

ROOTS & SEEDS XXI

BIODIVERSITY CRISIS
AND PLANT RESISTANCE



Roots and Seeds XXI.
Biodiversity crisis and plant resistance

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ROOTS & SEEDS XXI

BIODIVERSITY CRISIS
AND PLANT RESISTANCE

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INTRO- DUCTION

Roots & Seeds XXI. Biodiversity Crisis and Plant Resistance is an international cooperation project between Ars Electronica (AT), Leonardo-OLATS (FR), University of Barcelona (ES) and Quo Artis (ES) as lead partner, co-funded by the Creative Europe Programme of the European Union and developed between October 2020 and September 2022. With this project, the partners support that by using Art and Science practices, approaches, techniques and aesthetics we can develop passion and emotional connection for sustainable organizing and living, and promote habits that take care of our environment and specifically our plants, contributing to our botanical literacy.

Roots & Seeds XXI has come to life in a series of interactive, transdisciplinary tools, activities and outcomes that have allowed us to reimagine our relationship with botany, and rethink how we relate to each other and the environment. Between 2020 and 2022, the project has organized Art and Science forums, workshops, and activities with scientists, artists and curators, which have been documented in a series of partial publications and catalogues that will continue to stimulate artistic research and transference of knowledge between different communities. The project has traveled to different countries in Europe, and has sparked new international alliances.

This work has been edited by Quo Artis and constitutes the final publication of Roots & Seeds XXI. With it we pay homage to the different actors and institutions that have made this project possible and gather the partial publications generated over the course of two years, while also adding final reflections from key cultural agents. This final publication serves as testimony and as artistic object to be interacted and played with, and cherished in personal and public collections.

The partners of Roots & Seeds XXI joined with other institutions and independent artists, scientists and thinkers in a common effort to shift the perspective humans have on the botanic and the non-human world.

HERBART: ART AND SCIENCE IN CONFLUENCE

AMONG PLANTS AND WORDS. ART, BOTANY AND CITIZENSHIP

Within the framework of Roots & Seeds XXI, in July 15th and 16th of 2021, two events took place simultaneously. One was Herbart: Universitat de Barcelona and Botanical Institute of Barcelona organized the II edition of the International Forum of Herbart - Art and Science in confluence, featuring interdisciplinary talks from artists and scientists. The aim of the forum was to merge botany, art, science and humanities in one culture to face the future challenges of the biodiversity crisis from an integrative perspective.

The other event was Multidisciplinary Garden Cartography which Quo Artis organized at the Ferran Soldevila Garden (University of Barcelona). This event unfolded as a think tank in which artists and scientists discussed, through participatory mapping and knowledge-sharing, the possibilities of engaging with the crisis of botanical biodiversity from an emotional approach. The methodology of this event was later replicated in Paris and Linz during September 2021, adapting the format to its different gardens and participants.

What follow are the contents of the four round tables and transdisciplinary dialogues that took place during the think tank formed by the participants of the Multidisciplinary Garden Cartography.



The publication of the II edition of the International Forum of Herbart: *Art and Science in confluence* can be found on this QR code



Credits

Book cover Herbart publication:
Pep Herrera

Book cover Multidisciplinary Garden Cartography:
Pedro Strukelj

In the frame of Creative Europe Project
Roots & Seeds XXI. Biodiversity Crisis and Plant Resistance. 2021

I. WHAT IS THE BIODIVERSITY CRISIS?

[THROUGH THE EYES
OF ARTISTS AND
SCIENTISTS]

LUCIO MONTECCHIO (ITALY)

Full professor at the University of Padua, where he teaches Forest Pathology and Tree Health classes. Member of the advisory council of the Botanical Garden of the University of Padua (1575), he is the author of numerous scientific and technical publications and is a consultant to leading international institutions such as IPPC / FAO, EU, EPPO, EAC. In 2018, the Financial Times called him “The man who saves trees.”



| What is biodiversity crisis?

I have a great many pictures illustrating what, in my opinion, biodiversity crisis is. However, I have decided to display just this one, showing a huge motorway junction wrapped around and forever isolating a traditional house and its declining garden. What happened to those farmers? This picture represents the big problem we pretend not to see: the human crisis and, as a consequence, the biodiversity crisis.

Since 1988 I have been researching biodiversity related to plants and forests. For example, let's take a look at the internal

dynamics of a single, monumental oak tree. Within the same tree species, I found over 600 different species. I am talking about microscopic species—more or less twenty microns big—but, in this way, we can consider a single tree as an ecosystem.

As we are used to quantifying biodiversity through statistics, we can measure it using a figure. There are many tests that provide us with these figures. The Shannon Diversity Index, for instance, represents the probability of finding an individual in close vicinity to another of a different species. The result will be a number between zero and one hundred. But a number cannot represent the complexity of biodiversity from an ecological perspective. Is five high or low? Is it enough, or not? We need to find a different way to talk about biodiversity.

