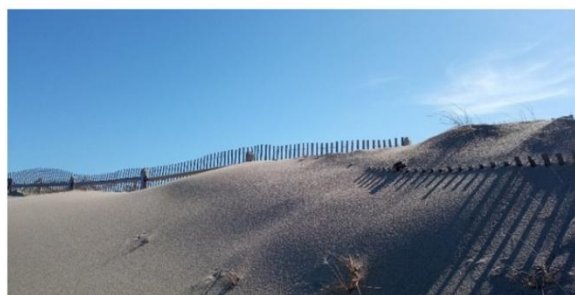

SPRINGS

THE RACHEL CARSON CENTER REVIEW

Issue #5 | 2024

June



Springs
The Rachel Carson Center
Review

Issue #5 | 2024

June

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Note from the Editors

[*Springs: The Rachel Carson Center Review*](#) is back with its fifth installment. Join us as we journey from the cold depths of a northern German lake to the warm dunes of southern Portugal.

When author Jessica Lee travels to the German village of Neuglobsow in "[The Magic Mirror: Legends, Limnology, and Nuclear Power on Lake Stechlin](#)," she uncovers a region shaped by the intangible legends of ferocious red roosters, waterspouts, and geysers, as well as by the tangible impact of a nuclear power plant nearby.

How do we talk about fungi in the English language? The illustrated essay by ecologist and photographer Alison Pouliot, "[Talking Fungus: Finding Language for a Troubled Kingdom](#)," contends that a new, re-enchanting vocabulary for the misunderstood kingdom of fungi is the first step toward a broader recognition of mushrooms as a vital part of our ecology.

RCC Director Christof Mauch sits down with filmmaker and anthropologist Martin Saxer to discuss what makes contemporary foraging different from the foraging of hunter-gatherers. "[Seeing with a Forager's Eye: A Conversation with Martin Saxer](#)" investigates both how and why this spatially unconfined practice happens in places as rural as the Siberian-Chinese border and as urban as Munich's own English Garden.

Ever since an open-pit mine became a Liberian nature reserve in the Nimba mountain range, the region has attracted various actors seeking to rethink the value of an area recognized as a hotspot of biodiversity—and, potentially, of infectious diseases. In "[The Value of Fragments: Making a Hotspot in Mount Nimba, Liberia](#)," anthropologist Emmanuelle Roth and historian Gregg Mitman follow a local park ranger through the reserve, investigating how the region's complex history has altered relations among its living and nonliving occupants.

Writer and historian Beth LaDow regales us with a story of the quirky relationship between humans and beavers as it unfolds around a small pond in Maine each year. LaDow's "[Beavering](#)" gives us a unique and local glimpse into the everyday life of this species and the carbon-sequestering, water-regulating, and diversified wetlands they create.

Among the shifting slopes of southern Portugal's human-shaped shoreline, Joana Gaspar de Freitas' personal history and professional research collide. As the environmental historian reckons with her self-professed muses, the sand dunes, "[The Poetics of Dunes](#)" shows how these transitory formations defy our normal modes of understanding and inspire new and imaginative ways of thinking.

Beyond these exciting new articles, *Springs* continues its efforts to champion writing from other open-access RCC publications. In addition to the curated collection of pieces from [RCC Perspectives](#) (2010-20) and the peer-reviewed online journal [Arcadia: Explorations in Environmental History](#), our *Springs* [archive](#) is now proud to include publications from the RCC's recently revived multi-genre blog, [Seeing the Woods](#).

Munich,
14 June 2024

TALKING FUNGUS: FINDING LANGUAGE FOR A TROUBLED KINGDOM

Alison Pouliot

Springs
The Rachel Carson Center Review

5 • 2024

Alison Pouliot

The fields were spotted with monstrous fungi of a size and colour never matched before—scarlet and mauve and liver and black. It was as though the sick earth had burst into foul pustules; mildew and lichen mottled the walls, and with that filthy crop, Death sprang also from the water-soaked earth.¹



Galerina marginata. Or a Discretion of *Galerina*? © Alison Pouliot. All rights reserved.

British writer Arthur Conan Doyle (1859-1930) penned these words in his book *Sir Nigel*, first published in 1905. Doyle epitomises the erroneous associations between fungi and disease that were common among nineteenth-century creative writers like John Keats, Alfred Tennyson, and Emily Dickinson, who all saw fungi as symbolic of degeneration and death. Things improved only slightly for fungi in the twentieth century with just a few positive portrayals within English literature. Such flawed and fraught impressions have fuelled a fungal vocabulary of disdain, fostering a mindset of aversion and unease within the Anglophone world.

Language greatly colours the way we perceive life. Words and concepts shape our perception of nature, and not all organisms receive equal consideration. Where do fungi sit in the English language? How are fungal words used, confused, and—at times—abused?

Language develops for the things we notice or confer significance. It is, of course, hard to discuss any subject without appropriate language, and the words we have shape our thoughts and impressions. In the English language, there's only a minimal vernacular vocabulary for talking about fungi relative to those for the other two major kingdoms of life—animals and plants. Indeed, fungi form a kingdom of their own. They live inside their food, they do not photosynthesise like plants, and they are in fact more closely related to us humans and other animals than to flowers or trees. Yet language is lacking to describe them—and when language is lacking, negative impressions and misunderstandings can arise.

This common aversion to fungi among English-language speakers has long been recognised. Negative portrayals of fungi result from ignorance and misapprehension, but also from the scientific focus on their destructive ability. This is unsurprising given the potential of fungi to wreak havoc on crops and bodies, albeit usually in direct response to poor human management. Such ways of thinking about fungi overshadow their ecological significance in underpinning terrestrial ecosystems and human dependence on their existence.



An Army of *Armillaria*, a Spotting of *Amanita*, and a Continent of *Coccomyces*.
© Alison Pouliot. All rights reserved.

Pathogenic Histories

How, then, did fungi come to be so muddled and maligned in the English language? Historical perceptions of fungi provide a good starting point to examine the warping of words and ideas—and misunderstanding of fungi stretches back centuries. After all, fungi are odd. They don't fit into our frames and assumptions for understanding nature, which are premised on plants and animals. Fungi seemed to do strange things. The sudden appearance, then disappearance, of mushrooms roused suspicions. Fungi seemed more fickle, appearing without invitation at times and in places we didn't expect them. They seemed elusive and unpredictable and messed with human desires for certainty. Our understanding of other organisms was more assured: the rooster crows at dawn, trees blossom in spring.

In the search for explanations for the seemingly mysterious life of fungi, all kinds of weird and wonderful theories therefore sprung forth, arising mostly from fundamental misconceptions about what fungi are. People mistakenly believed that mushrooms were entire organisms, rather than just

the reproductive structures of unseen subterranean mycelium—the living, feeding, growing part of a fungus—and they became associated with other “undesirables,” ranging from the supernatural to witchcraft. Furthermore, their need for moisture means that fungi grow in places that some people consider abhorrent, like forests and swamps, and their way of feeding, by dismantling plants, including those that we like to eat, won them few fans either. For many people, even today, fungi are unnerving and perplexing. It’s little wonder that they found their way into myths and fairy tales and became folklore for those struggling to make meaning from mushrooms.

For many people, fungi are unnerving and perplexing.

The early associations of fungi as agents of disease continue to shape thinking about fungi today. Yet, the fungi considered “problematic” are usually not those that produce the familiar mushrooms, but the ones we can’t see—that is, the microfungi. Microfungi with names like rusts, smuts, bunts, blights, and blasts have a lovely alliterative ring, yet they are unpleasant sounds in the English language. In many countries, these fungi are seen as an enemy of agriculture, one of the benchmarks of civilisation and progress. This capacity for destruction has made them the most “economically significant” of all fungi.

The paradox is that modern industrialised agriculture creates and perpetuates “fungal diseases” by planting monocultures. Unlike polycultures, which incorporate multiple species and attempt to mimic the diversity and resilience of natural ecosystems, monoculture cropping, or the practice of growing one crop, not only damages soils but requires expensive supplements. Monocultures are thus more susceptible to disease, including those caused by microfungi.

This is not to downplay the damage microfungi can wreak when agriculture or forestry are mismanaged. Rather, it is to question a pathologising framework as the only one with which to understand these organisms. This sets a precedent that sees them as problematic, disease-causing, and in need of control or elimination. Still, most fungi are not pathogenic. Those that are rarely become problematic in natural ecosystems. Seldom are fungi seen as symptoms of more complex environmental processes, and this limited perspective serves to scapegoat the fungus when in reality human actions may have caused the problem. Though fungi are better understood today than in the past, the teachings of agriculture and horticulture retain a strong pathogenic focus.



An Accident of Ink Caps, a Galaxy of Earthstars, and a Howdah of *Helvella*.
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Without the words to adequately conceive or contextualise them, fungi cannot be properly understood. As a result, they have little presence in concepts such as conservation. References to fungi in environmental policy and biodiversity-conservation management are usually only at the blunt taxonomic level of kingdom. In contrast, conservationists and land managers discuss fauna and flora at species level. This lack of resolution means there is no specificity with which to understand or protect a particular fungus species. The only fungi mentioned at species level are usually pathogenic fungi. When they flourish in an ecosystem, they're often regarded as a threat to other biodiversity rather than a symptom of larger environmental change that has enabled them to flourish.

If you're looking to widen your fungal vocabulary, the magical fairyland of the Internet will lead you further down a path of pejorative terms. A quick look at synonyms for fungi on various online thesauri reveals wildly inaccurate and derogatory words. Some such, as powerthesaurus.org, provide a rather nonsensical jumble of life-forms and infections including: alfalfa, moth, worm, ivy, kelp, pimple, viper, and yam, making it difficult to draw any connection to fungi at all. Others, such as thesaurus.com, list synonyms for fungi, including: affliction, bane, blot on the landscape, canker, contamination, corruption, curse, decay, dump, evil, eyesore, infestation, glop, goo, gunk, mildew, mud, muck, mire, mucus, ooze, pestilence, pollution, rot, scourge, scum, sludge, waste, withering, and woe.

New technologies see fungus mycelium transformed into building materials and textile alternatives.

What a striking ruinous wreck these terms create, if only they weren't describing these wondrous organisms. Where's that synonym that describes "fundamentally important organisms that help hang the planet together"? Or organisms that furnish us with bread, wine and beer, and vital medicines and pharmaceuticals? New technologies see fungus mycelium transformed into building materials and textile alternatives. Yet *Roget's Thesaurus* opts to search synonyms for "fungus" under the misguided subheadings "plant," "dirt," or "blight." It is easy to see how warped and erroneous

fungal synonyms can mushroom. These synonyms have evolved from the effects of a small selection of pathogenic microfungi, supplemented by fertile imaginations.

As we search for words to describe fungi, we often borrow them from plants and animals, but they fall short. It's a little like trying to describe a human being using language suitable for, say, a slime mould or a sea cucumber. That might sound silly, but using inappropriate terms for fungi is equally nonsensical and gives an inaccurate impression of the kingdom. For example, the reproductive receptacles of fungi are often called fruiting bodies. Yet, "fruit" is a botanical term for a structure that contains seeds. Fungi are not plants, nor do they produce fruit or seeds. Rather, they produce structures that contain spores. Scientists likely coined the term *fruiting bodies* when fungi were thought to be plants. Yet fungi have been classified in their own kingdom for over fifty years. Language often lags behind its subject, but it's time to catch up.

A Galaxy of Earthstars

A parliament of owls. A caravan of camels. A flamboyance of flamingos. A comb of bananas. Collective names for animals and plants abound. Even Linnaeus's lowly worms are collectively known as a clew. How do we refer to a group of fungi? Nouns like "flush" or "troop," "clump" or "ring," are sometimes used to refer to groups of mushrooms. Field guides certainly provide precise adjectives to describe how fungi grow, such as "solitary," "caespitose," or "gregarious." Yet English collective nouns for fungi generally, let alone for particular fungi, appear nonexistent.

