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Becoming Extinct (Wild Grass): An Exploration in Ecologies of Extinction and Collaborative Survival in the Southern Russian Steppes and Elsewhere

We gave no thought to anything at all. Everything was there for the taking then. We paid no attention: it was all for free. It had been this way for tens, thousands, millions, billions of what were later defined as years. If we had thought about it, we would have said it would go on forever, this fluent, fluid world.
And then something occurred to us. The climate changed. We couldn't breathe. It grew terribly cold. Far too cold for us. Everything we touched was poisonous. Noxious gases and thin toxic airs flooded our oceanic zone. Some said we had brought it on ourselves, that all our activity had backfired, that we had destroyed our environment by an accident we had provoked. There were rumors of betrayal and sabotage, whisperings of alien invasion and mutant beings from another ship.
Only a few of us survived the break. Conditions were so terrible that many of those who did pull through wished they had died. We mutated to such an extent that we were unrecognizable to ourselves, banding together in units of a kind which, like everything, had been unthinkable before. We found ourselves working as slave components of systems whose scales and complexities we could not comprehend. Were we their parasites? Were they ours? Either way we became components of our own imprisonment. To all intents and purposes, we disappeared.[1]
Sadie Plant, *Zeros and Ones: Digital Women and the New Technoculture* (2000)

What might be thought is the extinction of the climactic eye: can we imagine a mode of reading the world, and its anthropogenic scars, that frees itself from folding the earth's surface around human survival?[2]
Claire Colebrook, *Death of the PostHuman, Essays on Extinction 1* (2014)

Prelude

The two concepts of extinction and becoming are difficult to think of together, both are more than just metaphors and neither of them offers an easy way out. Extinction emphasizes the extraordinary level of disturbance and precarity that the bonding of science and capitalism has imposed on our, and other, species. Tossing more beings to the margins with increasing speed, most creatures and places of the earth have been measured, consumed, exhausted, infected, eliminated and otherwise killed. Becoming signifies taking up the struggle of a collective survival together with the nonhuman. It adds an affective dimension to our relation with the environment and helps to grasp the disappearance of species, not only as destructive and final, but also as transitory. Becoming-with-the-dead mobilizes our imagination for a future life without reconciliation or a place to hide and establishes an inclusive approach to ecological conservation and survival, where human reproduction is not the most important factor. We might begin by perceiving the world not as "our" environment, "our" climate, "our" epoch, "our" survival, or "our" films and "our" images.

We have learned that the forces working on reality are more complex than images can express.[3] Images do not explain anything – passive like data, they need to be explained. They stay on the surface of things, cannot permeate their subjects and lag behind rigorous scientific analysis; but they are useful to generate empathic affections and to illustrate examples. They can bring "matters to life," but cannot take action, or truly intervene. Since social and economic realities are constructed within the sphere of language, the truth about these realities can only be linguistically discovered and remodeled. Even though images are not non-linguistic, the visual and the auditory are led by text. Off-screen or on-screen, disembodied or embodied, while we watch, a voice guides us and cultivates our (critical) cinematic thinking. In this scenario, images are reduced to mimetic forces, shadows of human self-exploration. Anna Tsing analyses this present form of anthropocentrism as "not just ordinary human bias; it is cultural agenda tied to dreams of progress through modernization."[4]

Film has arisen in conjunction with this dream. It has a propensity to highlight mainly human activities and tends to make humans the main reference point for everything, constantly constructing "humanness." It goes without saying that not all films are modernist, and that an inclusive ecological approach in the fields of art and moving image challenges this human-focused rationale. Not just discursively, as a debate between humans, but as an involutionary swirl, formed by endless virtual connections. Within this mode of film practice, images are not just indexical mirrors of the world, but self-expressive beings. They take us by the hand and push us into an inhuman actualization – an actualization that is in fact a deep ecologization. Plants, animals, environments and matter are creating this continuum of sensation. They link, entwine and draw connections between interior and exterior, creating continuities between the organic and inorganic, the material and immaterial, between the haptic and the virtual. As haptic visions, film inhabits the interstitial spaces between enduring and becoming in and alongside the world.

Recognizing inhuman styles of thinking and acting, animism, for example, attributes life to nonliving things, and souls to plants and animals. It explores interspecies entanglements disconnected from the centrality of the human species and its representations, and replaces them with a sense of bonding and belonging to a diversity of existences. Notably indigenous people, who are often facing extinction themselves, have provided space to more-than-human others simply because they exist. Maybe through animist fabulations – fantastic as well as everyday experiments resulting from the desire for other creatures, and an ability to jump between scales of micro and macro – it is possible to grasp how more-than-humans perceive environments. To fabulate, I explore the possibilities of moving images and writing. As well as the title of this piece of writing, *Becoming Extinct (Wild Grass)* is the title of a short film I shot in the Southern Russian steppes, close to the current Russian–Ukrainian war zone and the exploded Chernobyl nuclear power plant. The film developed over the last three years in the context of *parallel diagonals*, an art and research project organized by Mikhail Lylov and the Divnogorye Natural Museum Reserve.

The text and the film are intimate companions, acting jointly, yet sometimes they go off in different directions and reindividualize. The film speculates about more-than-human relationalities, attempting to stimulate an environmentally attuned mode of acting in a damaged world. My writing focuses on bonding and on extinction. Rather than organizing a single argument, however, it meanders through relations and patterns of differences, through instances and encounters of affective engagements, and human-induced events of loss. Neither the film nor the text tell stories of sufferings of charismatic beings on the edge, such as blue whales, giant pandas, polar bears, addax antelopes, honeybees and snow leopards, but instead pay attention to wild half-lives like bacteria, flowers, fungi, stray dogs, algae, insects, and nucleoids. Neither text nor film single out one specific species; many have been lost and there are many more that we do not know about. There is no single or unattached extinction phenomenon.