In recent years, we have been reading about the loss of biodiversity. I think it is not only a loss. A loss is when you lose your car keys; when something is lost, it means that sooner or later you will find it. In the case of biodiversity, we are losing it forever; we are killing it daily—with our behaviour.

Biodiversity is not just a scientific matter; it is also behavioural. I am really happy today because, for the first time, I have an opportunity to meet not just scientists, but artists and philosophers, people in the field of arts and literature. These people are asking themselves questions that can be answered not with numbers, but with words.

So, thank you very much.

Question:

You are called “The man who saves trees”. Why it is so important to save trees?

I had an interview with *The Financial Times*, and I really don’t know why, but they gave me a full page.

Of course, they invented that name, because it is fascinating for people to read. But I cannot save trees; I am trying to keep them healthy, which is something different. I am trying to help trees to save themselves.

I work as a forest pathologist, or a doctor of trees. But the knowledge we have is not enough to act as a surgeon, like a doctor of animals and humans (and, of course, humans are animals).

With trees, the only way is prevention. Taking care of them is based on attempts to understand the dynamics that push forests and trees into decline, for example. And much more.

If you look at the last photograph, what do you think is the main reason for the deterioration of plants? It is quite easy: we are the reason. We have to help ourselves by allowing trees to live healthily for centuries.

I am lucky because my usual clients are, on average, between eight and 12 centuries old, and do marvellously by themselves. This is because we simply forgot about them for centuries, and now, when they are huge, it is too difficult to cut them down and turn them into furniture. And just because we forgot about them, they look good and are healthy.

Thirty years ago, a colleague of mine used to say: Touch trees. Touch them to understand the way they live. Touch trees became an international motto, a kind of mantra also repeated by the arborists who touched trees with heavy chainsaws.

I say: Don’t touch the trees. Just forget them, and they will survive. If you make a comparison and look at the trees we are trying to heal, they survive 60 or 80 years, usually no more because we fill them with pesticides and plant them in concrete, in places that are exotic to them. We have to remember that most of the trees in our gardens are forest trees that we decided to move into our cities.

Of course, we have to exclude the species we pollinate and graft artificially. The *Platanus* we are used to seeing every day is a hybrid created over 300 years ago by gardeners at the Oxford Botanical Garden. They bred *Platanus orientalis* and *Platanus occidentalis*, and the result was today’s *Platanus hispanica*.

This idea of human intelligence trying to adapt forest trees to exotic environments centuries ago is fantastic. There is no other way: if we want to protect our environment and our plants, we have to think differently, planting natural trees according to their wishes, or producing new selections according to their place of destination.

Question:

How is climate change affecting our trees?

Climate and weather are changing, and the process is speeding

up and changing dramatically. We have known this for some 45 years, but we are good at forgetting our negative experiences.

There are records of storms devastating forests dating back at least a thousand years. There is also a very simply written book by an Italian forester, Alfred di Berenger, about forest archaeology. It offers a simple recipe for creating stability, which we now call resilience. But we are not resilient. How can we create a resilient forest if we are not resilient ourselves?

We forget what was written, so every day in the newspapers we read something that seems new but is simply a copy and paste of something that was written 30 years ago. Eighty percent of what we read daily has been said before—perhaps in a different language or on the radio. We are simply recycling sentences, slogans and news, not knowledge.

This is why I think it is important to meet here today. Here, we have a new way to find a common language, getting away from slogans and advertisements, finding a non-scientific way to spread scientifically sound information through art, poetry, literature, painting and theatre.

Because I'm really bored. As I said, since 1988 I have been working with figures at the university. But this only works when I speak to my colleagues in academia; everything remains inside this kind of black box, to be discussed again in the same way a year later, never getting in touch with laypeople, showing all the different ways they can take care of the place where they live.

Not for their children, but for themselves.

GABINO CARBALLO (SPAIN)

Landscaper Architect and Project Manager with a MA from the University of Sheffield, a MPM from the University Ramon Llul in Barcelona and a Degree from the UCJC in Madrid. He is a senior advisor at the Parks and Gardens Department of Barcelona City Council, where he has developed projects and strategies for the implementation of nature based solutions and the promotion of biodiversity.



I find myself speaking between Lucio and Antonio, and I think that there must be a mistake, as I am by far the weakest in terms of authority to talk about green spaces. My one virtue is that I spend a great deal of time dealing with problems of green space management and, as a result of the inevitable cycle of trial and error, experience has given me a certain wisdom.

To illustrate my point, I would like to show you three pictures. I wanted the first to show gardeners working on a temporary garden, an ephemeral installation on the Ramblas in Barcelona. This is simply to remind you that, even though we would like to think otherwise about nature in cities, it is always ephemeral in the presence of human beings, and it does not just happen. What happens is something else. Planting is a cultural act; it needs effort and care, and a lot of work to get anything going in a suitable direction that improves our environment. The idea of improving nature is a very ancient one, a tradition that goes back centuries. It is not modern in any sense.