Like animals and plants, fungus species within a genus share particular characteristics, morphologies, or cultural associations that lend themselves to collective nouns. Here's a few below to get the ball rolling. For some of these, the inspiration for the collective noun is obvious, while others require a more multisensory exploration or some knowledge of their lives and behaviours. This collection refers to both vernacular and scientific names for genera, to accommodate different audiences.

- A Galaxy of Earthstars
- A Powderpuff of *Podaxis*
- A Sweetness of Chanterelles
- A Curiosity of *Cordyceps*
- A Plump of Puffballs
- A Crumbling of *Russulas*
- A Nudging of *Gymnopilus*
- A Stench of Stinkhorns
- A Pagoda of *Podoserpula*
- A Marvel of *Marasmiellus*
- A Weeping of *Lacrymaria*
- An Accident of Ink Caps
- An Unveiling of *Cortinarius*
- A Spectrum of Waxcaps
- A Glow of *Omphalotus*
- A Trembling of *Tremella*
- An Army of *Armillaria*
- A Spotting of *Amanita*

An Elegance of Bonnets

An Atlas of Cocomyces

A Discretion of *Galerina*

A Maze of *Daedalea*

A Lactation of *Lactarius*

A Deception of *Laccaria*

A Spike of *Gomphidius*

A Wobble of *Exidia*

A Field of *Agaricus*

A Disco of *Lachnellula*

A Howdah of *Helvella*

Re-Enchanting the Fungal Lexicon

The lack of vernacular terms for fungi in the English language means they not only lack our awareness, but our regard. Giving an organism “agency” through language is the first step towards its recognition. As the world becomes more mediated by technology and sensorial encounters with nature dwindle, we risk losing language not just for that which is important but also for that which inspires imagination.



A Marvel of *Marasmiellus*, an Elegance of Bonnets, and Trembling of *Tremella*.
© Alison Pouliot. All rights reserved.

Inadequate or inappropriate fungal language risks robbing fungi of not just their poetry but also the precision necessary to convey their science beyond scientists. To discuss any subject with a level of coherence and resolution requires a particular vocabulary and meaningful forms of expression.

The more articulately we describe and discuss fungi, the less likely they are to remain marginalised as obscure and unimportant.

The recent publication of a suite of narrative nonfiction books on fungi suggests we are in something of a “fungal awakening.” Perhaps in the twenty-first century mushrooms will finally have their moment.

Notes

¹ Arthur Conan Doyle, *Sir Nigel* (London: Smith, Elder & Co., 1906), 2.

Cite this article

Pouliot, Alison. “Talking Fungus: Finding Language for a Troubled Kingdom.” *Springs: The Rachel Carson Center Review*, no. 5 (June 2024).
<https://doi.org/10.5282/rcc-springs-7376>.

SEEING WITH A FORAGER'S EYE: A CONVERSATION WITH MARTIN SAXER

Martin Saxer and Christof Mauch

Springs
The Rachel Carson Center Review

5 • 2024

Martin Saxer and Christof Mauch

Martin Saxer leads the research project "[*Foraging at the Edge of Capitalism*](#)," based at the Rachel Carson Center (RCC). When this project began, he remodeled an old Mercedes bus to visit foragers on their journey, but he prefers the comfort of his self-made yurt. RCC Director Christof Mauch has a collection of rare alarm clocks from all over the world on his bookshelf, some medicinal plants on his balcony, and has yet to learn how to build a yurt. In this interview, Martin and Christof discuss practices of collecting and scavenging across the world.



Storage room for dried herbs. Between 60 and 70 species of wild medicinal and aromatic plants are collected for export.
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CHRISTOF MAUCH: You are currently supervising a team of five international scholars who are doing research on foraging in different parts of the world—in Asia, Europe, and North America, mostly in areas that many of us would consider to be remote. Before I ask you about “foraging” and what it actually means in the twenty-first century, I wonder whether you could tell us a bit about your previous research projects, which focused on “remoteness” and, in your dissertation, on Tibetan medicine in the People’s Republic of China and transnational trade in medicinal plants.

MARTIN SAXER: In the past project, we focused on the highlands of Asia, the vast mountain region from the Tian Shan and the Pamirs to the eastern slopes of the Himalayas. We were a group of five researchers working in what are usually seen as remote areas in China, Tajikistan, Nepal, India, and Myanmar. These areas are not as remote as one would expect, however. In fact, they typically have long histories of trade, then went through a phase of closure, and recently saw a revival, often in conjunction with the reopening of China.



The Vjosa valley in the south of Albania is one of the project's field sites. © 2023 Pauline Prückner. All rights reserved.

CM: Reopening?

MS: Yes. For centuries, until the 1950s or 1960s, there was ample border trade between China and its neighbors. However, with the Sino-Indian, Sino-Soviet, and later Sino-Vietnamese conflict, and with border-demarcation efforts such as in Nepal, borders closed. Some for years, some for decades. When the borders opened again, a substantial revival of trade took place. A decade ago in northern Nepal, for example, I found myself amidst this revival. Whatever people would drink, eat, or wear came from China. What was being sold to China were medicinal plants. There was a massive demand for medicinal herbs in Tibet.

After China's accession to the WTO [in 2001], new rules demanded the construction of new and bigger factories for Tibetan pharmaceuticals. An entire industry based on wild plants emerged, many of them not endemic in Tibet but imported from Nepal and India. People in the mountain valleys in Nepal started to collect herbs in large quantities and sell them across the border. In return, they would get rice, flour, cooking utensils, shoes, clothes, motorcycles, liquor, beer—anything of use, really. You can see this emerging frontier economy as expressions of remoteness, yes. But the people around me saw it rather as the return of the old cosmopolitan business of trans-Himalayan trade.

CM: So what is remote is a question of perspective?

MS: Yes. It is a fuzzy concept. Remoteness as such does not exist. It is produced, actively forged rather than a primordial condition. Often, remoteness has resulted from the consolidation of nation states and their borders in the twentieth century. Calling a place remote usually follows a purpose. Remoteness is a useful label, for instance, if you seek to boost development and better state institutions, or if you advertise a place for tourism, such as a "hidden valley" in the Himalayas.

Remoteness as such does not exist. It is produced, actively forged rather than a primordial condition.

CM: And in these seemingly remote areas you had discovered what you call foraging?

MS: Actually, my interest in foraging came out of a series of different experiences, not just with herbs but also with things like scrap metal.

CM: Scrap metal?!

MS: Yes. Scrap metal. I remember crossing from Siberia into China in 2005. Before the border, there was a line of trucks waiting—many kilometers long. The trucks were all fully loaded with scrap metal: parts of machines, industrial shelves, and so on. It was stuff mostly from dismantled Soviet factories. Years later, when doing research on herbs in the Himalayas, I realized that the difference between collecting medicinal plants and scavenging for scrap metal is not a fundamental one.

Whether foragers collect scraps or herbs, they engage in a certain way with the environment surrounding them. You need the eye of a forager to notice things that others don't. You need to see potential abundance where others see nothing or scarcity at most. Foragers work independently rather than being employed; they probably don't pay taxes, nor do they have health insurance or a pension scheme. And you neither need a degree nor substantial investment to start.

In some cases, foraging is a matter of last resort, a "poor practice," if you will. In other cases, it is more akin to treasure hunting, promising substantial gains or even an avenue to prosperity. Most often, however, there is both an element of necessity and an element of choice in the decision to try to make a living from foraging.



Ironwort (*Sideritis*), commonly known as mountain tea, is one of the species collected in the mountains of southern Albania.
© 2023 Pauline Prückner. All rights reserved.

CM: Modern-day hunters and gatherers, one could say...

MS: Yes. But with a tweak. Almost all foraging practices, whether collecting herbs or scraps, take place in legal grey areas. Whom does the scrap metal belong to? Is this plant protected? Does it grow in a protected area or on private land? Am I trespassing, and if so, what is the risk? This aspect of legal uncertainty together with access to a market—selling things rather than consuming

them—is what makes contemporary foraging quite different from the foraging of hunter-gatherers. Contemporary foraging is a product of the edges of capitalism. At the same time, it shapes these edges.

Contemporary foraging is a product of the edges of capitalism. At the same time, it shapes these edges.

CM: But if foraging is such a widespread economic strategy, shouldn't it make more headlines?

MS: The answer to this, I believe, lies in our production bias. We think of an economy as focused on producing goods—artisanal, industrial, or agricultural—and on selling them. We tend to see people as farmers or workers or service providers for a productive sector, even when they earn most of their income not from harvesting or getting a salary but from collecting, gleaning, or scavenging.

Once you approach foraging not as a relic of an era long gone but as a widespread, contemporary and global phenomenon, as a basic economic strategy and a way of relating to one's surroundings, you see a huge variety of practices. It includes not just mushroom hunting or berry picking but also practices like collecting eiderdown in Iceland, scavenging for mammoth ivory in the melting permafrost of Siberia, ripping copper wire in abandoned buildings, or even cutting up disused railway lines.



Interview with a herb-trader family in Këlcyrë, Albania. © 2023 Pauline Prückner. All rights reserved.

CM: Foraging is not just a rural practice then? It can also be urban? Is it something you could see here, in Munich?

MS: Yes. Absolutely. While writing the research proposal for my current project, I met a guy in the English Garden [in Munich]. He had a metal detector and was looking for coins and lost jewelry. He told me about his career as a software engineer. Sitting in front of screens all day long started

giving him terrible headaches, cluster headaches. With his metal detector and good ears, he made up to 2,000 euros a month from lost treasures in the English Garden and along the Isar river. The moles, he said, were his friends. They helped unearth things that had been lost years ago. His plan was to start washing gold in Spain. But that's a different story.

CM: This is amazing. Anna Tsing has of course written about humans who are foraging for mushrooms, Matsutake mushrooms, in contexts of economic precarity. In *The Mushroom at the End of the World*, she reminded us that humans are not the only protagonists and that landscapes are co-making our world. Your research has an affinity to that of Tsing, but it goes beyond it because you look at a variety of very diverse practices in many different parts of the world.

MS: Anna Tsing's work is very inspiring—ethnographically but also conceptually. I was reading her earlier work, *In the Realm of the Diamond Queen and Friction*, while doing research in Tibet and the Himalayas. When *The Mushroom at the End of the World* came out in 2015, it helped me understand the foraging practices that I had witnessed over the years in a new way. What she describes as pericapitalist spaces and frontier economies resonates strongly with what I call the edge of capitalism—understood as both capitalism's unregulated vanguard and its margins. Looking beyond herbs, mushrooms, or berries and including things foraged not from nature but stuff left behind by human activity shifted my focus into a slightly different direction, however. "Environment" is no longer synonymous with "nature," and I see the practice of foraging now as a much more fundamental human activity.



On the way to collect common ivy (*Hedera helix*) in the forest above Peshtan, southern Albania. Ivy is used in cough medicines. © 2023 Pauline Prückner. All rights reserved.

CM: Let me get back to Munich and the urban or suburban mode of foraging. I find this fascinating. Looking for metal in the English Garden is very particular but there are people who search for wild herbs and berries just outside of the city. Would you consider activities like this for your research?

MS: Yes, of course. On our team, several of us are looking into these forms of foraging. Over the last few years, not least since the COVID-19 pandemic hit, more and more people have been looking for things that grow in nature. Their motivation may be slightly different from that of the

commercial foragers I have so far talked about. People who look for wild plants and berries to eat in and around Munich may do so primarily to get closer to nature. It is often a way of stepping outside the structures of capitalist production, labor, and consumption.