The concept of ecology as a balanced equilibrium seeking harmony is currently being questioned.[5] Non-anthropogenic disturbances, like periodic wild fires, earthquakes, insect infestations, windstorms, droughts and floods are considered highly productive for environments, as they often lower the influence of dominant species, leaving patchy conditions for more diverse growth. However, humans attempt to control these diffractive entanglements across landscapes by building walls and embankments against floods, and by suppressing wild fires. At the same time, nearly everything that humans do or produce is violently affecting nonhuman communities. Due to direct and indirect human disturbances, 56 per cent of native species have declined in the past 50 years. The actual – and the impending – massive loss of species is hard to grasp. Many studies have been investigating the future of biodiversity and extinction on a global level using different methods, models and scales. The majority of the studies estimate that 50 per cent of the extant species will have vanished by 2050.[6] This means more than four million different species will be irreversibly gone. In Germany, for example, 75 per cent of the overall insect population has already completely disappeared.[7] Extinction "outweighs" climate change, but the rate of extinction due to climate change is an extremely terrifying thread. It makes it a near impossibility to safeguard affected species even in nature reserves.

Ecology evolves through relational and symbiotic bonds, but when companions vanish, extinction intensifies rapidly and involution ends. The branching chain reaction that comes with extinction fashions entanglements between single bodies and species with a new significance. We are inseparably linked in a great ecological disaster triggered by human ignorance. This enfolding of extinction and entanglement highlights the urge for an adequate ethics not based on interiorized capacities or external organization, but on ecological immanence. We are challenged with the question of how to intuit creative solutions for a collective survival with nonhumans. Deriving from direct entanglements, this ethics has nothing to do with self-reflectivity, or identification, but rather with pre-individual interspecies immersions and mutations. To live a “good” (ethical) life, to live well with non-humans, entails learning new/old commons and affections, new/old languages and infrastructures, new/old modes of gentleness and ruptures on every level and in all domains.

Tarpans

Russians call it “Buratschok” *or, in abstract terms,* Alyssum gmelinii. Buratschok is a rare perennial cabbage plant with tiny yellow flowers. It is a rhizome that prefers a warm and dry climate, chalk soil and a surrounding of grasslands. It was named by the German botanist Johann Friedrich Gmelin, a contemporary and supporter of Carl Linnaeus, the Swedish botanist and zoologist famous for his taxonomic method. Linnaeus assigned each plant and animal an exact place within a scheme of classification: species, genera, types and kinds – a highly differentiated, albeit soulless and impersonal system.

While Linnaeus was busy with ranking and fixing from home, Gmelin was an explorer who features in various stories that celebrate colonial epistemological mappings; for instance, his observation of wild horses during a journey to Voronezh in Russia in 1769. However, Gmelin not only observed but also killed three wild horses, two mares and a stallion. He also shot a feral mare and captured two foals, one of which was a crossbreed. What happened to the foals is unclear. Once back home, Gmelin’s description of the wild horses turned out to be rather sketchy, but it is the only one that exists. The *Equus ferus ferus* is small with a very thick head, pointed ears, a short frizzly mane and a tail shorter than in domestic horses. It is mouse-colored with a light belly and legs becoming dark. The coat is long and dense. It is very fast and extremely shy.

Rather than their abstract binomial, *Equus ferus ferus*, the horses have long been known as *tarpan* – meaning wild horse. This was a name given to them by nomadic Turkic (not to be confused with Turkish) people traveling between southeast Europe, western China, Siberia and Mongolia. Apart from steppe tarpans, there also existed forest tarpans, which were supposedly a bit smaller. The entire European and west Asian continent was richly populated by tarpan horses, from Russia to Ukraine to Sweden to Germany to France to Spain. Millions of them. *Equus ferus ferus* everywhere. In Native America by contrast, horses did not exist until they were introduced in the 16th century. For millions of years, horses in America were flourishing but suddenly became extinct between eight and twelve thousand years ago. The cause of this extinction is still uncertain. One hypothesis favors a climate change; another links their extinction to the newly arriving humans. Native Americans and First Nation Canadians of the American Great Plains never kept horses. The famous free-roaming mustang horses are feral fusions of different domesticated horses, arriving with the Spanish colonial settlers. In Europe and Asia two more subspecies exist: the *Equus ferus caballus*, which is the modern domesticated horse, and the *Equus przewalski*, which lived in the Eurasian Steppes and Mongolia. Today the przewalski horse is considered highly endangered, and undergoes intense breeding programs in different zoos and reserves throughout the world.

By the time Gmelin encountered the tarpan horses they were already very rare; now they are extinct. Like the North American bison, the European wild horses were systematically hunted down and slaughtered; not for sustenance, but for sport or because they interfered with settled agriculture and liberated domestic horses from pastures. If caught alive and interbred with local horses, the offspring of such mating was considered "stubborn." European tarpan horses survived the longest in the southern parts of the Russian steppe. In 1879 the last surviving individual, a mare, was killed during an attempt at capture. In the 1920s the brothers Lutz and Heinz Heck, both zoologists and directors of the Berlin and the Munich Zoo, made attempts to breed back the pre-domestic horse and other animals that had become extinct. Their project was highly supported by Fascist Germany of the 1930s, since it fitted perfectly within the ideology of primordial nature. The farming result was named "heck horse," an almost-tarpan with a wild look.

I learned about tarpan horses by joining an excavation led by Jasmine, a nervous dog. She gathered scattered bones from the floor of a pale crater in the very same region in south Russia near the Don river where Gmelin had seen tarpan horses and killed them. These bones belong to their ancient ancestors, dating back to the late Paleolithic period, 12 to 14,000 years ago. The excavation site is part of the Divnogorye Natural Museum Reserve, and the collection is the only one of its kind. It counts up to 8000 bones, making up a tribe of 67 to 68 horses. Some bones were clustered anatomically complete in shape, others were scattered widely. The geoarcheologists working on the site are still puzzled by why the herd of horses died all at once.