Gardens were called *la terza natura* by Jacopo Bonfadio, a third nature. They were also referred to as the greater perfection by the philosopher Francis Bacon, suggesting that it was harder to grow a garden than to build anything else. Gardens, for all their poetry, reflect our vision of the world in terms of what we think nature should be like.

Unfortunately, the idea that we can improve nature has gone a little too far. We have forgotten that every plant is an ecosystem, that there are several lines of improvement, that there are ways to improve and then there are ways to simply aggrandize. One of our main problems now is that we have been following a line that leads to efficiency, with technical products and solutions, and the overuse of pesticides. We have been managing the greenery in our cities as if it were an agricultural problem in order to achieve this greater perfection.

What has happened in recent years is that we have come to realize that we were going too far, and started backing away from this idea of being as efficient as possible by simplifying everything and applying chemicals to every problem. By trying to get back to an earlier state of knowledge, where we somehow worked together with nature to achieve our goals, we are trying to bring biodiversity back to cities. These changes mean that we are able to create places that are not just for humans. Gardens should not be just for people; gardens must be for other living things, too.

One of the main ideas that we have been developing in the last few years is the notion that, instead of fighting pests with chemicals, we could use what we call beneficial insects to attack pests and curb their expansion, and to create a basis for the ecological processes that we would like to see happening and are trying to create.

Unfortunately, our understanding of this idea is limited. For example, we found out that the insects, like ladybirds, that we brought into the city to fight pests would die off every year. Why? Because although they have food in the trees, they have nowhere to hide once the cycle ends and winter comes, because the streets are barren. These insects were dying in winter. So we thought: “Why not create small ecosystems for them to use?”

We developed the idea of using every tree pit in the street as a planting area or a space to spread organic matter, to act as an ecological refuge where insects could hide after doing their work in the trees. A tree pit can be used to create a managed ecosystem, with or without plants. We have been doing this for a few years now, and the results are surprising. It is amazing that you can create a little ecosystem in a square metre, and we call this approach “Alcorques Vivos”. The second image shows that if we pay enough attention—by taking a picture with our mobile phone, for instance—we see so much more life than we thought.

The third picture illustrates, once again, the importance of culture. What this picture shows is that if we leave space for spontaneous plants—what we commonly call weeds—to grow naturally in tree pits, a lot of local residents reject this approach. People do not like the idea of disorder in their landscape, so we had to develop a strategy to plant and sow interesting, attractive-looking flowers so that the neighbours find the planting interesting. I would like to underline this idea: biodiversity, as we understand it now and as it will be seen in the future, has to be a combination of culture and nature. Otherwise, we will find ourselves in a situation where people will reject either nature or culture. We need to change our attitude and go back to the stage where we work together with nature, not against it. And I think that is exactly what Lucio has been saying all along.

Question:

Do you think more things can be done to bring nature back into cities?

In the way we work now, yes, but sometimes it can be difficult to create continuity for our projects. There is a question of funding, of political approval. We are not working in a vacuum where we simply produce ideas and they happen. This is one reason why you might not have read about this project in the media, except in foreign newspapers, like *The Guardian*, because, somehow, here there is not much real interest in nature or biodiversity. The interest lies in narratives—in selling nice ideas to the public, rather than in the core belief of the project

itself.

And yes, if you read the newspapers, you will see that a considerable number of people are writing about changing city management; they want to see everything nice and green, they want more trees, more of everything. The problem is, when you work with nature, that not everything is about more, and not everything is nice and green all the time. There are processes, and the problem with processes is that they are variable and unpredictable.

In the last 100 years, we have been trying to kill processes in order to create a static, crystalized, mineral city, an architectural place where everything is perfect all the time. Working with nature, conversely, is akin to risk management. You need to allow for a certain level of risk, of life, of biomass, and waste and decay, and that is part of the problem. Once you lose a little bit of control, people think that you are losing control entirely, and that is not good.

So, part of the problem with the managed tree pits, with the *Alcorques vivos* project, is the fact that we do not have continuity in terms of funding. Furthermore, we got considerable criticism, because it did not always work well: natural greenery does not look pretty all the time. So even though bringing biodiversity into the cities is a good idea at its root, it is difficult to implement it, as it requires a lot of hard, repetitive work. It requires gardeners, and people working, and this is no good for the budget. You need to sow at a certain time of year, you need resources and supplies, and things sometimes go wrong because the weather patterns change, or because the insects are sometimes successful, sometimes not. This is nature; you do what you can as culture, but it is nature that operates the system.

So, citizens got upset this year because there were too many insects, and they got into their apartments through the windows. Sometimes we are not even sure what kind of insects they are: we have new pests arriving from Asia and the Americas. It is a dynamic situation; it is never static. So, if I had to summarize my reply in a single sentence: Yes, but the failure rate is very high.

