

Untitled

In 2017, I watched the news as my home city of Houston, TX was flooded under hurricane Harvey. I'd seen hurricanes blow through plenty of times, stayed home from school when the streets were all too flooded, but had never seen anything like this before. "This is it," I said to myself. After so many years of native wetlands and prairies being filled with concrete for new suburbs, Houston's day of reckoning had come. In the wake of Harvey, I saw something truly spectacular happening. People leaned on each other for support. Incredible acts of mutual aid spread like wildfire in those months. I listened to folks wonder at the incredible altruism of these people, as if mutual aid somehow breaks the natural order of things. At first glance, in our hegemonic neoliberal reality, this analysis is intuitive. After all, in America, why would someone spend considerable time and resources helping others out if they aren't making money off it?

We are taught that competition is the natural order of things. That mutualism, while a fanciful idea, is too utopian and frivolous for the cold hard realities of life. But in fact, ecologically, competition is the energetically unsustainable interaction. Life depends on mutualism when conditions get rough. Competition results in a net negative impact on all organisms involved. This is the reason why there is so much biodiversity on this rock we share: species are driven apart by the need to avoid competition, to find new niches to occupy. Mutualism, existing at the polar opposite end of the spectrum of biotic interactions, results in a net positive impact for all organisms involved. Ecologists consistently observe that symbiotic interactions turn towards mutualism in harsh conditions, because there just aren't enough resources for expensive competition. Organisms compete with one another for resources because we live in a finite world; when resources are scarce, the cost of competition becomes too high and mutualism becomes more evolutionarily favorable. Ecosystems clearly demonstrate that in harsh environments, it is competition which is the fanciful, yet frivolous and unsustainable interaction. Acts of

mutual aid in times of struggle are not at all out of the natural order of things; they are the natural order of things.

Knowing Fungi

Fungi look and feel alien. Have you ever looked at a lichen under a microscope? Or tasted a nutty morel? Dug up a truffle? If you see a mushroom fruiting in the forest, come back tomorrow, or in a few days. It's gone! Maybe it's a delicious edible that someone snatched up, or maybe it just melted back into the earth. The ephemeral fruiting bodies we can see are only the "apple off the tree." The adult mushroom lives beneath the surface, hiding their true form out of sight.

Fungi frequently live inside their food. Their intimate lifestyle with their food is the primary reason that they have evolved such a wild diversity of symbiotic relationships. Fungi possess many adaptations which make evolution a much more rapid process than in the case of most animals. As some lineages of living things began escaping their former marine and aquatic environments to create new ecosystems on terrestrial environments, symbiotic fungi proved essential. Through division of work, fungi opened up many possibilities that could not have existed otherwise.

Knowing Lichens

"Symbiosis" is a word coined by mycologist Heinrich Anton de Bary. The word is a contraction of the Latin sym-, meaning same, and -bios, meaning life. Symbiosis is frequently misunderstood to be synonymous with mutualism, but from an ecologist's perspective, symbiosis is simply the close association of two or more organisms. In this sense, symbioses are incredibly diverse, including habits like mutualism and parasitism. A lichen, put simply, the symbiotic relationship between fungi and algae*. The fungal symbiont, or mycobiont, builds the architecture of the lichen body, an abode for the algal symbiont, or photobiont, to photosynthesize in. The photobiont 'pays rent' by turning sunlight and nutrients into sweet, sweet sugars for the mycobiont to feed on. Schwendener, who first described and

published this symbiotic relationship, described a parasitism whereby the mycobiont acted as jailkeeper for their imprisoned algae (Shwendener's mentor, Carl Linnaeus thought that lichens were 'lowly' plants). For most of the 20th century, the nature of the lichen relationship was described as an entirely mutualistic relationship, where life begets life. Debate rages on, but the consensus lies somewhere in between (or perhaps outside of) this dichotomy.

Algae that live inside a lichen thallus are not genetically distinct from the same algae species that live in ponds or on your windowsill. In fact, they are often much more abundant in these places than in a lichen. Life inside a lichen thallus is tightly regulated. The mycobiont goes to great lengths to provide the photobionts with plenty of water and nutrients for photosynthesis. When things dry out, the mycobiont shields the photobiont from the worst of the desiccation, and pumps them full of water as soon as rain or mist hydrates the lichen. Using an arsenal of organically produced chemicals and hormones, the mycobiont also regulates the physiology and reproductive cycle of the photobiont.

