lutheran town they called Frankenmuth – the courage of the Franconians. The fertile land of Central Michigan had supported a very large Native population until it was wrested from them by the Treaty of Saginaw, a couple decades before my ancestors arrived. The territorial governor, Lewis Cass, promised the Chippewas that they could remain on smaller tracts of land in Michigan "forever." But then Cass became Secretary of War under President Andrew Jackson, and he was put in charge of enforcing the 1830 Indian Removal Act. He broke his promise to the Chippewas and forced most of them to move west. Some of their land became my family's farm. This is the land where I played with my

cousins during summer vacations, and where my cousins still live today.

My parents and my cousins didn't learn this history in the Frankenmuth schools. My 98-year-old father and I learned it together a few months ago by searching the internet for a couple of hours. What does this history mean for my family? What does it mean to the Chippewas, expelled from Michigan and spread out now across the Dakotas? I don't have clear answers to these questions, but I know that the land remembers, and I know that somehow the Chippewa people and my family are bound together in the story of this land.

I live in Colorado now, just outside the city of Boulder on the eastern slope of the Rocky Mountains. The Boulder Valley is the homeland of the Arapaho people. This is recognized in the 1851 Treaty of Fort Laramie. But in 1859, when miners discovered gold in the Boulder foothills, the Arapaho were forced out of their camps in the Boulder Valley. Their peace chief, Nawath, was told to camp on the eastern plains at Sand Creek, and that's where the US Cavalry attacked them at dawn one November morning. 180 people, most of them women, children, and elders, were slaughtered in what became known as the Sand Creek Massacre. Reflecting on this history, the Pawnee attorney Walter Echo-Hawk wrote, "The land can speak to those who listen....There is a bluff ... overlooking Sand Creek where you can hear women and children crying in the wind."

I wasn't alone in learning this history of the place I call home. About a year and a half ago, a group of Native and non-Native people in Boulder started meeting to learn about the area's Indigenous history. We sought out the only Arapaho person we knew of who lives in Boulder today. We told her we thought we'd like to invite some Arapaho people to come to Boulder to meet with us. She said, Well, that wouldn't be the way to start. You need to meet with them where they live now – in Oklahoma and Wyoming."

So we raised some money to make the trips, and she helped us set up meetings with elders and government leaders in both communities, and she came with us. When we asked the Arapaho people how they remembered Boulder, we heard, "Boulder? Boulder is home. Boulder is our home." Most of these people had never been to Boulder, but they remembered. Our ancestors lived in Boulder, they said, and they died in Boulder. Boulder is sacred ground to us – our homeland. When we asked how they would like to relate to the land and the people who live in Boulder now, they said they would like to have a reverent place, where they can pray, where they can honor their ancestors, where they can give their children a sense of what their lives were like before -- when the Arapaho people were free. They also told us they would like to educate the people of Boulder about their lives today, the challenges their young people face, the knowledge and stories of their elders. They want us to know they're still here.

So we carried this message back to Boulder and got to work. We raised money to bring Arapaho delegations from Wyoming and Oklahoma to meet with us last June. During their two days with us in Boulder, City and County government officials took us out to see several large pieces of city and county Open Space land that they thought might be appropriate for private use by the Arapaho and other Native peoples. One piece of land is the site of the fort where Boulder's

volunteer soldiers mustered to carry out the Sand Creek Massacre. Another has stone circles that date back to 500 years BC. Native people have lived in the Boulder Valley a very long time. Chief Elvin Kenrick sang memorial songs, gave offerings, and said prayers at these sites.

Stephen FastHorse, a member of the Northern Arapaho Business Council told us:

"The Boulder area was the chosen place for the Arapaho people in a spiritual sense. Our ancestors had a spiritual quest to search for a certain place, and when they came here they knew they had found it. It was foretold to us by the higher being of life. The Creator has always led our people. "Our hearts always yearn for our original homeland. We've never before been invited back to this area that we hold so dearly. It's a heartfelt emotion for us. We hope we will continue to be welcomed in this place that we belong to."

The land of the Boulder Valley is bringing together all the people who love that place. It is helping us uncover hidden connections, calling us to know that we are bound together, related through the land. Now, when I walk along the creeks in my neighborhood or on trails in the foothills, I remember the people who walked those paths before me, and I know some of their descendants face to face. There is pain in our shared history. And there is hope.



In our 2012 Jubilee year, the Loretto Community's Proposal 9 stood with Indigenous Peoples throughout the world who call for formal repudiation of the 15th century papal bulls that were adopted into US constitutional caselaw, enforcing a pattern of domination over the persons and lands of Indigenous Peoples.