Question:

People who live in urban areas want trees and flowers on the streets, but they also have animals at home. There is a growing trend of keeping dogs in cities. What happens to biodiversity when pets interact with the urban green?

The problem is not necessarily the dogs themselves, but the fact that humans are continuously modifying the environment, too fast for nature to adapt. In a way, we select all the time, and selecting is modifying. Cultivating is selecting, too. We select animals like dogs because we have a great affinity with them. But again, we get a divergent result from this choice, which does not necessarily work as we expect it to. By creating good environments for dogs, we are also inviting in animals like seagulls and rats, and expelling other living beings.

Urban dogs, or other pets, are not necessarily “animals”. The pet becomes an extension of the person who owns the animal. This is a complex issue. In the last few years, people with pets have started to say: I have rights, my pet has rights. This is entirely true, but the problem is that dog owners are saying that whatever rights they have, their dogs have the same rights exactly, or even more, and this cannot be called into question.

The problem is that green urban spaces were not designed to accommodate any number of dogs or other pets, which has led us to create special places for dogs, to suit their owners, in fact. The main problem here is that when a human being interacts with nature, they tend to consume it. We are not a particularly nice species to be around. Plants do not like us that much. We have to cultivate them to get them to grow the way we like them. Otherwise, they tend to try to escape us by dying. With dogs, exactly the same happens. They move around, they have their specific behaviours and change their environment fast in a way that is not necessarily favourable for plants. So again, the plants try to escape, like other species.

But people and dogs are not the only animals responsible for the changes in biodiversity in the city. Seagulls are now attacking pigeons, beginning to evolve into a predatory species in Barcelona. Animals like wild boars come down from the mountain into the city because they find the rubbish that we generate more appealing than eating what they find in nature.

We have also modified the mountain, completely altering the food chain. We want it to be like a big forest, thick and lush, but we do not want to manage it because it costs money, time and effort. The wild boar population is growing uncontrollably and they have started coming down into the city, and we are now having problems with these animals.

What we want is to find quick solutions for the appearance of the physical space, but we do not wish to address the root causes. We do not like managing problems. We neither question our behaviour nor our motivations, we just want to judge and get quick solutions. What we do best is moralizing: we attribute objects a moral function in public space. So we start saying that we need to put the fence here and create a space for dogs there, and so on. We start changing the appearance of public space, designing it to be neat. Instead of addressing our wrong decisions and behaviours, we create a moralizing environment where things are good or bad, right or wrong, according to who has the loudest voice or the most popular point of view. It is all about quick fixes and being seen to do the right thing and being right all the time, not about addressing the underlying causes.

Ten years ago, when I started working on projects to address the presence of dogs in green spaces, I simply used to say that dogs should not be allowed in parks and gardens because that was the law, and my job was to implement that. In practical terms, this was never how it was going to be. The rule is still there, but now we cannot simply say “No dogs allowed in green spaces”; we actually have to create green spaces for dogs in cities, even though their presence may not favour biodiversity.

Once again, the subject is one of dynamism, as there is never a static situation in the city. We can never say exactly what urban biodiversity is today, since it will not be the same tomorrow. In ten years’ time we will be talking about an entirely different situation—we simply do not know. What is nature? We have this idea of nature as something eternal and unchangeable, but the reality, when you look closely at it, it is a continuous state of change. It is all just very uncertain.

ANTONIO RIELLO (ITALY)

Artist with a degree in Pharmaceutical Chemistry with an eclectic and endless curiosity for social paradoxes. He taught anatomical drawing for several years at the Accademia Belle Arti in Bologna. Since 2010 he has managed seminars and conferences on Contemporary Art and Fashion (the relationship between the human body and clothing / uniforms) at various universities and art schools in the UK, including the Royal College of Arts (London), the University Westminster (London) and Ruskin Anglia University (Cambridge).



We know that visual artists have to be able to make the invisible visible to produce powerful, iconic pictures. But right now, visual artists also have to be able to do so much more. First of all, they have to be activists, voices of communities, or voices of social-environmental issues. Visual artists, right now, have to be anthropologists, some kind of philosophers, much more complex figures in the art world.

My project, Branded Garden, is about fictional botany. Some of you might remember an Italo-American writer, Leo Lionni. Some decades ago, he wrote *Parallel Botany*, a magnificent book about a fictional botany. I was inspired by him, and I decided to create this Branded Garden.

From an anthropological and social point of view, this Branded Garden proposes new botanic varieties, a kind of elite of species. Something that creates and disturbs our gardens—the ultimate place of peace and tranquillity—and renders them ambiguous.

I love my novel attitude of sowing seeds of war, seeds of conflict, as a kind of social conflict. Accordingly, I have decided to create an upgrade of botanical species. What we see here is just the beginning of this project, which started more or less as a joke at Tatiana and Marco's home in Treviso about a year ago.