Flower Pigment

Get on the floor
But reject gravity and welcome balance
Become like diagonally falling water
A flying seedling anticipating the landing
Each movement has to be different
Do not branch – dance
Or drip
Right into the head
Swell your cells
Excite your pigmentation
Like a fast folding mimosa
Become yellow, lilac, purple, and violet
Develop your photochromic molecules
Rest on the blue crème rhizome
Here you are like many
Like inflorescence fennel
A dazzled Iris pumila
Poisonous Pulsatilla patens
Woody Onosma simplest
A wounded Clematis integrifolia
Here you are not endangered
Because of your woolly long hairs
Androsace Kozo-Polianski
You are listed in the Red book of Russia

Plants possess 15 to 20 unmistakable senses or modes of awareness, including five homologous to those of humans. In a systematic language, plant perception and communication involves, as the environmental physiologist Anthony Trewavas enumerates, “nucleic acids, oligonucleotides, proteins and peptides, minerals, oxidative signals, gases, hydraulic and other mechanical signals, electrical signals, lipids, wall fragments (oligosaccharides), growth regulators, some amino acids, secondary products of many kinds, minerals and simple sugars."[8]

Grasslands

The plateau of Divnogorye Natural Museum Reserve is part of the Eurasian Steppe Belt, stretching east to west, from Mongolia to Kazakhstan to Russia to Ukraine to Romania. In North America there is similar grassland: the Great Plain or Prairie stretching north to south, from Manitoba to Kansas. Steppes have a semi-arid climate with dry, hot summers and cold, sometimes snowy, winters. Since they are not as dry as a desert and less humid than other regions on the same latitude, steppes provide a perfect biome for various wild grasses and herbaceous vegetation to survive. One is *Stipa pennata*, or Orphan maidenhair, a feather grass, endangered in the wild, but able to persist within the Museum Reserve. The grass can grow up to 70 centimeters high, and develops curled feather or hair-like awns with long soft lashes. Like bamboo, each stem stands close to one another in thick tufts. The awns can become 30 centimeters long, providing immense flight capabilities to the seeds, which can also easily get stuck in furs or coats for some interspecies journey. If in contact with water, the seeds drill themselves into the soil with a rotating movement – can anything be more inventive?

We touch feather grass together with Irina Shilova, a botanist working on native grassland recreation, contemplating its rhizomatic beauty and asking ourselves: What if there were no grass? This question at first sounds bizarre, like: What if there were no women? What if there were no insects? But it becomes less absurd when Irina recounts the effort it takes to make wild grass return. Young wild grassland is often blended with annual grasses and domestic crops, becoming feral. In the second phase, a riot of highly diverse wildflowers moves in. In the third phase, the flowers withdraw and the experimental plots contain already different short and medium-size grasses and some wild vegetables, but hardly any trees. Trees? Trees are not part of grasslands. Irina shows us how the grasses form dense masses from bulbs and tubers, and how their lateral spreading prevents tree seedlings from settling in. The rhizomatic multiplicity of grass strangles arborous structures.

A Thousand Plateaus, the book of rhizomes, nomads and smooth space by

Gilles Deleuze and Félix Guattari could have been written here. They metaphorically suggest that rhizomes, by growing horizontally, create a map with no specific origin, and through this perform immanence. By contrast, trees with their vertical lines, fixed on a single spot, are plotting, proclaiming transcendence … Indeed, Deleuze and Guattari favor the former, but they are also clear that there is no sharp distinction. Even if trees are fixed with their roots on a single spot, they spread upwards and downwards, fashioning various connections with the outside on many levels. Resolving possible confusions, Deleuze and Guattari clarify: "[p]lants with roots or radicles may be rhizomorphic in other respects altogether."[9] They go on to describe the wide range of possibilities: "there is always an outside where they form a rhizome with something else – with the wind, an animal, human beings."[10] Equally, many woody plants, like pines, spruces, willows, eucalyptus, beeches, birches and oaks create rhizomes with fungi, for example. Those entanglements are called "mycorrhiza."

These assemblages are genetically diverse and can be formed by at least 50,000 species of fungi with 250,000 species of plants. Those who grow a "hyphal" structure, or mantel around the roots are "ectomycorrhizas." Ectomycorrhizas grow large filaments branching out from the tips of the roots into the soil, into leaf litter. Here they forage water, organic material and minerals unavailable to trees. Some fungi penetrate into the tree root cells and become enclosed in the root cell membrane. Those are called "endomycorrhizas," or "arbuscular mycorrhizas." They create a similar mantel, but from within. Membrane touching membrane – can there be anything more intimate? In return, plants offer fixed carbohydrate shots made by photosynthesis to the fungi – for a "collaborative survival," as Anna Tsing puts it.[11] Fossil records reveal that this highly evolved relationship has lasted about 400 million years. It is believed arbuscular mycorrhizas crucially helped plants to invade the stony earth. Being able to digest rocks by secreting enzymes, they support pioneering plants with micronutrients. Ectomycorrhizas have evolved more recently. Their large groupings can be found in far distance, enlarging the surface area of a tree by up to 1000 times. These fungi do not only collaborate with one host but with many – promiscuously entangling various trees beyond "species specificity" (what a misnomer!) across entire forests.