Over the last few years, more and more people have been looking for things that grow in nature. Their motivation may be slightly different from that of the commercial foragers.

However, some start making it a profession, for example by offering seminars and guided forest walks, sharing their knowledge and seeking to attune more people to the abundance around us. Capitalism and its edges are present here as well—not in the form of commodity chains that feed foraged goods into capitalist production but rather in the attempt to escape capitalism and transcend its confines.

The more we get to know foragers in Munich and places in other countries of the Global North, the more we learn that there is more to their stories than just middle-class urbanites seeking to reconnect with nature. The lives of the people we got to know are a lot more precarious than such an imaginary would suggest. While they may have chosen to leave the rat race of capitalism, there may not be a clear path back, should things not work out.

CM: I am wondering how you approach this project methodologically. You work on so many different sites. How do you communicate with one another?

MS: We work very closely together in our team. We have weekly meetings, mostly online and sometimes in person. We talk at length about our work, the people we meet along the way, and the next steps ahead. This is a new experience for me, an experience facilitated to a certain extent by the culture of doing online meetings. The direction our research takes, the questions and observations we follow up, come out of these weekly meetings.



In the forest above Peshtan, Albania. © 2023 Pauline Prückner. All rights reserved.

CM: The practices you study happen “in the open,” if you will. Foraging is happening all over the place, not on a farm, not in a factory, not in a greenhouse. How do you approach this spatially unconfined practice?

MS: We don’t just do interviews. We seek to understand the kind of entanglements of foragers with their surroundings, which are not always obvious from the outset. We focus on rather small samples of foragers in each of our projects, putting depth before breadth. Methodologically, we found that film, or the creation of documentary media, is an ideal approach. The people we work with are not just research subjects but rather protagonists in a collaborative attempt to see and tell a story.

Collaborative documentary media require a much deeper level of consent than interviews or surveys or participant observation. Filming is a fundamentally sensory approach. It helps us understand what people do rather than just asking what they think. It gives us access to the drudgery of foraging but also the joy of seeing and finding. Film is thus not an artsy choice; it is the backbone of our inquiry into the practical relations between foragers and their environments—before these relations become framed in already known narratives of conservation, stewardship, overharvesting, the commons, and so on.

CM: Foraging is an ancient activity, but it seems like what you are documenting is a revival under different globalized auspices. Is the rise of the activity that you are exploring and documenting connected to global crises? What role do today’s crises play? How is foraging different in the twenty-first century from in premodern times?

MS: The climate crisis but also the Great Recession and, before that, the War on Terror and the breakdown of the Soviet Union created the kind of precarity that makes people explore alternative livelihood strategies—such as foraging. At the same time, crises also tend to create niches in which strange booms take place. Hunting for mammoth ivory in the melting permafrost of Yakutia is an example of this. The warming climate unlocks the kind of ivory that you can sell legally, because, as an extinct species, the mammoth is not protected.

Filming helps us understand what people do rather than just asking what they think. It gives us access to the drudgery of foraging but also the joy of seeing and finding.

A changing environment mandates a reaction and makes people ask themselves: what can we do now? In the Aral Sea, for example, there was once a thriving fishing industry. When it dried out, the salinity of the remaining basins became so high that no fish could survive. People have started collecting the larvae of *Artemia*, a kind of shrimp that thrives in very salty water, and the larvae are then sold to the Chinese cosmetics industry.

CM: So is foraging or scavenging becoming more widespread because of the polycrisis?

MS: I wouldn’t say that foraging is a phenomenon of the polycrisis per se but it is certainly amplified through crises. When more people find themselves in a precarious situation, they start improvising. When the dream of a middle-class life seems thoroughly out of reach, upward mobility is not happening, and a regular job is difficult to find, more people start foraging. But regardless of crises, foraging is crucial for livelihoods.

CM: How many people are relying on it?

MS: There are estimates that between a quarter and a third of rural household incomes in the Global South are derived from foraging practices—and this is only counting organic matter. In the

Himalayan regions where people pick *Ophiocordyceps sinensis*, the famous caterpillar fungus that is worth more than gold, the percentage goes up to 90.

CM: How do you select your sites? And do you feel you are missing out by focusing only on three continents?

MS: The ground we can cover in this project is just a modest beginning. Once you start thinking about foraging practices, you see them everywhere. I have a list of at least thirty foraging topics I would love to follow up on. The projects we selected focus on small-scale foraging and practices that lend themselves well to explore the entanglements between foragers and their surroundings.

Semi-industrialized foraging is less interesting for us at this stage. For instance, at the beginning of the project, I was looking into pine nuts in Portugal or Spain. Harvesting pine cones is now often done by enterprises on a semi-industrial scale, using rattling machines similar to the ones used for the olive harvest. I decided not to follow up on this case. As soon as machines are in play, you need investment, and the questions posed are then somehow different. So yes, we are missing out—in terms of the variety of practices but also in terms of global reach. We don't have projects in Latin American, Africa, and the Pacific, for example.

The commons we witness are messy, gray, and partial—quite different from the contemporary vision of commons as a good force in eco-social transformations.

CM: I am trying to understand what the foraging activity means from a legal perspective. Is it in any way related to commons in medieval or early modern history? In some parts of Europe, peasants benefitted from natural resources as a result of forest-common rights. They took firewood out of the forest or drove pigs into the forest for food.

MS: The topic of commons is at the heart of foraging practices. But the commons we witness are messy, gray, and partial—quite different from our images of commons in preindustrial peasant communities in Europe or the contemporary vision of commons as a good force in eco-social transformations. In such imaginaries, there is always a coherent and local community that assumes stewardship. This is not necessarily the case. Commons are often something more situational and negotiated on the spot, beyond legality or tradition. You might be able to forage a specific resource at a certain time and place even if you are an outsider. Thais travelling in groups to Sweden to commercially harvest berries during the season are an example here. Even private properties may become commons at certain times. In France, for instance, everyone is entitled to glean fields and vineyards after the harvest.



Climbing a tree to collect ivy. © 2023 Pauline Prückner. All rights reserved.

CM: So is there a sense at all of community among foragers?

MS: Sometimes, in certain ways, perhaps. But there is also competition. If a resource is scarce and difficult to find you may try to keep your knowledge secret. Truffle collectors in Italy, for example, would never let their neighbor know where they found truffles the previous year. Here, success depends on secrecy rather than cooperation. In other cases, it may make sense to pool risk and reward.

We seek to assume the open eyes you need to forage and not to start with preconceived theories or concepts.

CM: This all sounds like a fascinating project. What would you say has been the biggest surprise so far in your research?

MS: The whole project keeps surprising me. Foragers don't fall into neat categories. They are neither ruthless looters of environmental treasures nor naturally eco-conscious stewards of their environments. Foraging can provide meaning and income; it can be a measure of last resort or a gold rush; it can provide independence and even a sense of freedom; it can be legal but problematic or not-quite-legal but very legitimate. We seek to assume the open eyes you need to forage and not to start with preconceived theories or concepts. Like this, we let things and stories find us as much as we find them.

Cite this article

Saxer, Martin, and Christof Mauch. "Seeing with a Forager's Eye: A Conversation with Martin Saxer." *Springs: The Rachel Carson Center Review*, no. 5 (June 2024). <https://doi.org/10.5282/rcc-springs-7046>.

THE VALUE OF FRAGMENTS: MAKING A HOTSPOT IN MOUNT NIMBA, LIBERIA

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Springs
The Rachel Carson Center Review

5 • 2024



This article is peer reviewed

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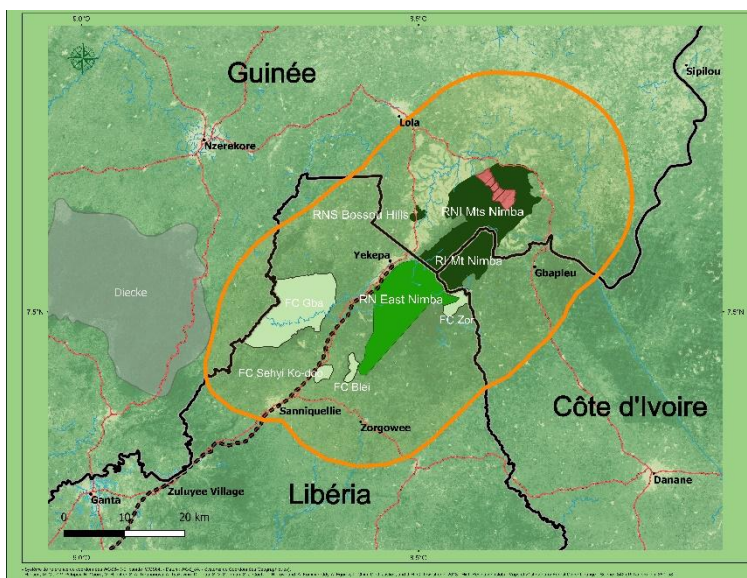
Les Grands Rochers, with Mount Signal Sempéré in the distance, Mount Nimba Strict Nature Reserve, Guinea. Photo by Gregg Mitman. [CC BY-NC 4.0](#).

Faint high-pitched sounds echo up from the cavernous pit into which we peer. At twilight's edge, the dry season's intense midday sun has mellowed into a cool orange glow as bats take flight. Moses, a middle-aged Liberian park ranger with a solid frame and a taste for good stories, shows his anxiousness when we lean just a bit further over the concrete-lined chasm obstructed with twisted steel. One man died here already, salvaging scrap metal from the abandoned conveyor shaft. Moses holds in his hands our protection, and that of the bats who reside in these fragments of a once-prosperous iron-ore mine.



Abandoned iron-ore conveyor shaft, now home to bats, Mount Nimba, Liberia. Video by Gregg Mitman. [CC BY-NC 4.0](#).

We stand on a plateau in the southern reach of a mountain range named Mount Nimba at the triborder region where Liberia, Côte d'Ivoire, and Guinea meet. Stretching 40 kilometers and towering above the rainforest below, the Mount Nimba range is a series of sky islands that capture moisture-laden clouds to envelope its summits and slopes in mists.



Map of Mount Nimba priority landscape, extending across the borders of Liberia, Guinea, and Côte d'Ivoire. Map created by the EU project [Programme d'Appui à la Préservation des Ecosystèmes Forestiers en Afrique de l'Ouest \(PAPFor\)](#), 2021. Courtesy of VisioTerra/AGRECO. [CC BY 4.0 DEED](#). This map has been cropped.

This plateau was once subterranean, before men and machines whittled down this part of Mount Nimba. After two decades of open-pit iron-ore extraction, the roar of machines ended in 1990. Depletion of the main ore body, departure of a major investor and buyer, and disarray wrought by the outbreak of the First Liberian Civil War (1989-1997) brought a silence now broken by the squeaky creatures rustling below us.¹

At the plateau's edge, terraced ledges, carved to stabilize rock walls and move heavy equipment, plunge downward and surround the mining pit that now holds the collected waters of Blue Lake. A shoreline signpost warns the trickle of tourists who visit this mining-site-turned-nature reserve: Swim at Your Own Risk. Across the lake, the highest remaining remnant resembles the ruins of an ancient Inca temple.

The sculpted vistas and fragmented landscapes of the Mount Nimba region reveal what human, nonhuman, and inanimate beings can be to each other when extractive enterprises and conservation concerns seek to derive value from nature.



A mist cloud above Blue Lake at the end of the rainy season. Photo by Gregg Mitman. [CC BY-NC 4.0](#).