The concept is pretty simple. What I did was cut little shapes of well-known fashion brands and shone light over the leaves, where the energetic chlorophyll process happens, gently covering very small parts. After a while, there is a mysterious emergence of what I like to call botanical tattoos. After a while, they gradually disappear, and the solid green of the leaf is restored. It is like a happy end when order is restored.

I really love the idea of doing something a little strange, somehow not politically correct, suggesting a possible conflict. That, in short, is the project.

Question:

Even though your art does not directly address the topic, what does the biodiversity crisis mean for you?

When you think about such a terribly dangerous situation, losing environmental life and quality of life every day, it is extremely disturbing from an anthropological point of view. Something similar is happening in the human community: we are losing our differences and the quality of social life in much the same way. Of course, it is much more complicated, but I like to use this comparison. Every day, we are losing a lot of knowledge and a lot of happiness.

I would also like to add something here as a visual artist. When talking about these issues, we cannot just expect people—and when I say people I include myself—to do the right thing because someone tells them what is right or wrong, or to do the right thing when it is fashionable. We need the aesthetic side to make the right things ethical, to make them attractive to us. We do things because we like to do them, not because we

have to do them. I think that the visual arts and visual artists in particular have an extremely important duty right now: to illustrate these issues in a way that is more visually interesting to the public. And this is something that all of us have to think about.

II. COLLABORATIVE PRACTICES

[PLANTS AS AGENTS IN ART, SCIENCE & PHILOSOPHY]

PACO CALVO (SPAIN)

Professor of Logic and Philosophy of Science in the Department of Philosophy, where he directs MINT Lab (Minimum Intelligence Laboratory, specialized in Philosophy of Cognitive Science and Plant Neurobiology). He is a member of the scientific committee of the International Laboratory of Plant Neurobiology (LINV, Florence) headed by Prof. Stefano Mancuso.



“Houston, we have a problem, a huge problem.” I think we just don’t get it; we don’t get what plant intelligence is and we don’t get what the problem of this crisis is.

I set up this Minimal Intelligence Lab in a philosophy department because I couldn’t address the type of questions I wanted to in a biology department. I realized that undergrads taking a degree in Plant Biology were not being exposed to the type of questions that I thought they needed to be exposed to. They were basically studying plant physiology or cellular and molecular biology, and being exposed to a reductionist or mechanistic understanding of plants, not to plant life.

Things only get worse if we go on to Environmental Studies. My daughter started Environmental Studies and then switched to Biotechnology. I was amazed when I saw her

first-year Environmental Studies notes. They wouldn't drop the "resources" label, simply saying how we should exploit plants sustainably. It was about the wise or sustainable exploitation of resources, rather than saying we are not dealing with resources here, we are dealing with agents; not objects, but subjects. If we don't get that, we miss the whole point.

If you think about plants from a physiological perspective, with the translocation of minerals, nutrients, water and sugars through the plant's vascular system, the phloem and the xylem, connecting the whole body, you are missing the point. We need to understand the vascular system of the plant—which can be very sophisticated, as in the case of the trees Lucio was talking about—as an information-processing network. It is about the information-processing taking place on behalf of the plant, in order to deal with whatever matters to it. The really important point is to put ourselves in their place, to think hard about what they care about and what is meaningful to them.

In our lab, we try to cast some light on these questions by using time-lapse photography. We take pictures every minute and assemble the footage to try to understand what is going on. Many people think that plants can afford to be stupid because they're rooted, whereas we animals need to be fast and furious. To which I say: Hold on a second, you don't get it. How smart do plants have to be to pass their genes, despite being rooted?

You turn the argument upside down; it's the other way around, and we are not getting it. We need to speed up what we miss to appreciate their behaviour. So we speed it up with time-lapse photography. Then we also insert electrodes, which we call phytol-acupuncture because they are actually acupuncture needles, used as electrodes, that are wired to the amplifier so we can see the signal. The signal is flat because we put the plant to sleep. We use the same anaesthesia they use for dogs and cats in a veterinary hospital to put the plants to sleep.

Just think about it: plants are subjects, not objects. They are sentient. Take the Venus flytrap, which snaps shut when you trigger the inner hair. If you put it to sleep with anaesthesia, it won't snap shut because it is anaesthetized. After a while, it recovers and starts to snap again.

What is it that the plant has recovered from if you put it to sleep with anaesthesia? It is normal to ask this question when

we anaesthetize a cat or a dog. When it comes round, we talk about mentality, agency and awareness. But if we apply these terms to plants, we think it's crazy and go back to basic physiology. We miss one thing: the fact that we are trying to understand plant intelligence by forcing it into an animal mould. We shouldn't be doing that; we should be trying to understand plant intelligence in itself, not comparing it to our standards of what we think animal or human intelligence is about.

This video shows a young bean plant rotating around its axle. What you see here are the electrodes we attach to the stem, the booth we use for time-lapse photography, and here, on the left, we have a climbing bean. We know they care about support, because they are climbers. They need to find support and climb up it to do photosynthesis, so we know that it is meaningful for them. This is what's happening when it gets closer [*Paco makes noise of effort*]. Almost there! We need to be careful not to do what I was doing when I made that noise. We don't need to anthropomorphize what they are doing.