Preserving Diversity: Indigenous Languages

By Loretto UN-NGO Representative Beth Blissman CoL

The UN's International Year of Indigenous Languages 2019 connects the dots among preserving indigenous languages, the larger right of Indigenous Peoples to steer their own course, and our ability as a whole to implement the 2030 Development Agenda.

Wherever we live, Indigenous Peoples are our neighbors. Search "10 things to know about indigenous peoples" from the UN Development Program, @UNDP on Twitter. To hear the voices of indigenous peoples from Bolivia, Honduras, Guatemala, follow the latest @UNESCOcourier: [on.unesco.org/2CYlmgS](https://www.unesco.org/2CYlmgS)

Throughout the year, follow these hashtags for videos, articles and opportunities for action: #IndigenousLanguages #WeAreIndigenous #IYIL2019.

We Are Not Alone

LEN's 25th Anniversary presentation by Miriam Therese MacGillis, OP, deepens our engagement in the Universe Story. Search Loretto Earth Network and scroll down to Resources at www.lorettocommunity.org.

The Land UMC is a faith community that nourishes sacred relationships between the Creator and all of Creation. It exists to draw people together from all walks of life to cultivate spiritual community through faith, farming, and food. www.thelandumc.org

Search "Columbus mural" on www.nd.edu to read the January 20 letter revealing one university president's respectful response to Catholic history while facing "the reality and experience of Native Americans in the aftermath of Columbus's arrival." This is especially moving in the light of recent research, <https://www.ucl.ac.uk/news/2019/feb/great-dying-americas-disturbed-earths-climate>.

Weather from the Ground Up: Biodiversity Helps Shape Local Climate

By Adam Sacks, Executive Director, Biology for Climate

On a local level, there's much we can do to affect a number of weather factors—temperature, for example. An average 90 °F day can have a land-surface temperature *difference* of up to 60 °F. This is measuring the temperature difference between coolest (shady spots as, say, under the bushes) and warmest (asphalt) spots. What makes this temperature difference?

Water, shade, and ground cover do. Asphalt is the equivalent of very bare soil, made worse by its low albedo i.e. low reflectivity and increased heat absorption. Water - which is cycled by plants and biodiversity - acts as a great temperature buffer in this regard. Thus, local temperatures, including heat-island effect in cities may be significantly moderated.

All species, from microbes to megafauna, have worked out strategies for obtaining and cycling water to benefit themselves within the overall balance in their habitats. Rainfall is a vitally important weather process where humans have a significant role to play. For atmospheric water vapor to fall as rain or snow, it must condense around microscopic particles called condensation nuclei, comprised largely of biological particles and bacteria. Scientists are taking a closer look at these nuclei – how

plant-based nuclei make their way into precipitation and how we might influence that process.

The concept of the biotic pump, developed over the last decade, is one example of large-scale movement of water driven by trees. According to this theory, the vapor pumped by trees into the atmosphere condenses and creates an area of slightly lower air pressure (since humid air at a given temperature and pressure weighs less than dry air). In turn, the lower pressure draws moisture inland from an abundant water source, primarily oceans. The theory explains what happens in the Amazon, where the forests themselves pull massive volumes of water, dubbed “flying rivers” into the interior.

In the past, farmers were encouraged to leave some fields fallow during the growing season to conserve water. But abandoning that practice can lead to notable changes in weather and increased capture of atmospheric carbon in soils, along with significant economic and soil conservation benefits. “The surface-atmosphere exchange of carbon dioxide, water, and sensible heat across a dryland wheat-fallow rotation”_from the 2016 journal *Agriculture, Ecosystems & Environment* has details. Riparian zones (the areas around

creeks and rivers) are the lifelines of arid and semiarid regions, and often corridors of great biologic diversity. Recovery of these zones is the first step in restoring floodplain function. The before-and-after photos below show the change in Susie Creek (northeast Nevada) after better grazing management, then the return of beavers and their water engineering skills. Even after a four-year drought (2012–2015) in which other ranchers were having to truck in water, the Susie Creek area still had perennial ponds and streams.

These are just a few examples of how better caring for the land can make major differences in many factors affecting the biosphere and the weather. A project that I founded with four colleagues, [Biodiversity for a Livable Climate](#), has held [ten conferences](#) over the past three years, bringing together scientists and land managers from five continents. They have explained many instances of regenerative management that can return abundance to billions of desertified acres across the planet. (All conference videos are available for viewing on www.bio4climate.org.)

LENN thanks Pat O'Brien for introducing us to Adam Sacks. Pat's connection with Loretto is through Maureen Fiedler (high school) and Mary Ann McGivern (WILPF).