Conservation biologists identified this fragment of the Upper Guinean Forests of West Africa as having significant concentrations of endemic species threatened by extinction. This determination earned the region “hotspot” status in 2000, one of 25 (now 36) areas on Earth designated as places of critical endangerment in need of protection.² British conservationist Norman Myers appropriated the term “hotspot” in 1988 to call attention to regions of the globe with high concentrations of endemic species experiencing “extinction spasms”—accelerated, human-induced species loss—due to habitat destruction and fragmentation.³ In the era of the sixth extinction, hotspot identification is a “silver bullet” strategy that touts a simple solution to a complex problem: concentrate the scarce resources dedicated to conservation on areas where preventing habitat loss should save the largest number of species.

In 2013, Ebola disease became visible for the first time in West Africa near Liberia’s Mount Nimba. Ecologists came to posit a correlation between biodiversity loss and disease emergence, which garnered Mount Nimba new attention from virus hunters. In the post-Ebola landscape of pandemic preparedness, Mount Nimba is a hotspot for both biodiversity and emerging infectious diseases.

Hotspots are inseparable from the infrastructures of extraction, knowledge regimes, and the ecologies that make them.

We came to Blue Lake to interrogate the concept of the hotspot, a place deemed by scientists to be simultaneously worthy of protection and harboring a potential threat. In this essay, we build on critical scholarship that reframes the hotspot as a site where the slow violence of capital investment and extraction dramatically alters environments and amplifies disease transmission. Hotspots, we

argue, are inseparable from the infrastructures of extraction, knowledge regimes, and ecologies that make them.⁴

Over the last 60 years, natural scientists, mining engineers, multinational firms, scrappers, tourists, and others have come to Mount Nimba to extract value—both living and inert—from the landscape. As open-pit mining gave way to the East Nimba Nature Reserve (ENNR), the welfare benefits provided to the mine's workers became more diffuse expressions of corporate social responsibility that extend care into the nonhuman world. Care, Maria Puig de Bella Casa reminds us, "is more than an affective-ethical state." It involves labor to create, maintain, and repair ties between interdependent worlds. Care can also be selective and violent.⁵ In the care of Mount Nimba, interests of mining, conservation, pandemic preparedness, livelihoods, and ecotourism converge, collaborate, and collide.

The East Nimba Nature Reserve was established in 2003 to protect a fragment of the Upper Guinean Forests, including most of the Mount Nimba range within Liberia and the abandoned mining landscape where Blue Lake formed. But mining remains. Since 2011, the international mining and steel producing conglomerate ArcelorMittal has been piloting a biodiversity conservation program as part of its pledged commitment to environmental and social responsibility. Liberia is one of many places where the relationships between mining and conservation are intensifying and deepening.

From the vantage point of the Peruvian Andes, geographer Timothy Norris sees "hotspots of biodiversity and extractive investment as two sides of the same coin."⁶ In Liberia, Peru, Madagascar, and Gabon, mining and conservation both work "to gain control over land and resources" in the creation of commodity frontiers.⁷ Both depend on the formalization of territory and the parceling of land, whether a mining concession or a protected park, to extract value in capitalism's quest for cheap nature and cheap labor.⁸

Spaces of endangerment accrue value in an era where market mechanisms, from offsets to ecotourism, are seen as tools of nature conservation and pandemic prevention.

Capitalism fragments nature to make value. Before mining and logging operations on Mount Nimba began, surveys distinguished high-grade iron ore and useful timber from waste rock and worthless trees. But fragmentation of the mountain for profit also created spaces of endangerment. Habitat destruction threatens the lives of rare endemic species, like the viviparous Nimba toad. On fragmented edges of the forest, new relations among people, viruses, and their animal hosts are thought to give rise to zoonotic diseases like Ebola. These spaces of endangerment accrue value in an era where market mechanisms, from offsets to ecotourism, are seen by organizations like the World Bank as tools of nature conservation and pandemic prevention.

In many tales of the Anthropocene, the hotspot plays a role.⁹ Here, we attend to a genealogy of the hotspot whose multiple beginnings offer points of entry into the relations between rocks, animals, viruses, and capital that constitute the Mount Nimba story. How Nimba became a hotspot and how, in turn, this designation has altered relations among the living and nonliving occupants of the region is a question that guides a journey informed by ethnographic and archival research through this fragment of the Upper Guinean Forests of West Africa.¹⁰

Rocks

The name Nimba comes from *Niamba Tun*, a Mano-language expression that means "[hills on which] a young maiden slipped and fell." As we traverse the grass-covered summit along a chiseled, thin ridge, the place name seems apt. A unique combination of climate and geology formed the precipitous escarpments of Mount Nimba.¹¹ Tropical weathering exposed the Precambrian spine of

iron-rich quartzite at heights above one thousand meters, making early mining easy. “Green iron,” the best grade, Moses says, remains abundant around Blue Lake.



Our team descends the steep peaks of Nimba. Photo by Shadrach Kerwillain. [CC BY-NC 4.0](#).

In the early 1950s, Scottish geologist Sandy Clarke made surveys on the Liberian segment of Mount Nimba. He found high-grade iron ore exposed on the mountain ridge with lower-grade itabirite accessible downslope, an estimated 227 million tons of iron ore valued at more than two billion US dollars in 1957.¹² Clarke’s explorations relied upon the knowledge and labor of people in the neighboring village of Gbarpa. Among Mano and Kpelle people, the ability to transform iron ore into tools and weapons had long been revered and smithing was a closely guarded art. Nimba’s iron ore had been essential to the contested territory in the chiefdom wars that raged in the late nineteenth century along the Upper Guinea Coast.¹³

In 1955, the Liberian-US-Swedish Mining Company, LAMCO, formed; it was a joint venture between the Liberian government, Bethlehem Steel Corporation, and a Swedish syndicate. The Stockholms Enskilda Bank and the mining conglomerate Gränges were entrusted not only with the mining operation but, in their words, “civic and social responsibility” that would result in a “project of major importance for the economic and social development” of Liberia.¹⁴

Major open-pit mining began in 1963. Within a year, men and machines extracted between 7.5 and 10 million tons of ore by removing one hundred meters of rock. In the concession, more than rocks were fair game for extraction and capitalization. From the manufactured plateau, Moses points to a few African greenhearts (*Piptadeniastrum africanum*; Dahoma) and ekki trees (*Lophira alata*),

ideal woods for constructing railways and a harbor needed to move iron ore from mountain to sea. Waste rock became fill for wetlands at the mountain's base where miners' camps sprouted alongside the booming town of Yekepa. Moses also shows us tall sugar plums (*Uapaca kirkiana*) and niangon trees (*Heritiera utilis* and *H. densiflora*), which Liberians use for carpentry, furniture, and dugout canoes. As the region became economically attractive, the forest was increasingly fragmented to serve the needs of the company and its workers. Moses laments, "They cut down the trees. This is why the air became so hot down in the valley."



LAMCO's mining operation in Nimba in the 1970s. Published in Maxime Lamotte and Roger Roy, eds., *Le peuplement animal du Mont Nimba (Guinée, Côte d'Ivoire, Libéria)* (Paris: Muséum National d'Histoire Naturelle, 2003), 23. © Françoise Xavier. All rights reserved.

When we visit the village of Zolowee, elders speak nostalgically of LAMCO. At a meeting convened to evoke memories of the company, many more residents come with their phones to record the old men. Sitting on a shaded veranda, we can see Mount Tokadeh, another Mount Nimba peak, being eaten away by the machines of ArcelorMittal, who took over the LAMCO concession. The old men remember LAMCO with affection and express disappointment with this new mine operation. One worker recalls fondly that LAMCO provided salaried employees with "comfortable housing with 24-hour electricity" and hospital "facilities equipped with trained doctors from Sweden, Germany, the USA, and other parts of the world."

LAMCO also built a water-purification plant and a piping system that made the Yah River and its mountainous effluents safe to drink. Sewage was treated, made into manure, and distributed to farmers. In Yekepa, a town built by LAMCO, the deteriorating housing, swimming pool, school, and cinema are reminders of when free worker housing, healthcare, education, and entertainment marked a fulfillment of corporate responsibility, when LAMCO directed part of its profits into population care. Now, "imperial debris" saturates Yekepa's landscape, evoking a sense of abandonment and resentment, of a future lost.¹⁵

In the mid-1960s, strikes for higher wages culminated in a July 1966 confrontation between Liberian mine workers, Swedish management, and the Liberian military and police.

Not mentioned are the hard-fought struggles that won benefits. In the mid-1960s, strikes for higher wages in Yekepa and the port of Buchanan, organized by the National Mine Workers' Association, culminated in a July 1966 confrontation between Liberian mine workers, Swedish management, and the Liberian military and police. During the strike, a Swedish television crew documented police brutality, squalid living conditions, and alleged malnutrition suffered by Liberian LAMCO workers. The resulting documentary, *Black Week in Nimba*, sparked a national conversation when it aired on Swedish television in October 1966. The episode critically challenged Swedish executives' proclamations that moral ideals governed operations abroad. The public embarrassment brought the series of social-welfare reforms that retired LAMCO workers now remember, and long for.¹⁶



The remains of LAMCO's swimming pool. Photo by Gregg Mitman. [CC BY-NC 4.0](#).

The priority placed on worker health, education, and housing was typical of high modernist ideology and its promises of care. Such benefits were relatively cheap and easy to deliver when few environmental regulations inhibited natural resource extraction in countries like Liberia, desperate for foreign capital for development. In 1969, Swedish conservationist Kai Curry-Lindahl, under the auspices of the International Union for the Conservation of Nature, urged the creation of a nature reserve in southern Mount Nimba.¹⁷ He lamented the LAMCO-fragmented landscape, where "roads cut frightful scars" in "dense high forest."¹⁸ But, in the mind of capital, fragmentation was a necessary prerequisite to assess what held value and what did not. Care, in this instance, was tied to a calculus that weighed the fluctuating value of iron ore, the demands of labor, and profits to be made.

Forests

Among the world's ten largest tropical rainforest ecosystems, the Upper and Lower Guinean Forests of equatorial West Africa swathe a huge coastal area from Sierra Leone to the Nigeria-Cameroon border in a verdant cloak. Standing with Moses at a cornerstone marker of the ENNR, a stone's throw from Guinea and Côte d'Ivoire, we gaze over a precipice at a fragment of the Upper Guinean Forests. A canopy of broccoli-like evergreen forest spreads along the steep slopes and off into the distance, its green smoothness interrupted occasionally by a section of a haul road, burnt trees, or farmland patches. After LAMCO's arrival, farming extended into the hills and valleys at the mountain base, partially attributable to the worker influx. After LAMCO left and civil wars raged, a younger Moses accompanied his parents to these slopes during lulls in the fighting to cultivate cash crops, like banana, coffee, and rubber. He knows every ditch in the reserve where so-called "secondary forest" has taken over former farms.

Mount Nimba's isolation, both climatic and geographic, contributes to the abundance of endemic plant and animal species, a metric conservation biologists value as promoting biodiversity.

As we head back to Blue Lake, Moses sees a crab shell in a stream. It is a trace left by the semiaquatic otter shrew, one of the many rare species, including the live-bearing Nimba toad, poisonous giant butterfly, and tool-using chimpanzee, that make this area a prized fragment of the Upper Guinean Forests. Abrupt relief changes along the range make for a dense variety of microhabitats. Biologists identify Mount Nimba as an "inselberg," an island in the sky.¹⁹ Mount Nimba's isolation, both climatic and geographic, contributes to the abundance of endemic plant and animal species, a metric conservation biologists value as promoting biodiversity. In the 1990s, when the whacks of cutlasses and cracks of guns replaced the roar of earthmovers, Mount Nimba was named a biodiversity hotspot and, thereby, acquired new value around which conservation and mining converged.



A high-altitude thicket near a research camp in Guinean Nimba in 1942. Published in Maxime Lamotte and Roger Roy, eds., *Le peuplement animal du Mont Nimba (Guinée, Côte d'Ivoire, Libéria)* (Paris: Muséum National d'Histoire Naturelle, 2003), 14. © Maxime Lamotte. All rights reserved.