Earlier, Antonio was talking about botanic tattoos. What happens when he hides part of the leaf surface to make the mark is that the chloroplasts are displaced differently within the cell. Think of the cell as a dome; if there is too much light, the chloroplast will move towards the edges. If there is very little light, they will concentrate right in the centre to optimize their sun intake.

But we can go further than this. Think about the plant reaching for the pole. If I am trying to reach an object, and my target is getting closer, in my retina the image is getting bigger. So, what's happening when the plant concentrates on those chloroplasts or when the plant reaches for the pole? The energy flows change in the very same way the world changes when I move around, navigating my surroundings. This happens to the plants as well; when it moves around, it is generating information, by the very act of growing.

So, if we understand plant behaviour in terms of growth and development along these lines, and we forget about ourselves, we can try to start understanding what it is that matters to them and what the world looks like to them, rather than through our eyes. Then we can drop the idea of how to exploit them as resources altogether.

Question:

What is plant intelligence?

I would like to provide a definition and say: This is plant intelligence. I refrain from doing so because the biggest mistake we can make is to put forward a rigid definition: “Hey, this is the definition of intelligence, and if you play along with these rules, we’ll let you into the club that we have tailor-made for ourselves.”

Because we think intelligence has to be related to what we do as humans: we’re the smart guys, and if you’re intelligent, you do similar things to the ones that we do. I think that this is the mistake, so I try to not give an explicit definition of intelligence because I think we need to keep revising it so we can look at features and ask if any organism, whatever it is, meets them. Then we might be on to something.

If we think about what plants are doing, like the climbing bean, we realize that their behaviour is anything but hard-wired. It’s not coded in their genes, it is flexible. We also tend to think that their behaviour has to be anticipatory, so they cannot behave reactively. Think about it. Remember the pole: if there’s a pole there, I simply grow and bend towards it. “Oh, lucky me, I got the pole!” That’s reactive behaviour: I react to what happens around me. But you need to behave proactively, not reactively. You have to anticipate, because that’s the only way you can control the approach manoeuvre like the growing bean. This is our working hypothesis for our test in the lab: the plant somehow controls the way it grows in order to reach its target.

Plants need to deal with their surroundings in a flexible manner. So their behaviour is flexible, anticipatory and goal-directed. Who cares if they don’t have neurons? We put the plant to sleep with anaesthetics that work on action potentials. So, plants fire on action potentials and spikes of voltage, and are simply non-neuronal. But as humans we are obsessed with neurons.

EVGENIA EMETS (RUSSIA-PORTUGAL)

Artist and founder of the Eternal Forest Sanctuary, a multidisciplinary art project that aims to create 1000 Sanctuaries and protect them for 1000 years, through art, ecology and community.



I’m grateful to all the previous speakers for setting the scene and for saying what they said. I would like to start with a poem, which I think directly relates to our crisis of biodiversity.

Single tree where sacred forest no more
Barren vein once a myriad strata
Rare voice—a relic of obsolete song
Idle seeds race perpetual cycle
Roots once severed grow forever apart
Vacant dream amidst human desert
Instant past of the future all we can plant
Every word spoken here is present
Living memory dire cry for emergence

I titled my presentation “Eternal Forest Sanctuary: A vision for the future old-growth forest”, which is a little utopian, but I think it is possible.

I believed it was possible, and I started spreading this dream and vision, and suddenly a lot of people started believing it was possible. I'd like to share a little of the background story with you, where I'm going with it, how I feel everything fits together, and how we can contribute.

One of my main questions is: How do we turn from short-term to long-term thinking? How do we start listening more closely to the future, where old-growth forests are loved, cared for, appreciated, respected and protected? How do we respect plant beings that form their own relationships and families in a very different time to ours as humans? And how do we co-create and collaborate with them without trying to induce or impose our own patterns of thinking?

Eternal Forest is a multidisciplinary project that started a few years ago, and I hope it can transform our relationship with forest biodiversity, time, community and the sacred by creating a thousand Eternal Forest Sanctuaries in the world and protecting them for a thousand years. I am inviting all of you to embrace long-term thinking, starting now for a thousand years into the future.

An Eternal Forest Sanctuary is an offering—a gift from us to future generations. We all know that there are very few old-growth forests in the world. This project offers the experience of standing in front of a thousand-year-old being for those who come after: our children and our grandchildren.

So, how did my whole experience start? In 2017 I left London after ten years and moved to Portugal, my new home country. This move prompted me to start this work; I wasn't an ecological artist before that. The year 2017 was the year of hugely destructive fires in Portugal, and what you see in this picture is the view from Monchique all the way south: eucalyptus monocultures all the way. Of course, we know that this situation is not just Portuguese or Spanish; it is all over the place. Human beings are the culture of monocultures. So I started by listening to people, trying to understand what they are like, and what the reason was for the disappearance of real forest. I am going to tell you a little about that.