Though grassland does not stimulate the growth of woody plants, it offers itself as fresh food for an extraordinary diversity of insects, and as habitation. The

Museum Reserve recorded up to 7000 different insect species. Leaf beetles are the most common. Seven out of the twelve bumblebee species living in Divnogorye are endangered. During our walk with Irina we encounter the sophisticated *European mantis*, or praying mantis. Its big triangular-shaped eyes are curiously looking right into the camera, making clear that movement and vision are not only of great importance for humans. Another famous inhabitant of the grassland is Spike the Magician, known in the scientific community as *Saga pedo*. She is Europe's largest grasshopper and insect in general, and has the capacity to enchant other insects before eating them. Similar to the mantis and to humans, she has a tendency to cannibalism. But what makes Spike the Magician even more unusual is that she avoids the duality of sexual reproduction: there are no "male" Magicians. In her "all-female" world, unfertilized eggs start to divide without any external organizing factor. A simple change of hormonal activity is enough to start the self-copying machine. This does not lead to genetic poverty, but has helped her to remain on the planet much longer than other organisms depending on sex for reproduction.

Trees and fungi, grass and grasshoppers, bumblebees and leaf beetles… Why does biodiversity matter? If individuals, populations or entire communities disappear, it might not have an effect on the rest; on the contrary, others might benefit from their absence. Disturbances are productive, the loss of some might enhance the "ecosystem" overall. Within rich environments more than one species performs "ecosystem services," like pollination, stabilization of soil, recycling of nutrients, water purification, and so forth. If the task is to sustain an ecosystem, it does not matter if one or two get lost. Even if entire groups disappear, like honeybees and ash trees – other insects and plants can replace them and maintain usable continuance. But what if this is not the main purpose of an environment? Some species facilitate nothing for the global market of ecosystem services. They keep their integrity by leading a liminal existence.

Over the past decades scientific research on fruit flies, blowflies, mosquitoes, and molds has been preoccupied with their suppression and eradication. Utilitarian arguments that attempt to safeguard biodiversity, relating to "ecosystem services," may not be able to protect these species since they offer nothing but "disservice." Even vultures are more loved, though fruit flies, blowflies, mosquitoes and molds have been living closely with humans over centuries. Their wildness is part of our everyday. We do not depend on them, but we are bound up with them. The same goes for unwanted plants. How can we understand them not as “pests” or “weeds” that need to be annihilated, but continue to make room for them and their useless wildness in this time of extinction simply because they exist? We might need to reach out towards an inclusive ecological ethics that avoids the spectacle of endangerment with its establishment of borders, controls and otherings of all kinds, playing one off against the other, and at the same time take seriously the disappearance of even the smallest companion.

Soils

The subterranean system of temperate tall-grassland with its many bifurcating bulbs and tubercles, swollen filaments, nodules and buds accumulates reserves of moisture and creates high proportions of black and dark-brown colored soil. Humus! Rich in nitrogen and carbon, humus generates the fertile land the Ukraine and southwest Russia depend upon and are valued for. The first person to study humus in its environment was the geologist Vasiliy Dokuchaev (1846–1903). Mapping a biogeography of different Russian soils, and emphasizing the formation process that generates soil as time-based independent media, he is considered to have laid the ground for contemporary soil science. But humus is becoming extinct, too. Shipped in truckloads to be sold as potting compost, plowed and chemically treated by a ceaselessly expanding agriculture, radioactively contaminated by fallout clouds from Chernobyl, chopped into bits and pieces by the constant digging for oil and gas – the giant steppe is enormously under stress.

At the same time, steppe soil is particularly important for the global carbon and nitrogen cycle. According to the soil scientist Rattan Lal, soil and climate are strongly interconnected.[12] When soil is plowed, it becomes damaged. Plowing releases carbon dioxide into the air and leads to a lack of carbon in the soil. Plowing has the same consequence for the climate as the combustion of fossil fuels emitting carbon dioxide. Most agricultural land has lost 50 to 70 per cent of its carbon storage into the atmosphere. But it is not only carbon: the global nitrogen cycle is upset by the steady increase of human-generated nitrogen fertilizer for growing plants. In the last 15 years vast amounts of artificial nitrogen have been dropped on farming fields and created massive environmental pollution. From the farmland nitrogen is fed into the groundwater, acidifying fresh water streams and oceans. In the atmosphere, oxidized forms of nitrogen gases and ammonia contribute to the formation of ground-level ozone. On the middle level, oxidized forms of nitrogen act as a greenhouse gas, enhancing global warming. At very high altitudes, nitrogen destroys ozone. The atmosphere is no longer able to remove the amount of carbon and nitrogen we pour into the environment.

We have inherited an agriculture that has been destabilizing the rhizosphere through tillage for a few thousand years, leading to a loss of diverse flora and fauna. No-tillage farming is a way of dispersing seeds and growing crops or pasture from year to year without disturbing the soil and the air. Farming on unplowed ground with a permanent cover and continuous growth of a rich diversity plants provides a multiplicity of "ecological services" from which humans and also nonhumans benefit. No-till agriculture counters the loss of soil moisture and desertification, reduces fuel and machinery input, cycles nutrients better, increases biological fertility, stores organic matter, prevents erosion and enhances the sequestration of carbon. Plants inhale carbon dioxide. They capture it through their leaves by photosynthesis, pump it down into their roots and into the soil. Carbon-rich soil acts like a sponge, absorbing water and giving it back to the plants when needed. Certain plants are also able to inhale atmospheric nitrogen, and exhale it into the soil for other plants to flourish. Soya beans, clover, legumes, lucerne, and alder trees, for example, make disturbed soil prolific. They send molecular signals of interest into soil, which some bacteria, like *Frankia alni*, are able to decode. The bacteria then enter the plant's root cells as friendly intruders. Similar to endomycorrhizas, the bacteria lives in the cells of others, where it forms nodules in which the nitrogen is bound to hydrogen, becoming converted ammonium. The ammonium is released into the soil and acts as natural fertilizer, nourishing the surroundings.