Unlike the algae, the mycobiont requires its photosynthetic partner in order to live. Their relationship is imbalanced, with the photobiont perfectly capable of photosynthesizing without the mycobiont. This symbiosis is beginning to sound like an abusive relationship, but don't be too quick to apply human morality onto these beings. After all, lichens are some of the most abundant and diverse living things on the planet, and the lichenized state enables the algae to reach heights and places they never could without help from their dutiful mycobionts. The fact is that lichens do not prescribe themselves to human paradigms of understanding. They defy simple description, and while it can be helpful to describe them with analogies and oversimplification, it is important to keep the limitations of these ways of thinking in mind.

We can learn from the lichens' resistance to our attempts to classify and categorize them. While developing climate solutions, oftentimes it may be best not to try and label or categorize our work.

When we do the work of climate action in this way, we may be surprised at the kinds of allies we can garner. Someone who rejects climate change as a communist plot to take over the world may also be willing to change their land use practices, if they can see that doing so will lead to better outcomes for their children. For so many people, questions of addressing environmental degradation feel so distant and esoteric. Many folks in rural counties are naturally suspicious of leftist ideas and are perfectly willing to engage in mutual aid when the framing is right. As activists and students of the environment, it is our job to help people see the forest as it is.

Knowing Mycorrhizae

While lichens are the relationship between fungi and algae, mycorrhizae are the relationship between fungi and algae's big sisters: land plants. Mycorrhizae grow in the soil, building a network of tiny threads 1/10th the diameter of fine human hair. These threads, called hyphae or mycelium, are far more efficient at extracting nutrients and water out of the soil than plant roots. More than 90% of vascular plants form mycorrhizal symbioses in the wild, and mycorrhizae were essential to the land plants' establishment on terrestrial ecosystems, 400-500 million years ago.

In a mycorrhizal relationship, the photobiont, which may be a small herbaceous plant or an ancient Oak tree, have considerably more freedom and autonomy than the lichen photobionts do. The mycobionts work tirelessly to bring gifts of water, Nitrogen, Phosphorus, and other nutrients, and the photobiont graciously returns the favor in the form of sugar. A single tree can have several mycorrhizal partners, all competing for the best deal on sugar.

Modernized agricultural practices have completely ignored the role of fungi in the growth of crops. The mass use of fertilizers make it so that plants don't need mycorrhizae. Why would they pay up precious sugar to a fungus when there's plenty of artificial fertilizer to turn into fruits? In turn, when mycorrhizae don't get their payment, they turn increasingly parasitic. Taking by force what would have

been freely given in a healthy environment. Industrial fertilizer use in North America has selected for increasingly parasitic mycorrhizal strains. Modern industrial agriculture, with its synthetic fertilizers and biocides, has destroyed natural ecosystems and replaced them with something sterile, something simple, something easily manipulated. This can work for a few short generations, but every ecologist knows that this is a house of cards waiting to fall, and when it does, the world will starve.

Learning from Fungi

I am fascinated by the incredible lengths fungi push themselves to in order to survive and thrive in a harsh world. Through millions of years of intimate contact with their food, they have developed some of the most diverse symbiotic strategies known. But along with a fascination and love for fungi comes fear and solemn respect. As much as fungi are nurturing mothers, directly responsible for all terrestrial life, they are also parasites and savage murderers. Fungi are ancient necromancers. Their evolutionary lineage long ago tapped into powerful truths. They understand that life and death, when wielded with precision and intention can be molded into new life.

In studying fungi, one encounters a magnitude of diverse strategies to life that go far beyond simple competition. Diverse strategies are essential to the work of forging sustainable societies. When learning from Fungi, we must consider all parts of them. In regenerating the Earth, we will see things die. Global systems of extraction have sown the seeds of their own destruction, but we don't have time to wait for capitalism to die on its own.

Fungi show us how to turn death into something more. If we decay an economy based on profit and exploitation without nurturing something to replace it, we will be left with a world of ruin. Yet, if we nurture new communities without challenging oppression, we will perpetuate those tired systems. We must tear down the lies of white supremacist capitalist patriarchy and directly confront fascist governance with violence. In the same stroke, we must seek to empower the voices of those who were

systematically silenced for generations. We must knit bonds of kinship with our allies and lean on one another for support. We must nurture feminist communities, radically reshaping tired understandings of family and parenthood. We must decompose the dead and dying carcass of capitalism, reappropriating what was stolen and mobilizing the fires of industry to their own destruction. From this carcass, we can fertilize a regenerative and equitable future