As an artist, I ask questions like: How can art help to deepen our relationship with nature? How can art bring communities together to take care of forests? How can art change our

relationship to time? How can we be good ancestors? And how we can collaborate with forests plants and ecosystems?

I started listening to people first because I didn't know I could listen to the land. And I made a film, which then I toured all over the country and beyond. What hit me was this huge abyss between having a productive relationship with nature and yet not having a sacred relationship anymore. I think this is one of the biggest problems of our time. That was when I realised I had to go deeper and listen to the land, to hear her needs, stories and dreams, because it is always about us, humans. So, how can we go and listen to the ecosystem, and hear what she has to say?

I created this tentative scenario in which an Eternal Forest Sanctuary was created by an artist and a series of collaborators, and supported by the community in the long term. It would be a space where arts, nature and culture would come together, and where we would go to observe ecology, practice deep listening and produce artistic creations. Hopefully, it would be like a focal point that could emerge in any community. With nature's cycles, community embedded in nature and cycles of celebrations and art.

I believe that art and artists can contribute massively to that. I am working with many artists in my international network who are ready to kickstart their own Eternal Forest Sanctuary where they are. And with different approaches: creating artistic experiences and scientific residencies, and hopefully extending this network around the world. I am talking about artists who are ready to collaborate and co-create with the forest ecosystem.

How do we go and listen to the land? How do we co-create with the land? I think it requires deep dreaming with the land and deep listening, and, of course, organized collaboration between the various experts who need to be involved: artists, scientists, forest experts, landscape designers—it requires many of us. I believe that community is one of the most important pillars, because without engaged communities supporting this work, this place will not be here for a thousand years—it simply would not be possible. I'm inviting people to form a Circle of Guardians in their own locations and take care of the natural forests. I invite people to create cycles of deep listening

between communities of plants, communities of people and the future, to imagine the future and bring it towards us, shifting from despair to hope.

And one more thing I want to share with you, just one example of land being conscious and talking to me, is the Eternal Forest Sanctuary in Abrigada that we are creating with an intentional community. When I went there, on my own, to dream with the land, she told me: “I need to heal, I need to re-establish the natural flow that was disrupted by intensive agriculture practices, and I want to regain my sovereignty and the sovereignty of all the beings that are inside me.” I believe the land is conscious, and we just need to learn to listen.

What I am doing right now is setting up an organization, because the project has grown beyond my artistic boundaries. As an artist, I cannot do all of this work alone, so I am now creating a legal body and starting to look for partners, including universities and organizations. My dream to go from one to 1000 sanctuaries involves creating a blueprint and running it in five or six different locations, primarily in Portugal, but also creating a supportive international network of different places in different countries. The blueprint includes the process of creating this place and sharing all the learning and observation internationally.

Question:

How do you address human memory for such a large timescale?

I believe that human memory can be a good and a bad thing. I think we have lost all perspective of what a forest is. When I moved to Portugal I literally had a cultural shock.

People—both forest engineers and laypeople—say forest when they talk about monocultures. If you watch my film, you will see a forest engineer talking about forests. We had to stop this person after 40 minutes because she was talking about monocultures and productive forests; I said: No, we can't do this.

I think we have a problem of loss of perspective and references—what is called shifting baseline syndrome. Ecologically

speaking, we don't know what the baseline is anymore and we have no aesthetic perspective, either. We are visual beings, but we are also experiential. When we go to a forest, we have to know what it is and experience biodiversity viscerally; it is a set of processes, and we are part of it. What I am trying to do is to imagine—imagination is very important in this work—and to start this pilot project as soon as possible, so people can start seeing and experiencing what it means, how it feels and how it looks.

We are working on the whole spectrum, not just land that is completely degraded. This means that we can go to a fully protected, biodiverse national forest park and create a sanctuary there, by introducing just the artistic and the community part, because everything else is there.

On the subject of the eucalyptus, to give you the context, in the north of Spain and throughout large parts of Portugal, the eucalyptus is a huge problem. The eucalyptus itself is a fantastic species; there are over 600 eucalyptus species in Australia and New Zealand. The problem is that we have taken just one. I have been to a very special arboretum in Portugal where there are 125 species of eucalyptus planted in little squares, so you can go and observe what the trees do. But just one was chosen—*Eucalyptus globulus*—and planted in dense rows everywhere. This has already affected two or three generations of people and their idea of the landscape around them. And it has completely messed with their minds, creating a very deep sadness and melancholy that I saw when I worked with this community. How can we change this? My solution is to allow people to experience biodiversity again, through the naturalization of the space and transformation of certain parts of the land, including abandoned eucalyptus land, into a lush, real forest environment.

These are little steps, but this is why, for me, it is important to work internationally, so we can do this work together. It is not just my project; it is for everybody, and I am inviting you to take part.