Wild soil accommodates and fosters earthworms, termites, insects, springtails, mites, nematodes, slim molds, fungi, algae, and innumerable numbers of poorly understood microorganisms. In one handful of soil live more microorganisms than there are stars on the sky. Their immense diversity and complexity make it simply impossible to capture them. Their DNA is largely unmapped, and their natural history is not yet written. Soil microorganisms resist classification through multispecies complexity. Time, climate and spatial scale created an immense multiplicity of different soils that cannot be separated from their populations. Soil and soil lives depend so sturdily on each other that individuals cannot be singled out and subtracted from the complex network. This turns the categorization of soil micropopulations into a hopeless enterprise. Mick Smith describes these unmanageable critters as follows: "to identify many species they first need to be extracted from the soil matrix, isolated, and cultured in artificial media, and many simply cannot be so cultured."[13] Creating such complex environments needs strong collaborations. This ethical community is deeply relational. They produce all the nutrition plants require and that the lives of animals and humans rely on, though microorganisms themselves still need complex environments to flourish.

To test microbial resilience to the effects of climate change and global warming, a group of scientists transplanted soil from cooler and wetter to hotter and drier regions, and found that the microbial community could not adapt well: "[a]lthough soil is widely regarded as one of the most functionally and taxonomically diverse microbial habitats on earth, highly stressed environments can limit local diversity and presumably functional robustness."[14] Another survey conducted in the environment of Chernobyl also showed their sensibility to radioactivity. Surprised about the unusual piling up of plant material in the forest close to the exploded nuclear power plant, a group of scientists placed about 600 bags filled with leaves from different tree species in several locations with various levels of radioactivity throughout the exclusion zone. After a year results showed that in locations with high radiation, only 40 per cent of the leaves were decayed, whereas in areas with low radiation 70 per cent of the leaves were gone. The scientist assumed that the microorganisms were not doing well under the influence of radioactivity, since they are the main performers responsible for the decomposition of organic material.[15]

The vulnerability of soil microbes is surprising, and discloses our extraordinary ignorance and lack of appreciation of soil and soil inhabitants to a bare resource for human reproduction. Pointing to the fragility of soil and our destructive powers, María Puig de la Bellacasa highlights that the time required to renew soil is much longer than the accelerated timescale of late-capitalist production.[16] To keep up a complex environment takes time, but our destructive treatments have left soil in a very poor condition and killed many microbial companions. We probably will never know which is endangered and which is becoming extinct, nor understand how diverse soil microbes actually once were. Many soil micropopulations, if still alive, are most likely enormously slowed down. Those residing in the upper layer can make use of wind, meltwater or stormwater for their flightlines, wanderings and migrations. Others might have to wait for the subsurface flow of water, or for erosions to run off to more hospitable and sustaining environments. The Museum Reserve, in trying to convert tilled cropland and otherwise degraded fields into highly diverse grassland, saves the lives of plants and insects, and as a side effect, soil microorganisms can recover on their own. Some of them would probably be in the Russian Red List for threatened species, if only we were aware of them.

Gradual Difference

Most plants inhabiting the Museum Reserve like sunny grassy hills or dry calcareous soils; many have a history much longer than ours. Wind and animals have been transporting their seeds. They have been eaten as vegetables or used for medical purposes. Now their numbers and territories have decreased dramatically and some are endangered.

How can we grow into an inhuman proximity with plants? Irina has a detailed knowledge about their ecological forces. When she meets them, she greets them like other people do friends or family members. Irina's elaborate performativity of repeating refrains of intimacy, reminded me of Karen Barad's conceptualization of "intra-activity."[17] In contrast to "interactivity," which presumes independent individuals (observer and observed), "intra-activity" relies on components, which perform "specific agential intra-actions" that determinate certain properties and boundaries so that particularly "embodied concepts become meaningful."[18] To be immersed in intra-actions presumes a receptive proximity and mutual dependence.

Focusing on intra-active relationalities of microorganisms, the microbiologist Lynn Margulis established a radically new understanding of evolution. What pushes evolution for Margulis is symbiogenesis – the intra-action and transfer of nuclear information by bacteria and viruses living inside plants and animals. Mitochondria organelles, that function as the power station of the animal cell, were once free-living bacterial cells that came to live inside a larger host cell. The same applies to plants. The specialized organelles inside the plants called chloroplasts were once cyanobacteria, and now conduct photosynthesis for the plant, making glucose, glycerol, and amino acids. Mitochondria and chloroplasts have their individual DNA, independent from the DNA in the nucleus of the cell. A double membrane surrounds both, mitochondria and chloroplasts, a sign that each was once ingested. They still reproduce like bacteria, replicating their own genetic code and directing their own division and growth.

According to Margulis, all genetic information and its variations are the result of single-cell bacterial transportations. She states that these symbiotic assemblages of bacterial interactions have made animal and plant life possible, and suggests reconsidering us, humans, from the viewpoint of bacteria populations. In the Museum Reserve I encountered populations of cyanobacteria. They live in oceans and on land, in deserts and in alpine climates. Their fossil-recorded lives reach geological time, as it goes back 3.5 billion years. They constitute not only the oldest, but also the largest group of bacteria on the planet. They are unicellular and very small, but since they form nugget-like clusters for convenience, it is possible to actually see them. They prefer reproduction without sex by crumbling, and perform photosynthesis for their subsistence. Their color makes them look like algae, which is why they are often called “blue-green algae” and are eaten as salad. Unlike eukaryotic algae, cyanobacteria have no nucleus or membrane-bound organelles, and perform photosynthesis in distinctive outer folds. In fact, they are the only non-eukaryotes able to perform photosynthesis, a capacity they truly invented. As legendary ecosystem engineers, cyanobacteria converted the atmosphere of the young earth, and sparked what is called the “Great Oxygenation Event.” They dramatically changed the metabolism and composition of the entire planet by producing oxygen with photosynthesis. The new oxygen made plant and animal diversity possible, and also altered in the chemical intra-action between rocks, clay and sand, stimulating mineral complexity. The transformation of airs, however, was pollution for others, and brought about the extinction of various oxygen-intolerant anaerobe organisms – killing many early life forms.