The inclusion of the Upper Guinean Forests in Myers' expanding list of the world's biodiversity hotspots was intended to attract the attention of governments and NGOs to protect, police, and care for fragments of this once-vast ecosystem through acts of enclosure. In 2003, as peace came to Liberia, the interim government established the ENNR as a protected area. Where once Liberian police forces guarded LAMCO property and surveilled workers, the hand of the state now protects and monitors a heavily mined peak and the rare species that still populate this fragmented landscape.

Immediately, conflicts with communities nearby the reserve arose. Saye Thompson, a farmer, artisanal miner, and former hunter who took college courses in natural resource management, told us that the ENNR was created "without community consent." In 2010, so-called community forests were established in the Liberia's Nimba county, and Thompson was selected to chair the reserve's comanagement committee. Land rights were formalized. Conservation was to be done according to the community paradigm favored by global actors since the 1980s. Comanagement-committee members ensure that park patrols do not treat the occasional hunter or farmer who encroaches beyond the reserve's buffer zone too harshly. Coexistence—of mining, conservation, and local livelihoods—depends crucially on the mitigation of conflicts in a fragmented mosaic of discordant uses.

In the twenty-first century, transnational mining firms have become a leading source of conservation funding in much of Africa.

Development of the ENNR occurred under the auspices and with the financial support of ArcelorMittal. In the twenty-first century, transnational mining firms have become a leading source of conservation funding in much of Africa. ArcelorMittal markets itself as a custodian of Mount Nimba, with the reserve serving as the company's biodiversity offset in Liberia.²⁰ The ENNR is a resource commodity that benefits ArcelorMittal in appeasing shareholders and critics attuned to questions of corporate social responsibility and care. Since completion of an environmental impact assessment in 2010, the company has been intermittently funding wildlife surveys and park guards as compensation for environmental harms unleashed by a new wave of mountaintop removal on nearby Mount Tokadeh.²¹



A pregnant female Nimba toad (*Nimbaphrynoides occidentalis*). Courtesy of Johannes Penner, Frogs & Friends. [CC BY-NC 4.0](#).

Strange alliances arise where life and nonlife meet in the extractive zones of mining and conservation.²² On the Guinean side of Mount Nimba, a toad that gives birth to live young, the only known species in existence to do so, proved decisive in 1981, turning another nature reserve into a UNESCO World Heritage Site. The viviparous amphibian inhabits a mere four square kilometers of grasslands above 1,200 meters. The capitalization of iron ore and the Nimba toad collided when the Société des Mines de Fer de Guinée (SMFG, Guinean Iron Mines Company) learned that one of the Nimba toad's three largest populations lived on Mount Signal Sempéré, within their mining concession.²³ In a gesture of corporate responsibility and care, the company removed the mountain from its mine plan as a "set-aside," and made doing so a key component of their corporate communications. The Nimba toad and the mountain to which it is endemic became locked in a relation of codependence. Entanglements of life and nonlife, of toad and mountain, in the growing nexus of conservation and mining, wield power.

Viruses

Precious ore and rare animal species are not the only attractors to Mount Nimba. Viruses, which confound the distinction between the animate and inanimate, also draw attention. They, too, accrue value out of the fragmented landscape of Nimba.

In 2017, ArcelorMittal orchestrated its first translocation of bats living in an old mining adit. The project is a purported act of care, rendered as a biodiversity offset for the company's plans to extend open-cast mining to a new peak in the range. But ArcelorMittal's environmental manager had heard bats could be "carriers" of Ebola. In the wake of the 2013-2016 West African Ebola outbreak, the largest recorded epidemic of the fatal disease, precautions seemed warranted.

The team detected an RNA fragment of Ebola Zaire virus. It was the first time Ebola Zaire virus was found in a bat in West Africa.

It happened that a Liberia-based team of PREDICT, a consortium funded by the United States Agency for International Development (USAID), was in the region sampling wildlife for viruses. A charismatic American virus hunter and director of the PREDICT team, Jim Desmond, offered the team's services to help minimize the risks of moving potentially disease-carrying bats. ArcelorMittal provided the necessary infrastructure to carry out the work. Virus hunters donned protective suits and helped capture more than two thousand bats at dusk. Moses helped. With colleagues, he placed bats by the handful into cages, stacked the cages in pickup trucks, and transported the flying mammals to their new home—a concrete tunnel near Blue Lake built by ArcelorMittal. Before releasing the bats, the PREDICT team collected blood and swabbed orifices of hundreds of bats, searching for the elusive origins of Ebola. In a blood sample taken from a greater long-fingered bat, the team detected an RNA fragment of Ebola Zaire virus.²⁴ It was the first time Ebola Zaire virus was found in a bat in West Africa.



(Left) A free-tailed bat is being sampled for blood by PREDICT employees in Guinea. (Right) A PREDICT makeshift laboratory near a Guinean forest. Photos by Emmanuelle Roth. [CC BY-NC 4.0](#).

Habitat fragmentation figures prominently in ecological tales about the causal drivers that sparked West Africa's 2013-2016 Ebola outbreak. In 2015, the Environmental Foundation for Africa (EFA), a Sierra Leone-based NGO, published a study of the relationship between changing land use, forest fragmentation, bat ecology, and Ebola-virus disease. Their investigation included a village in Guinea, several hundred kilometers west of Mount Nimba, where the outbreak is thought to have originated. Using satellite-based data and mathematical modeling, the NGO found a common pattern in six of seven Ebola outbreaks in Africa. Deforestation that resulted in more isolated patches of forest, as in a landscape mosaic of forest, farms, and plantations, led to a greater likelihood of Ebola outbreak. The group recommended protecting large forest blocks from fragmentation to minimize human-wildlife contact and thereby the risk of zoonotic spillover.²⁵

Mining companies, NGOs, conservation biologists, and virus hunters each find value in a virus inhabiting a fragment of the Upper Guinean Forests.

The Ebola-risk maps produced by EFA owe their origins to another hotspot concept that has come to dominate growing concerns around pandemics in the Anthropocene. In 2008, a group that included Peter Daszak from the Wildlife Trust, later renamed EcoHealth Alliance, published a letter in *Nature* that was instrumental in shaping US federal policy on pandemic preparedness. The authors analyzed data from more than three hundred emerging infectious disease events that

occurred between 1940 and 2004. Approximately 60 percent of these events were associated with zoonoses, the majority of which originated in wildlife. Their conclusion: low-latitude, biodiversity-rich tropical rainforest regions in Central and South America, Africa, and Southeast Asia were the highest-risk “hotspots” for zoonoses and posed “an increasing and very significant threat to global health.”²⁶ The next year, USAID launched PREDICT. Over 10 years, the program spent more than two hundred million US dollars furthering research, strengthening surveillance, and increasing laboratory capacity, all aimed at discovering and detecting zoonotic pathogens at the human-wildlife interface.



Moses Darpey hikes across a mass of fallen rocks above Blue Lake. Photo by Gregg Mitman. [CC BY-NC 4.0](#).

The finding of a fragment of Ebola Zaire virus by the Liberia PREDICT team has acquired evidentiary value in the making of Mount Nimba into a disease hotspot. Such a designation has, in turn, been mobilized to incriminate different types of land use in environmental critiques of deforestation. Who is to blame for forest fragmentation, and, by inference, disease outbreaks, is deeply contested among conservation NGOs, mining companies, and local people.²⁷ This became evident when we interviewed the environmental manager of a mining company in the area. “If this theory [of fragmentation] holds,” he told us, “then of course mining can open a corridor for contact! But so can slash-and-burn agriculture.” Mining companies, NGOs, conservation biologists, and virus hunters each find value in a virus inhabiting a fragment of the Upper Guinean Forests. But they are different valuations that advance contested and collaborative visions of land use, and may differently affect the futures of human, nonhuman, and inanimate beings of Mount Nimba.

Meanwhile, some scientists criticize the commotion around the detection of Ebola virus in a Nimba bat. At a conference on African Small Mammals in Namibia, wherein a fault line ran between virologists and conservationists, a bat specialist reminded us that “fragments are no ecology.” A bit

of RNA reveals nothing of the complex interrelations and historical processes that brought bats to inhabit an old mining adit, scientists to suspect a mammal as host to a virus, or a virus to infect and kill thousands of people across Liberia, Guinea, and Sierra Leone.

Conclusion

Multiple genealogies and scales of the hotspot converge in Mount Nimba.

Hotspots, we argue, depend upon fragments. Fragments, by definition, are broken parts, detached, incomplete. Uneven fragment edges attract novel gatherings. Fragments can evoke what was, beckoning nostalgia and begging repair. They can signal new futures, inviting salvage and reuse. Fragments create value.

Nimba has been fragmented into pieces of worth—iron ore and timber, rare toads and viruses, ephemeral jobs and cash-crop farms—in the ever-changing production and extraction of value from nature. As residues, fragments invite management.²⁸ In hotspots, fragments require care and containment. As private businesses and the state reconsidered social and civic responsibilities,

modes of care morphed from paternalistic provision of worker welfare to neoliberal care of the more-than-human. We hold that the governance of fragments, replete with notions of repair and restoration, is both the epitome of and a litmus test for late extractive industries. In these fragmented landscapes, codependencies, trade-offs, and quests for profit bind together lateritic rocks, trees, toads, bats, viruses, and humans. Past relations sever, new bonds forge, and uneasy compromises form in the disarray and order unleashed and imposed in cycles of capitalist extraction.

Moses is confident that the forest will again become whole. As we hike up the Sika Valley below Blue Lake, where each rainy season reveals its lot of fragmented rocks, rusty steel rods, and concrete pieces, he directs our attention to forest sections separated by the riverbed. "Look," Moses says, smiling, "they are coming together."

Acknowledgments

We thank Moses Darpey, the people of Gbarpa, Zolowee, Camp 4, and Yekepa, the forestry staff of the East Nimba Nature Reserve, and the environmental offices of ArcelorMittal and the SMFG. We acknowledge the archival research that Katharina Karrenbauer and Rebecka Mähring contributed to this article. Our gratitude goes to Moussa Douno, John Fayiah, and Shadrach Kerwillain for their insights and teamwork, and to Kerri Arsenault, Debra Klebesadel, the RCC Springs editorial team, and two anonymous reviewers for their editorial comments and suggestions. Research for this article has been supported under the project "Fragments of the Forest: Hot Zones, Disease Ecologies, and the Changing Landscape of Environment and Health in West Africa," funded by the European Research Council (ERC) under the European Union's Horizon 2020 Research and Innovation Programme (grant agreement no. 885120; <https://cordis.europa.eu/project/id/885120>).

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Cite this article

Roth, Emmanuelle, and Gregg Mitman. “The Value of Fragments: Making a Hotspot in Mount Nimba, Liberia.” *Springs: The Rachel Carson Center Review*, no. 5 (June 2024). <https://doi.org/10.5282/rcc-springs-6716>.

BEAVERING

Mary Beth LaDow

Springs
The Rachel Carson Center Review

5 • 2024

Mary Beth LaDow



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Spring is approaching. The beavers have left a single stick about a meter long across the pond outlet, marking their intentions. “No mud yet, but we are back.” Like humans, beavers do not hibernate; they have spent the winter hunkered down in a warm lodge of their devising, a pair mated for life packed in with several kits and yearlings and the occasional muskrat, safe from predators. Now the long winter of mating and living on stockpiled branches is ending. We humans (my husband and I) pull the stick from the water and toss it aside. Our annual dance with the beavers has begun: for eight months, April through November, we perform a *Castor pas de deux*.