In their chapter on “Becoming-Animal” Deleuze and Guattari link symbiosis to the notion of affect. By exchanging affects, heterogeneous bodies mutate, transform, die and grow. Symbiosis and affects emerge through intra-connections beyond conventional differences between species. These zones of becoming foster creative transformations and introduce an entirely different ecological framework. By tying together humans, animals, plants, microbes and matter, categorizations like those by Linneaus are obscured. This ecological framework does not suggest that difference is insignificant, but on the contrary, that difference can only be a question of degree as opposed to structural. A gradual difference particularly helps humans to negotiate their proximity to fungi, grass, bumblebees, carbon and cyanobacteria.

Rewilding Chernobyl

In 1998 and 1999 31 rare przewalski horses from the collection of the Ukrainian Askania Nova Biosphere Reserve and a local zoo were released into the exclusion zone surrounding the exploded Chernobyl nuclear power station. Eight of these died during the transportation, or soon after. The rest lived first in an acclimatization zone and then left into the wilderness a few weeks later. One horse from the local zoo denied to live in wilderness and died. In 2004 another 13 horses were transported into the exclusion zone, this time without acclimatization. They all died. The horses from the first release developed positive relations with the new environment and thrived. In 2017 132 endangered przewalski horses were living in the Chernobyl exclusion zone.[19]

Surprisingly, not only horses, but the overall diversity of animals inside the exclusion zone is said to be much higher than outside: black storks, boars, beavers, deer, elks, moose, brown bear, foxes, wolves, lynx as well as endangered eagle owls and rare white-tailed eagles were spotted. It seems that one of the most radioactively polluted areas in the world is becoming a fold of protection for various species. Chernobyl is not the only heavily polluted environment where nature is bouncing back. Ecosystems appear to blossom in military zones and mine fields; in uninhabited areas where hunting, agriculture, industries and cars are limited, yet Chernobyl draws extraordinary public and scientific interest. In 2006 the Chernobyl Forum, an international panel gathered by the United Nations, the World Health Organization and the International Atomic Energy Agency supported the theory that, apart from some heavily contaminated areas that are still possibly lethal such as the Red Forest, the Chernobyl exclusion zone is turning into “a unique sanctuary for biodiversity.”[20]

By contrast, the evolutionary biologists Timothy Mousseau and Anders Møller question the idea of the exclusion zone becoming a place of thriving nature. They suggest that low radioactive intoxication affects even migrating animals like barn swallows with genetic damages, tumors, albinism, increased malformations and high mortality rates.[21] Mousseau and Møller have researched the genetic effects of exposure to radiation in Chernobyl since 1991, and extended their research to Fukushima in 2014. Their rigorous data was challenged by Robert Baker and Ronald Chesser, two biologists from Texas Tech University, who claim that there is an abundance of wildlife. They too have been studying the effect of exposure to radiation on genes by collecting small mammals from the exclusion zone since 1996 and maintain that these animals do not show any abnormalities. Even though their main paper on Chernobyl, published 1996 in *Nature,* was withdrawn because of data inconsistencies, Baker and Chesser continue to publish in popular science journals affirming an abundance of small mammal diversity even at the most radioactive sites in Chernobyl.[22] Excluding humans from the ecosystem appears to significantly outweigh any negative cost associated with the radiation, they argue. Jim Smith and Nick Beresford, two UK biologists who focus on bigger mammals like elk, roe deer and wild boar support Baker and Chesser, stating that there is no evidence of a negative influence of radiation on bigger mammal frequency. Zoology and animal studies in radioactive zones, specifically those concerned with larger mammals, are more or less taken to estimate the consequences of ionizing radiation on human bodies, to determine future bio-politics and how nuclear exclusion zones will be managed. The lives of animals, plants and matter are not important in this respect.[23]

Considering the wider impacts of low radioactive pollution on the entire ecosystem, Mousseau and Møller come to a very different conclusion than Baker and Chesser. Studying animals across all taxa, including small-scale animals like spiders, bumblebees, butterflies, grasshoppers, and dragonflies, they claim that there are 50 per cent fewer animals in the zone than in areas of similar warmth without background radioactivity, and that, on top of this, the animals in the exclusion zone are severely depressed. Through their calls, male cuckoos, for example, do not only announce the presence of females, but also express the conditions of their environment. Male cuckoos produce more syllables per call in their favorable habitats with black soil and in forests. In the radioactively contaminated areas of Chernobyl they produced fewer and more aberrant syllables, signaling environmental perturbation.[24] However, Mousseau and Møller, who are still collecting mutant birds and bugs around Chernobyl, are clear that over evolutionary time these mutations will disappear and the genetic status will return to the moment before the contamination, if the mutations were not beneficial.

Half-lives

The most dangerous radioisotope that was released in Chernobyl and Fukushima was Cesium 134 and Cesium 137. Both elements release radiating particles, which have the ability to enter the tissue of plants and animals, and harm their cells and genes. Radioactive isotopes cannot be removed from a body, an object, or an environment. They decay rather like organic matter and while they decay they are very lively, migrating from one object to another. There is no immateriality in the wilderness of radioactivity. Some isotopes decay faster than others. The process already begins with the nuclear fission. Cesium 134 has a short half-life of two years; Cesium 137 has a long physical half-life of 30 years, is very volatile and has a low capture rate. It can affect large areas. Cesium 135, another byproduct of nuclear fission has a half-life of about 2.3 million years. Half-life is the time required to reduce the element to half of its initial value. This means, that if 2000 atoms of Cesium 137 are released, there will be 1000 atoms left in 30 years, and 500 in another 30 years. However, in this process Cesium 137 does not simply disappear, but transmutes to radioactive Barium.

In order to normalize the evacuated areas surrounding the Fukushima Daiichi nuclear plant, the Japanese government created a decontamination area of 24 square kilometers of land. It meant shifting highly radioactive material from one place to another. While the radioactivity was halved on one site, other places were pushed deeper into contamination with additional amounts of radioactivity. Nine million bags full of contaminated scraped topsoil from farmlands, roadsides, town floors, school- and house-yards, generated enormously radioactive dumpsites. Now the evacuation orders have been lifted in many places, and people are demanded to move back. However, apart from recontamination going up and down like floating dust, moving back means being restricted to staying on the sports ground, at the kindergarten or the convenience store, or simply to staying at home, since forest, hills and fields are still heavily contaminated. Forest soil cannot be scraped off the ground, and 70 per cent of Fukushima consists of forested mountains. Additionally, much of the material that was collected in the cities and villages is now discarded in the forests without bothering about the lives of its nonhuman inhabitants.

A group of Japanese scientists, who began to study the fluctuation of radioactivity in forests in 2011, found out that different trees cope differently with radionuclides. Whereas in Japanese cedar trees, or *sugi*, the concentration of radionuclide decreases over time, in *konara* oak trees, it increased. At first, oak trees seemed much less affected, since the contamination happened in March, when they still had no leaves. But over the years, the concentration in the leaves reached the same level as the initial contamination of evergreen needle trees immediately after the accident.[25] Tree barks initially showed a lower concentration of radionuclide than needles and branches, but this increases rapidly over time. A comparable behavior was reported from Chernobyl studies. Taking the same internal pathways and channels, plants mistake radioactive Cesium 137 with Potassium and circulate it in their tissues. Radiocesium migrates inside and outside forests, inside and outside plants and animals. With a radionuclide concentration of more than 100,000 Becquerel per kilogram, the contamination of Asian giant hornet's nests are jaw-dropping. Japanese monkeys, contaminated with 10,000 Becquerel per kilogram, are not able to produce sufficient red blood cells any longer. Pale grass blue butterflies show an increase of physiological and genetic damages and abnormalities.[26] Birds, boars, dears, monkeys, mice, bugs and butterflies who live in a forest and live on its edibles, all suffer from radiation. After being exposed to an immense human-caused pollution, they are often caught and killed in order to be measured. Disasters like Fukushima and Chernobyl legitimate various kind of research on animals and plants for scientific and conservationist reasons. Of course there are good individual scholars, but what is conveyed in these endless examinations for the nonhuman? Will "their" data increase the quality of the life of those who survived, or is it just collected to satisfy curiosity?

The Fukushima meltdown created another exclusion zone with outcomes more resistant to measurement and quantification. The initial radioactive material vented into the atmosphere, but most of the fallout descended into the ocean. Until the present day the groundwater from the mountains seeps through the ruined power plant, continuously oozing 300 tons of intensely radioactive Strontium into the ocean. Ocean currents dilute substances, but the pollution from Fukushima constitutes the largest radioactive contamination of marine life on the planet. It affects many species in the ocean to various degrees, and can be measured in Hawaii, Canada and along the

North American coast. Cesium 134 and Cesium 137 are both anthropogenic, which means that they do not exist in nature. Scientists are happy: anthropogenic Cesium allows them to finally visualize how ocean currents move.

Appendix

Often approaches addressing extinction, pollution, biodiversity, climate change etc., generate all-too-human views. The representations that conjure up and dramatize the Anthropocene are surprisingly limited. Examples include animated data-images of illuminated logistical networks seen from outer space or aerial views in high-resolution of expanding cities in the southern hemisphere suffocating in streams of garbage. These images and films imply that impending disasters, overpopulation and scarcity of resources call for global governance and control. The visual regime of the Anthropocene is not one of frictions, but suggests the totality and continuity of data. The human subject is not decentered, but is busy mapping the world from a classical transcendent perspective. It is fair to say that the understanding of interconnectedness sparked by discussions of the Anthropocene is accompanied by a peculiar crisis of visual representation that causes cartography to become the dominant mode of visual representation.

Then, there also seems to be an alternative approach to images and film, one that is more closely observing and more personal with long takes that give time for looking slowly, and that is tuned into the rhythms of life. This late Romantic post-phenomenological observational mode of filming addresses the problem by asking the spectator to consider an ethical turn towards profound empathy and care, presuming the human has lost herself and needs to reconnect in her relationship with the natural environment. In this approach, the human is an immensely self-conscious, cognitive subject – or as Claire Colebrook put it in her recent thought-experiment on extinction: "any theory that assumes a natural or proper connectedness (however occluded), reinforces what Foucault referred to as the specifically modern nature of bio-power and maintains an extensive and bourgeois approach to values."[27] Restoring a sensuous flow with the world, in these phenomenological approaches means to preserve homogeneity rather than welcome frictions of heterogeneous perspectives, temporalities and scales.

By contrast, I suggest another approach to images and film, one that does not refurbish an enchanted, unified, expansive or apocalyptic vision, but that is a messy expression of living and surviving in multispecies commons. I would like film to become an even more intensified *disenchantment* – an abstract and impersonal machine that replaces judgment, selfhood and personal connectedness with mutual deterritorializations. Film organizes relations within frames and between images. Cuts might be bossy. They chase objects and spectators around, and require activity. My approach imagines inhuman worlds of perception and amalgamates cartographies of multiple and simultaneous scales, spaces and temporalities. Again in the words of Colebrook: “It is the cutting power of the eye that needs to be thought: the eye would be approached as a form of synthesizer, but as an analog rather than digital synthesizer. That is: the eye does not need to free itself from imposed distinctions to return to the flow of life, but should pursue ever finer cuts and distinctions, beyond its organic thresholds.”[28]

Affective encounters beyond the lived, and outside the human with machines, earth strata, light, lichens, soil, bacteria, plants, animals and their symbiotic endeavors, heterogeneous micro- and macro-perceptions and temporalities might potentially help us to learn inhuman interspecies modes of care and attention and enable us to confront the limits of the very concept of the human.