What we call the beaver pond is actually the middle pond of three. It sits in Mid-Coast Maine, the tide-pooled, deep-dark woodland region that inspired Rachel Carson to plumb the drama of life in *The Edge of the Sea* (1955) and *The Sense of Wonder* (1966). The beaver pond and its wonders lie further inland at the edge of a field, 3.2 hectares covered in native grasses, low-bush blueberries, wild strawberry vines, and cranberry bogs, punctuated by 30-meter-tall pine trees and a large cast of characters.

Deer, foxes, coyotes, porcupines, otter, fisher cats, herons, bald eagles, osprey, ducks, Canada geese, songbirds, woodpeckers, and flickers appear and disappear, along with renegade domestic guinea fowl, peepers and frogs, a flock of wild turkeys, the occasional pair of kestrels, a bobcat, lightning bugs and dragonflies, plus the annual scourge of black flies and mosquitoes, and, once, two gigantic, escaped hogs rooting for acorns.



(Left) A confusion of guinea fowl. © Mary Beth LaDow. All rights reserved. (Right) A northern green frog, one in a multitude that form a nighttime wetland chorus in spring and summer. © Mary Beth LaDow. All rights reserved.

The field is flanked by a long stone wall, a few pondlets (one with an island), a house, a barn, and stands of trees—birch, oak, maple, beech, spruce, fir, hemlock, wild cherry, and pine—that replaced the old-growth forests felled during four centuries of intensive New England logging. The pond is as wide as a football pitch and two and a half times as long, the largest of three ponds that sit like beads on a strand 800 meters long. Each regulates the wetland the beavers first created and acts as a giant sponge during drought or floods. The upper pond is long and skinny, maintained by a beaver dam with an earthen slide down the middle shared by the occasional snapping turtle; the lower pond, plugged by a short, ragged dam, forms a small, irregular glade.

This complex of ponds and fields is the evolving expression of decades, if not centuries, of beaver and human engineering. The beavers, for their part, have created an elaborate habitat including three dams, two lodges, and a network of trails, chutes, and channels that serve their nocturnal building and foraging.¹ Humans have also shaped the place for our own, irregular purposes, beginning with the Indigenous Wabanaki, who both hunted beavers and respected them as cosmological partners for thousands of years, followed by neo-European field-clearers and stone-wall builders, who sometime after the seventeenth century used the land for pasture, including, some 50 years ago, for horses.² Two twentieth-century rectangular coves, dredged out by machines, extend like an upturned claw from the middle pond into the open eastern shore, designed for training Labrador retrievers to fetch padded batons that stand in for game birds. Every week until late fall, and then resuming after the spring mud season, a caravan of vehicles arrives carrying bird dogs—some clueless, some graceful—and turns them loose for training.

A large beaver dam that should be at the foot of the middle pond is lost to the mists of time, replaced by a berm about nine meters wide. We imagine a muddy event featuring an explosion and lots of dredging. This further expanded the wetland, and though beaver activity still regulates the area, it relieves the beavers of some dam maintenance. The berm creates a walkway scored by a beaver trail and the little outlet stream, which empty into the lower pond. Near the outlet is a culvert that sneaks water out past the beavers through a buried black plastic pipe.



(Left) Beaver channel to the west. (Right) Human channels to the east. © Mary Beth LaDow. All rights reserved.

This is the stage upon which a quirky drama of beavers and humans—a symbiosis of sorts—unfolds each year.

Most every day, beginning at dusk and continuing throughout the night, the beavers cruise to the outlet stream and [weave a tiny dam](#) across it, a barrier of wood and mud, pulled-up pond grasses, and occasional rocks. We humans let them go at it until the pond is about to overflow, then muck it all out, flinging sticks and branches and sometimes whole dead trees onto a growing seasonal pile. This ritual pauses only when one party gets tired or has something better to do. Beavers never seem to get tired or have anything better to do. One year it felt like a dozen beavers were piling it on, laughing at us, building little Taj Mahals every night. The next spring they eased up, weaving a few sticks into feeble sieves. This went on for a few weeks. We didn't know why. Then they crushed us once again, the annual burn pile doubling to two piles.

Before it became a scientific term in the 1880s, *symbiosis*, from the Greek, meant simply “living together, or companionship.” Our evolving relationship with the beavers has come to feel somewhat like that, a passage out of a murderous North American past, touched with shades of science and seeds of wonder. We know that beavers pool water for protection, foraging, and food storage; that giant beavers the size of bears once roamed North America; and that the surviving genera are masters at clogging and flooding things humans don't want clogged or flooded. (A municipal worker in Oregon reputedly unclogged a single culvert almost daily for 30 years.) Beavers also possess fur and scent glands that humans have prized for centuries. Consequently, as the ancient rusting beaver trap hanging in our wood room attests, “something better to do,” for humans, often has consisted of extirpation. Beaver wetlands once covered as much as [60 percent](#) of North America. By the twentieth century, both the Eurasian and North American beaver were hunted to near extinction. “Living together” begins with humans letting beavers live.

One afternoon a couple of years ago, as we were walking around the far side of the middle pond, we observed several oaks that had been newly gnawed by the beavers. Every fall, they work on a big tree (or several), yet seldom fell them. It isn't clear why they choose some trees, in some locations, and not others. The same is true for dwellings, which they use for protection, warmth, and mating. Their two lodges are about 100 yards apart—one in the middle pond surrounded by water, one in the upper pond against the bank (a bank den)—and they seem to alternate every several years between the two. The beavers last departed the middle pond lodge a few years ago. A material

scientist and engineer who studies beavers told me we are not sure why they do this, or why they engage in any number of other behaviors.³



Middle-pond lodge, which has remained vacant for several years. © Mary Beth LaDow. All rights reserved.

An elusive, long-term relationship with wild animals only glimpsed at dusk is like a shadow dance, choreography worked out with minimal visual contact and no spoken language. There are a few beaver references in our house. A beaver T-shirt that says, “Dam it” (more like a rag, actually, but still worn regularly); a beaver-themed WI-FI password; and “Wally,” a nickname for the beavers—they all have one name, though we respect them as individuals. But that’s about it. The beavers squeak and grunt among themselves. Otherwise, aside from the occasional warning slap of the tail, they glide across the pond in silence. To us, they are action-oriented. While there isn’t much to say, there is always something to do.



(Left) A beaver slaps its tail on the upper pond. (Right) Oak tree by Wallace T. Beaver. © Mary Beth LaDow. All rights reserved.

This year, we surrounded the remaining stand of oak trees with low fences. (Restoring [old-growth forest characteristics](#) requires, among other things, protecting mature trees.) But what about the beavers? A few days later, we had another idea. Pulling a black plastic sled fitted out with anvil loppers, a hand saw, and an electric chain saw, one of us (not me) cut hardwood saplings for the beavers. (Beavers do not like eating softwoods, though they will occasionally take a hemlock sapling and put it on the dam, like a Christmas tree on a construction site.) Then one of us (me) dragged the saplings down to the edge of the beaver channels like a delivery truck at the back of a grocery store. Within a few days, the saplings disappeared. No more gnawed oaks. Beavers may have earned their “busy as a beaver” aphorism, but they can also be opportunistic. “If there is an easier option, they will take it,” the same beaver scientist told me. It is her favorite fact about beavers.

The beavers, as if in exchange, occasionally ferry downed wood from the hillside to the daily dam, less work for them and saving us from moving it ourselves (though much is left to decay). A reminder that, in the bigger picture, beavers are emerging as vital partners as we [adapt to a changing climate](#).⁴ Beaver wetlands are not always an unqualified positive—moving north as the climate warms, they are increasing methane emissions on the [Arctic tundra](#). Yet their net effect is an air-cooling, carbon-sequestering, water-regulating, fire-mitigating bonanza, and humans across the world are beginning to [invite them back](#) to [American ranches](#), [Bavarian valleys](#), [Mongolian watersheds](#), and even near a [West London](#) shopping mall. It is also possible that beavers, or at least their methods, could help save China’s [sinking cities](#).

Our *Castor pas de deux* is really more of a quirky call and response. There is no strife, no hollering about saving the planet, no humans apart from nature. Inhabiting the same ground, we each trace

the tracks of the other. We think with our bodies. We tug on the same rough sticks. We cut and dredge and shape and build, and each goes home trailing bits of the same pond grass.



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Notes

¹ Beavers' impact on Earth has been significant for millions of years. A 125,000-year-old fossilized beaver dam containing the foot bone of a woolly mammoth was found in the Yukon, Canada, along with fossilized beaver-chewed sticks four to five million years old; a 150-year-old beaver dam in Michigan is still in active use; and the largest beaver dam on Earth, in central Canada, is half a mile long and visible from outer space. Emily Fairfax, "Beaver Fact of the Week: The Oldest Dam Fossil," *A Rattlin' Blog*, 9 December 2015, <https://arattlinblog.wordpress.com/2015/12/09/beaver-fact-of-the-week-the-oldest-dam-fossil/#more-281>; and Fairfax, "Beavers in the News: 150-Year-Old Map Reveals that Beaver Dams Can Last for Centuries," *A Rattlin' Blog*, 9 August 2016, <https://arattlinblog.wordpress.com/2016/08/09/beavers-in-the-news-150-year-old-map-reveals-that-beaver-dams-can-last-centuries/#more-1054>; Ian Frazier, "Deep in the Wilderness, the World's Largest Beaver Dam Endures," *YaleEnvironment360*, 11 December 2023, <https://e360.yale.edu/features/worlds-largest-beaver-dam>.

² Historian Calvin Martin argued in *Keepers of the Game* (1978) that some Indigenous people's relationship with beavers (not specifically the Wabanaki) changed radically during the fur trade (1600s-1900s), from a "mutually courteous relationship" and "fear of spiritual reprisal" from the beavers to unrestrained overkilling because they blamed beavers for epidemic disease, a subject of intense controversy among anthropologists and historians. Calvin Martin, *Keepers of the Game: Indian-Animal Relationships and the Fur Trade* (Berkeley: University of California Press, 1978), 18-19; and Fred L. Ragsdale, Jr., review of *Keepers of the Game: Indian-*

Animal Relationships and the Fur Trade, by Calvin Martin, *Natural Resources Journal* 23, no. 1 (Winter 1983): 281-83, <https://digitalrepository.unm.edu/cgi/viewcontent.cgi?article=2629&context=nri>.

³ From email correspondence with Jordan Kennedy, bioengineering and design scientist, 22 and 27 April 2024. She has studied the collective intelligence of beavers, or stigmergy (her analogy is mound-building termites), and promotes Indigenous-led conservation as a native of Montana's Blackfeet nation. She and Montana beavers are featured in *Beaverland: How One Weird Rodent Made America* by Leila Philip (New York: Twelve, 2022).

⁴ A growing literature features beavers as climate-management heroes, including a story of beavers parachuted into central Idaho in 1948. See Kelly Kizer Whitt, "Parachuting Beavers Created a Fire-Resistant Wetland," *EarthSky*, 30 July 2023, <https://earthsky.org/earth/parachuting-beavers-dams-fire-resistant-wetland/>; Daniel Cusick and E&E News, "The Beaver Emerges as a 'Climate-Solving Hero,'" *Scientific American*, 11 July 2022, <https://www.scientificamerican.com/article/the-beaver-emerges-as-a-climate-solving-hero/>; and media sources compiled by geology professor and ecohydrologist Emily Fairfax, <https://emilyfairfaxscience.com/media-coverage/>.

Cite this article

LaDow, Mary Beth. "Beaverling." *Springs: The Rachel Carson Center Review*, no. 5 (June 2024). <https://doi.org/10.5282/rcc-springs-6381>.

THE POETICS OF DUNES

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Springs
The Rachel Carson Center Review

5 • 2024

Joana Gaspar de Freitas

Sand, solid, substance
From high mountains with valleys and vineyards
Down the river to the sea.
Washed ashore,
Blown by cold northwest winds,
Trapped by the roots of the marram grass.
Slowly piling and growing, flowing and being
Dune, story, dream.



Dunes: the beauty of geopoetry. Photo by Joana Gaspar de Freitas. [CC BY 4.0](#).

I grew up by the sea, in the warm south of Portugal, swimming in the ocean and playing in the sand. I didn't know then that my childhood playground was actually an "anthropocoast," a hybrid or human-shaped coast, the product of one of the first beach nourishments made in my country. And when I later became a historian, I didn't think that my professional path would lead me through sand hills. But years ago, I realized that dunes have stories too, which prompted me to write a book on the historical connections between humans and the coast—on the history of dunes.¹

Coastal dunes have been the subject of extensive scientific literature. They are highly valued for their role in coastal protection and are recognized as important ecosystems for endemic flora and fauna. Scientists describe coastal dunes as being made of sea, sand, wind, and vegetation; they use mathematical formulas to translate the forces and processes behind the formation of these natural phenomena and a highly specialized language to refer to them. However, dunes don't only have geomorphological and ecological characteristics, they also have social and cultural features that are hardly ever mentioned.

In the archives, I discovered the stories of the human bodies, values, institutions, policies, and technologies that have shaped dunes over the centuries—along with the sea, the sand, and the vegetation. Dunes are common landforms, found on all five continents and at almost all latitudes; stories make them unique, part of a shared local heritage. This cultural experience is tied to specific geographic and temporal contexts; it is not universal, and yet it can be connected to the global world. *That* was what I wanted to write about.

Writing dune history turned out to be easier said than done, for it led to some methodological challenges. Historians turn people's messy lives and past events into histories with meaning. On the other hand, environmental history is full of well-

intentioned ideas about overcoming our anthropocentric views and getting into the skin of the nonhuman subjects we are dealing with in order to portray the world as they would see it. But a dune has no skin. Not even a body. It is not one thing, but many. A dune is a gathering of materials and beings, ephemerally put together by the right combination of elements and forces. Could I turn this incessant movement of the dunes into a coherent history?—I thought to myself. Could I write history from a dune's perspective?

I soon realized I couldn't write as a dune—yet, I was firmly determined to tell their stories, using my own voice. As historian Greg Denning points out, in storytelling, speaking is not enough to be heard. Just as in theater, telling a story is about sharing an experience; it is necessary to create "moments in-between, moments of seeing, moments of reflection," moments of expansiveness or immersion.² That was why I decided not to hide for the sake of objectivity or to pretend that I am not what I am—human.



Almofala, Ceará, Brazil. This church was once buried by the sand dunes but was later uncovered by the locals. Photo by Joana Gaspar de Freitas. [CC BY 4.0](#).



Historian in the dunes. Photo by Joana Gaspar de Freitas. [CC BY 4.0](#).

After all, readers are human, too. I would reach them by acknowledging and reflecting on what life and the dunes are made of, by unfolding the human experience of the dunes, by peeling off the many layers of the encounters between people and sand that I uncover through my inquiries and findings. As a historian, I'm bound to the truth, but I could also bring creativity and emotion to the pages, making readers feel the dunes, taking them on visits to my beaches, using the power of narrative and the rhythm of poetry.³

The ever-changing history of dunes has made lasting impacts on human lives, livelihoods, and societies—just as it was shaped by humankind. Legends, archaeological data, and historical records show that dune drift has been a problem for coastal populations for centuries. The cold and stormy climatic conditions of the Little Ice Age combined with the increasing effects of human activities such as deforestation, agriculture, and cattle grazing set many European dunes in motion.⁴

In Portugal, the small village of Paredes, on the northwest coast, was abandoned in the sixteenth century because the sand blown by the winds invaded the houses.⁵ The hamlet and fields of Lavos suffered the same fate.⁶ On a stormy night in the seventeenth century, according to Scottish legend, sand destroyed the manor of Culbin and the agricultural lands of the wealthy estate.⁷ Likewise, in France in the mid-1700s, the dunes buried most of the houses and fields of Soulac, a village near Bordeaux.⁸ And in Denmark, at the end of the nineteenth century, about 62,000 hectares of land were covered by the drifting sands, sometimes reaching more than 10 kilometers inland.⁹ Such events explain that in the eighteenth and nineteenth centuries, dunes were mostly described as useless and dangerous places, referred to as “evils” and “threats.”¹⁰



(Left) Human-made dunes: planting marram to trap the sand. Lacanau Ocean Beach, France. (Right) Hybrid dunes in Peniche, Portugal. Photos by Joana Gaspar de Freitas. [CC BY 4.0](#).

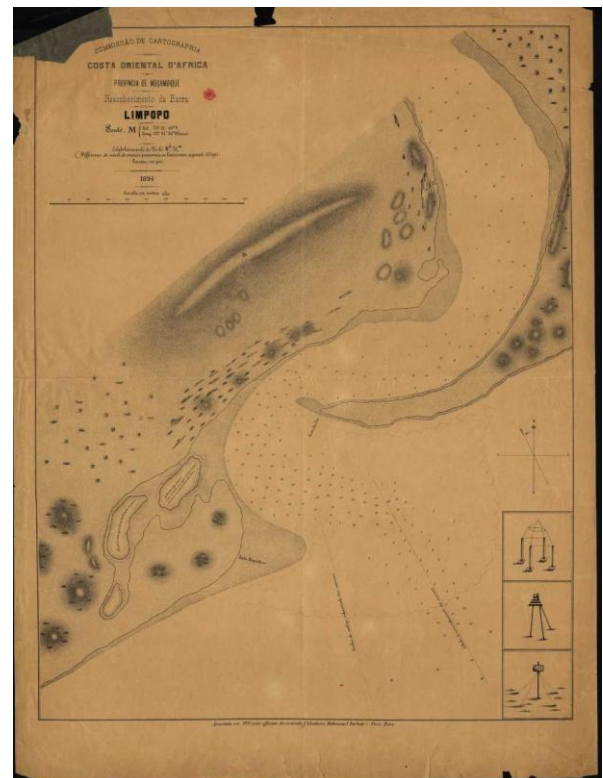
But dunes are more than useless and dangerous places. Those who described them as wastelands were usually outsiders, often state agents or experts sent to marginal sandy coasts to evaluate their resources and who did not know the territory. On the contrary, those who had long lived near the sea, from Europe to New Zealand, Brazil, and Mozambique, had a close relationship with the dunes, which were familiar landscapes named according to local uses, traditions, and sacred beliefs, such as the *Medo Inglês* (Trafaria, Portugal), the *Dune du Pilat* (Arcachon, France), and the *Duna Encantada* (Tatabuja, Brazil). The resources of the dunes were valuable to supplement the often

meager livelihood; people collected wood and grasses (to thatch roofs and make mattresses or baskets), grazed cattle, and raised rabbits.¹¹

Moreover, these local communities understood the importance of dunes as a defense against storms and sea flooding, and the need to maintain their vegetation cover to prevent sand drift. This way, they developed coping practices to ensure dune stability. For instance, in the fourteenth century in Lincolnshire, United Kingdom, a custom forbade the cutting of the grasses that covered the sand hills.¹² Similarly, in fifteenth-century Holland, the inhabitants of some localities were required to plant marram grass to trap the sand and prevent it from being blown by the wind.¹³ Another common strategy when it was impossible to stop the dunes from invading fields and villages was to retreat or move infrastructures inland.

Depending on the perspective, these stories of humans and dunes can be seen either as disasters or examples of resilience and ingenuity. Some question the relevance of this old knowledge. "Obsolete," they call it. But it isn't. In the twentieth century, dunes were repeatedly destroyed, eliminated as a nuisance or as the cost of development of the cities and resorts that were built along the coast.¹⁴ It was not until the mid-1950s that scientists realized their key role as buffer areas and rediscovered the strategies long used by coastal communities.¹⁵

Today's dune rehabilitation projects are based on the planting of grasses to fix the sand, which is referred to as an (innovative) nature-based solution. Retreat is not an outdated solution either. It is currently defended by scientists and managers as the best approach in some cases, and it may well be the most likely future for many coastal settlements. These examples show that there is still much to be learned from past experience.



The dunes at the mouth of the Limpopo River. These dunes constituted the first dune area that the Portuguese tried to stabilize in Mozambique. Map produced by the Comissão de Cartografia, 1894. Public Domain. Courtesy of the Portuguese National Library.



Urban development on the coast. Building on dunes destroys the beach's natural protections, increasing its vulnerability to coastal erosion. Ofir Towers, Portugal. Photo by Joana Gaspar de Freitas. [CC BY 4.0](#).

The dunes are my muses. In the process of acknowledging them, I became a different historian, and someone who sometimes would like to be a poet. For dunes are transient environments; when writing about them, I often felt the insanity of trying to nail down sand with words. How does one describe an entity that never stands still? Dunes have no place of their own, no flesh, no boundaries; they are a collective of substances, creatures, and forces that came from other places and belong to other worlds, so perfectly aligned that they can be considered *geopoetry*.

Dunes embody the experience of being here and now and soon somewhere else, without longing for the previous. They are nomads in their existence, representing the fluidity of life. I remained a human being and could not become one with the dunes. But to work on them, I had to adapt to their unsettled nature. My writing had to flow, not like the water, but like sediment: salting, resting, rolling, settling, waiting for a new gust to take it to the next place before starting anew. And now that my dune book has been completed, it's time to end this cycle and move on—to find another purpose, another dream, another story to write.

Acknowledgment

This article is based on research from the project DUNES, which has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 Research and Innovation Programme (Grant agreement n°802918)

Notes

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- ² Greg Denning, "Performing Beaches of the Mind: An Essay," *History and Theory* 41, no. 1 (2002): 1-24, pp. 8, 11, <https://doi.org/10.1111/1468-2303.00188>.
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Cite this article

Gaspar de Freitas, Joana. "The Poetics of Dunes." *Springs: The Rachel Carson Center Review*, no. 5 (June 2024). <https://doi.org/10.5282/rcc-springs-8461>.

THE MAGIC MIRROR: LEGENDS, LIMNOLOGY, AND NUCLEAR POWER
ON LAKE STECHLIN

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Springs
The Rachel Carson Center Review

5 • 2024

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On the horizon of the small German village of Neuglobsow, the chimney of the Rheinsberg nuclear power plant rises above the surrounding beech and pine trees. It stretches to the sky, twice the height of the forest beneath it—a solitary concrete monument in a picturesque landscape. Beneath the tower and the trees, there is water: glass-clear and shining blue; cold and immensely deep. Lake Stechlin is a mirror. Named from the old Slavic word for glass, *steklo*, it reflects the forest, the smokestack, the landscape around it—and other, more global phenomena too.



The IGB LakeLab. © 2018 Volker Crone. All rights reserved. Courtesy of the Leibniz Institute for Freshwater Ecology (IGB).

A silver fish striped with pink flits in its depths. A crayfish crawls over the open shells of mussels. A black-necked bird streaks overhead. Neon algae spin their way around the branches of a fallen tree. And clouds move in reflection across the water's surface. Stechlin is both the largest and deepest lake in the area, remarkable for its clarity. On good days, you can see ten metres into its turquoise depths, at times to the very bottom.



Lake Stechlin. © Jessica Lee. All rights reserved.

"Everything is silence here," wrote the German realist author Theodor Fontane, who made the lake famous as the setting of his 1898 novel, *Der Stechlin*. "Not a single boat leaves its wake and no bird may be heard to sing . . . Yet from time to time at this very spot things do get lively."¹ Fontane drew on local histories and legends for his fictional Stechlin, which would in turn shape the cultural understanding of the real lake—and the scientific legacies that followed.