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[1] Sadie Plant, *Zeros and Ones: Digital Women and the New Technoculture* (London: Fourth Estate, 2000), 3–4.

[2] Claire Colebrook, *Death of the PostHuman, Essays on Extinction* 1 (Ann Arbor: Open Humanities Press, 2014), 57.

[3] Bertolt Brecht explains it this way: “The situation has become so complicated because the simple ‘reproduction of reality’ says less than ever about that reality. A photograph of the Krupp works or AEG reveals almost nothing about these institutions. Reality as such has slipped into the domain of the functional. The reification of human relations, the factory, for example, no longer discloses those relations. So there is indeed ‘something to construct,’ something ‘artificial,’ ‘invented.’” Marc Silberman (editor and translator), *Brecht on Film and Radio* (London: Methuen, 2000), 164–165.

[4] Anna Tsing Lowenhaupt, *The Mushroom at the End of the World* (Princeton: Princeton University Press, 2015), 155.

[5] Paul Rogers, “Disturbance Ecology and Forest Management: a Review of the Literature,” *Intermountain Center for Research on Disturbance Ecology* (May 1996).

[6] Céline Bellard, Cleo Bertelsmeier, Paul Leadley, Wilfried Thuiller and Franck Courchamp, “Impacts of climate change on the future of biodiversity,” *Ecology Letters,* Volume 15, Issue 4 (April 2012), 365–377.

[7] Caspar A. Hallmann , Martin Sorg, Eelke Jongejans, Henk Siepel, Nick Hofland, Heinz Schwan, Werner Stenmans, Andreas Müller, Hubert Sumser, Thomas Hörren, Dave Goulson and Hans de

Kroon, "More than 75 percent decline over 27 years in total flying insect biomass in protected areas," *PLoS One* (2017).

[8] Anthony Trewavas, "Aspects of Plant Intelligence in Annals of Botany," *Oxford Journal* 92 (2003), 1–20.

[9] Gilles Deleuze and Félix Guattari, *A Thousand Plateaus* (Minneapolis; London: University of Minnesota Press, 1980), 6.

[10] Deleuze and Guattari, *A Thousand Plateaus*, 11.

[11] Anna Tsing Lowenhaupt, *The Mushroom at the End of the World*, 138–139.

[12] Rattan Lal, "Climate Change and Food Security," *Science* 304 (2004). See also: Rattan Lal, "Managing Soils and Ecosystems for Mitigating Anthropogenic Carbon Emissions and Advancing Global Food Security," *BioScience* 60 (2010).

[13] Mick Smith, "Dis(appearance): Earth, Ethics and Apparently (In)Significant Others," in *Unloved Others, Death of the Disregarded in the Time of Extinctions,* edited by Deborah Bird Rose and Thom van Dooren, *Australian Humanities Review* 50 (2011).

[14] Ben Bond-Lamberty, Harvey Bolton, Sarah Fansler, Alejandro Heredia-Langner, Chongxuan Liu, Lee Ann McCue, Jeffrey Smith and Vanessa Bailey, "Soil Respiration and Bacterial Structure and Function after 17 Years of a Reciprocal Soil Transplant Experiment," *PLoS One* (2016).

[15] Timothy A. Mousseau, Gennadi Milinevsky, Jane Kenney-Hunt and Anders Pape Møller, "Highly reduced mass loss rates and increased litter layer in radioactively contaminated areas," *Oecologia* (May 2014), 429–437.

[16] María Puig de la Bellacasa "Encountering Bioinfrastructure, Ecological Struggles and the Sciences of soil," *Social Epistemology* (2014).

[17] Karen Barad, "Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter," *Signs: Journal of Women in Culture and Society* 28 (2003), 20.

[18] Ibid, 815.

[19] Kateryna Slivinska, Nataliya Yasynetska and Daniel Klich, "Przewalski`s wild horses and their 18th years management in the Chornobyl exclusion zone," *Ecology Symposium* (2017).

[20] The Chernobyl Forum, *Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts and Recommendations to the Governments of Belarus, the Russian Federation and Ukraine,* 2003–2005.

[21] Hans Ellegren, Gabriella Lindgren, Craig R. Primmer and Anders Pape Møller, "Fitness loss and germline mutations in barn swallows breeding in Chernobyl," *Nature* 389, (October 1997), 593–596.

[22] Ronald K. Chesser and Robert J. Baker, "Growing Up with Chernobyl," *American Scientist* 94, (2006).

[23] It seems important to mention that Ronald Chesser had to step down his position at Texas Tech University pending an investigation for extreme sexist remarks he had made at Robert Baker's retirement party, and which were caught on video. Later Baker as well was accused of sexual harassment.

[24] Anders Pape Møller, Federico Morelli, Timothy A. Mousseau and Piotr Tryjanowski, "The number of syllables in Chernobyl cuckoo calls reliably indicate habitat, soil and radiation levels," *Ecological Indicators* 66 (2016).

[25] Naohiro Imamura, Masabumi Komatsu, Shinta Ohashi, Shoji Hashimoto, Takuya Kajimoto, Shinji Kaneko and Tsutomu Takano, "Temporal changes in the radiocesium distribution in forests over the five years after the Fukushima Daiichi Nuclear Power Plant accident," *Scientific reports* 7 (2017).

[26] Atsuki Hiyama, Chiyo Nohara, Seira Kinjo, Wataru Taira, Shinichi Gima, Akira Tanahara and Joji M. Otaki, "The biological impacts of the Fukushima nuclear accident on the pale grass blue butterfly," *Scientific Reports* 2 (2012).

[27] Claire Colebrook, *Death of the PostHuman: Essays on Extinction, Vol. 1* (Ann Arbor: Open Humanities Press, 2014), 57.

[28] Ibid. 23.

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