It is 1755, and three thousand kilometres away in Lisbon an earthquake is raging. It is November, All Saints Day, mid-morning. Fissures erupt in the centre of the city, and thousands are killed. Inexplicably, just as the earthquake strikes in Portugal, the lake water at Stechlin roils and erupts in geysers.

This a local legend, documented by historian Friedrich Wilhelm August Bratring in his 1799 account of the region.² A century later, Fontane took this story further: during far-off quakes and volcanic eruptions, he wrote, Stechlin gives rise to an enormous red rooster that flaps his wings above the waves, that crows over the solitude of the lake. Fontane also drew on local tales from Karl Haase's 1887 book of regional legends, in which a hubristic fisherman called Minack casts his net over Stechlin in a storm, only to be pulled into the water and drowned by the rooster.³



Art installation on Lake Stechlin. © Jens Hahn, www.hahn-stechlin.de. All rights reserved.

These tales, for Fontane, had a literary function. Depicting social and political upheaval in nineteenth-century Prussian society, Fontane used the lake as a metaphor for the cultural transformations in his story about aristocrats living on its shore. But Fontane's novel would impact the lake's actual future: the rumour of Stechlin's powers—a kind of limnological divination made famous by Fontane—would linger and transmute in the decades that followed. In the present story, however, there is no rooster and there are no aristocrats—just a lab and a nuclear reactor.

In 2017, two years after my first visit to Stechlin, I take up a post as writer-in-residence at the Leibniz Institute for Freshwater Ecology (IGB) in the village of Neuglobsow. The IGB sits on the lake's eastern shore, a complex of wood-clad buildings set around the village's old fisherman's hut, where the mythical Minack may once have been found. I am here to write about the lake's significance in literary history and limnological research and spend days at a time shadowing the lab's researchers, interviewing them about their work. Swimming out to the lake's centre, I think about why this place is so captivating to me. From my little office, I trace the lake through the archives.

I find Stechlin in the pages of a limnology journal, *Archiv für Hydrobiologie*, a major text in freshwater science. In 1935, the editor August Thienemann recounts the tale of a quasi-scientific article published in a newspaper. In the article, a local mining engineer proposed construction of a research centre at Stechlin, intending to study the lake's eruptions and their geological link to far-off earthquakes. He argued that German researchers should pay closer attention to Stechlin, that it could be used as a naturally occurring "pre-seismograph" to warn of disasters in Europe. The article, Thienemann recounts, caused outrage in the scientific community, in part for its enrolment

of local legends and not least because limnologists had long taken an interest in the lake for its size and clarity.⁴

Today, Fontane is still everywhere in Neuglobsow—red roosters are painted onto shutters, affixed to rooftops, in framed pictures in the IGB's lunchroom.

But the legends nonetheless captivated scientists. In the same 1935 volume of *Archiv für Hydrobiologie*, Lotte Möller, a limnologist from Berlin, argues that isolated oscillations in the water as described by Fontane and Bratring were possibly just a result of wind circulation and other meteorological phenomena.⁵ And today, Fontane is still everywhere in Neuglobsow—red roosters are painted onto shutters, affixed to rooftops, in framed pictures in the IGB's lunchroom. On quiet afternoons, when the village-bakery truck rolls by, the laboratory's staff gather for Kaffee und Kuchen, divvying up cups of coffee and slices of custard cake under the cockerel's watchful eye. The scientists I speak to all know the lake's legend by heart and aren't shy about discussing it. I find myself enthralled that limnologists should ever have needed to refute a tale that, for Fontane, so clearly functioned as a metaphor.

On a crisp autumn day, I am invited to join the lab's researchers on a visit to the nearby nuclear power plant. It is being decommissioned, and part of that process involves educating any interested parties on the work the plant carried out and the process of dismantling it. We meet at the IGB's lab and carpool through the forest to Rheinsberg. From the potholed parking lot, a man ushers us into a classroom to learn about the site's history and its future.



Inside Rheinsberg nuclear power plant. © Jessica Lee. All rights reserved.

When it opened in 1966, Rheinsberg was the first nuclear power plant built on German soil. Plans for the project began in the early 1950s, when East German engineers and scientists assessed the region's suitability for a project that would herald a modern, technologically advanced GDR. The plant was a construction of Cold War beauty in a sylvan landscape, complete with tiled pillars and pea-green control panels overflowing with dials and buttons. A canal was dug between Stechlin and the neighbouring lake Nehmitz, so that water could be drawn up from Lake Nehmitz, through the nuclear reactor to cool it, and then flow onward into Stechlin—before flowing back through the canal again. As West Germany's first nuclear plant came online just five years before, the plant was a statement of

technological mastery for the GDR.

Rheinsberg operated for 23 years—longer than the 20 it was built to function for—storing its nuclear waste in containers on-site and pouring the reactor's cooling waters into an area on Stechlin's western shore near the canal. And then, after the fall of the Berlin Wall in 1989 and Germany's reunification a year later, the plant finally stopped operating amidst safety concerns and began the process of decommissioning.



Lake Stechlin and Rheinsberg nuclear power plant, with Lake Nehmitz in the foreground. © EWN - Entsorgungswerk für Nuklearanlagen GmbH. All rights reserved.

During our visit, we are led through the buildings still standing. Though the plant no longer produces power, it is by no means “closed”: of the original 670 workers, over one hundred remain, carrying out the slow process of dismantling the building and its contents, waiting out the half-life of radioactive contaminants found across the site. One building is entirely encased in tarps, sealed so that not even dust from its demolition can escape. The reactor and core components of the plant have already been removed and stored in a facility near the Baltic Sea, but the work at Rheinsberg, our guide explains, will continue for another decade at least, far exceeding the time the plant actually operated.

As our tour is comprised largely of freshwater ecologists, the conversation centres on the plant’s impact on Lake Stechlin. During Rheinsberg’s operations, some 400,000 cubic metres of water circulated through the cooling system daily, heating up to ten degrees Celsius before flowing out into Stechlin. Combined with the workings of climate change, the lake as a whole warmed by 1.5 degrees Celsius over a matter of decades.⁶ Even this seemingly small transformation would have profound effects.

The power plant created a perfect experiment in a time of global warming. The glut of nutrients and heat flowing into the lake’s west bay transformed communities of microphytes, invertebrates, and other organisms.

Besides attracting locals who would swim and luxuriate in the warm outflow, the power plant created a perfect experiment in a time of global warming. Over decades of research through the

Limnological Laboratory Stechlin (the predecessor institute to the IGB), scientists collected an enormous dataset on the lake's changes. The warmer water reduced ice cover on the lake, and the glut of nutrients and heat flowing into the lake's west bay transformed communities of microphytes, invertebrates, and other organisms. While underwater plants had previously thrived as sunlight travelled deep into the water, the knock-on increase in plankton, algae, and bacteria greatly reduced the lake's clarity, diminishing plant cover. Some species, unused to the newly warm and nutrient-rich conditions, disappeared altogether. As a group of East German scientists wrote in 1985, "the organismic society was thrown into disorder."⁷ The impact of this warming continues to be felt: researchers surmise that the glut of nutrients that amassed in the heat perhaps remains in the sediment and is now slowly flowing into the lake.⁸

Out in the lake's centre floats a year-round companion: the IGB's LakeLab. It is arguably the most ambitious research station of its kind, far larger than most freshwater ones. It is a series of 24 "mesocosms": nine-metre diameter enclosures that run to the lake's floor, fastened together and connected by walkways, appearing from above like a piece of honeycomb floating on the water's surface. The LakeLab allows Stechlin to be studied under strict controls and to be used as a mirror for wider environmental trends. Two-and-a-half centuries after Bratring reported bizarre movements in tandem with the Lisbon quake, scientists today are looking for signs of climate change.

Two-and-a-half centuries after Bratring reported bizarre movements in tandem with the Lisbon quake, scientists today are looking for signs of climate change.

They do so in a variety of ways. The site hosts one major experiment a year, and the experiments often build on one another: 2014's experiment replicated the impact of 2011's large summer storm, Otto, which allowed scientists to observe how cyanobacterial (blue-green algae) blooms are encouraged by churning waters. In 2015, they studied "brownification" of the lake: how increased rain and storms can add carbon, phosphorous, and other nutrients to the water, reducing its clarity. The following year, they studied the effects of light pollution—from sky glow to moonlight—on the lake's zooplankton, examining the ways changing clarity and light-penetration changes the behaviour of organisms.⁹

During my time at the lab, I help out with maintenance tasks that keep the mesocosms running. The outboard motor of our boat rips into the silence. Matthias, one of the IGB technicians, is at the helm. Motorboats generally aren't allowed on the lake, but an exception is made for a few local fishermen and the IGB's researchers. It's a short journey, just a minute until we dock against a floating walkway.



The LakeLab, with Rheinsberg in the distance. © Jessica Lee. All rights reserved.

We spend the morning laying fish fences around the perimeter of the mesocosms, lengths of plastic webbing circling each enclosure. The larger perch in the lake, Matthias tells me, have a habit of hunting smaller fish inside the seclusion of the lab—which can cause problems for the experiments. I crouch on the narrow ring surrounding each enclosure, fastening zip ties around the mesh and metal framing, repeating the process every metre. Once we finish, before boating back to the lunchroom—haunted as it is by its painting of the red rooster and the tale of the drowned fisherman Minack—Matthias pulls out a fishing rod. He casts it into the space between enclosures, and for a moment we stand watching in silence, Stechlin’s mirror-glass reflecting in the midday light.

It’s hard to know whether scientists would have so focussed on Stechlin if it weren’t for the fictional geysers or the nuclear plant. Fontane’s influence pervades not just the place itself but also the understanding of it: books on lake science emerging from the lab never fail to mention the myths. A fifty-year anniversary publication from the IGB opens with a retelling of the legends.¹⁰ One 2010 study went so far as to argue that the story of the rooster could be explained by an outbreak of *Planktothrix rubescens*, a red-hued alga.¹¹

When I interviewed the researchers, I spoke with one of the IGB’s lead scientists, Rita Adrian. I asked about the idea of the lake as a mirror and the way the legends have shaped the lake, and our conversation moved on to earlier notions of Stechlin as a warning system for global disaster. She explained that her preference was to describe Stechlin as a “sentinel.” “2008 was pretty much the first time when people sat together and discussed the idea,” she told me. “Sentinels are guards who

detect something—the term comes from the military. We could also say ‘indicators’ . . . But sentinels suit global climate change.”

Lakes in this region have warmed at a rate of 0.34 degrees Celsius per decade in the past 30 years. Water is slow to heat and cool, so this is a drastic change—and a worrying one.

Aside from the localised warming from the nuclear plant, lakes in this region have warmed at a rate of 0.34 degrees Celsius per decade in the past 30 years, roughly twice the rate of air and surface temperatures. In a month-to-month study of Central European lakes since 1961, every month showed warming.¹² Water is slow to heat and cool, so this is a drastic change—and a worrying one.

Stechlin’s depth and clarity mean that it is more susceptible to warming, and more likely to see a reduction of ice cover in winter. In turn, a reduction of ice can have the knock-on effect of warming the lake sooner in spring and summer, shifting the timing of seasonal mixing. In lakes worldwide, climate change doesn’t simply mean warmer water, but entirely transformed ecosystems. Fontane’s red rooster crowed warning; the wasting away of ice crackles with the same intensity. From the Lisbon quake until now, Stechlin has been held as a mirror to the world around it. Today, it really is portending disaster.

Notes

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Cite this article

Lee, Jessica J. "The Magic Mirror: Legends, Limnology, and Nuclear Power on Lake Stechlin." *Springs: The Rachel Carson Center Review*, no. 5 (June 2024). <https://doi.org/10.5282/rcc-springs-5909>.

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ISSN 2751-9317

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