PAULA BRUNA (SPAIN)

Artist who graduated in Environmental Sciences and holds a PhD in Fine Art with a thesis about art and political ecology. Her practice takes as reference concepts of ecology, ecological economy, and theories on strong sustainability and degrowth, emphasizing the interaction between our society and the ecological system where it lies.



We have known for so many decades what is happening; we know the problems and consequences of our way of life; we know why we have this climate crisis and why we are losing habitats and, as a result, species are going extinct. But we are not reacting. After so many decades of knowing, we stand still, immobilized, or simply adopt superficial solutions that sustain us in this unsustainable way of living and this apocalyptic imaginary of the future. We are not able to go beyond this.

The problem is the way we think, which is a very anthropocentric paradigm. What we see are resources and ecological services, but we are not looking beyond. What I am trying to do in my artistic practice is to address other, non-human realities. By extending our way of thinking to non-human perspectives, we might just be able to think about other possibilities of coexistence that are impossible to see from our current viewpoint.

I'm trying to approach from a non-human point of view, but how, as a human, can we adopt non-human points of view? I'm trying to do it by means of a combination of scientific basis, artistic practice and speculation. I'm trying to go beyond our limitations as humans to explore other points of view. This also involves de-anthropomorphizing ourselves. What I am trying to do is to make it both physical and emotional.

This video is part of an example of what I do. I start organic processes, mainly with plants. I follow them. In this case, we were a group and we analysed how the landscape grew inside our artistic residency, and how this landscape talked to us about our immediate environment, the place we were working on. How the path of plants was growing. The landscape told us where the light was coming from. Also that the floor was not even. We realized that the floor was not even because the plants were growing more on one path than the other. We discovered the source of the water seeping from the ceiling, and we also encountered other creatures cohabiting with us that we hadn't noticed previously: spiders, ants, as well as mice, bats, and numerous other creatures that had escaped our attention.

With these types of works, in which we adopt a non-human point of view, we can comprehend the environment through a plural reality, providing us with a broader, more complex understanding of what reality is.

Our second step was to inhabit this landscape that we had created. Because we followed the growth of the landscape, we were able to become part of it and immerse ourselves in it. This was only possible because we had been following it for many weeks, as entering this place is quite repulsive. I noticed that participants who joined the workshop later were more distant from it, whereas those who had been there since the beginning were already more acquainted with the bats and other creatures. The importance of following, being there and taking care of it, somehow enabled us to become part of the landscape.

By inhabiting this landscape, we establish contact with it through our bodies. The contact of the roots with our bodies may create a sensorial and emotional experience that allows us to de-anthropomorphize. It is emotional as well as physical, in a shamanic way.

To conclude, I would like to highlight three points:

1. The need to explore non-human points of view is crucial for comprehending the plurality of reality, not merely through coexistence but by truly understanding it.
2. The combination of art, science and speculation to go beyond scientific reason allows us to understand and to explore.
3. The need to submerge ourselves in other rhythms, other species and other ways of perceiving. When approaching the non-human, it is important not to do it from our humanity; it is important to move into realities based not on the concepts of resources or ecosystem services, which involve discomfort or even disgust.

Question:

How do you deal with the paradox of human identity?

I cannot avoid being human, and that's why speculation and art are important: to go beyond this reason, without perceiving limitations. For example, one of the last artworks I made in Portugal was at the Cultivamos Cultura Residency. I was working with plants and with their roots, and I discovered that the pieces had a human-like shape. I could only see a human shape, and that was at the end of my residence. I was there for a month, exploring non-human realities and, at the end, the roots said that I was human. This is the limitation I have to be aware of. We have to be aware, of course. It is impossible to escape completely from anthropocentrism. We are humans, but we have to broaden our minds and our thoughts.

CLAUDIA SCHNUGG (AUSTRIA)

Researcher and curator with interdisciplinary experience in social sciences, business administration, cultural sciences, and the arts. She is a curator in the fields of collaboration between art and science, organizational aesthetics, incorporated knowledge and artistic interventions, and is the author of the book "Creating ArtScience Collaboration", one of the great references in the field.



It is a pleasure to talk in this group and I would like to start by introducing myself. I'm a researcher and curator working in the intersection of art and science, or art and science and technology. My academic background is in social and economic science, and in cultural science. This background enables me to investigate how people deal with each other, work together, and understand and inspire each other. In my research I try to understand these processes. I use theories from cultural studies, but I also draw on organizational research, economic studies and social sciences.

So, what does this have to do with art and science? Or, in this case, as we are meeting in the framework of *Roots & Seeds XXI*, what does bringing together art and science have to do with biodiversity and the biodiversity crisis? Looking at these processes with other people, especially people from a wide

range of disciplines, we learn to understand why bringing together artists and scientists can be an impactful tool to reach our goals.

What are these goals? They can be very diverse. As biodiversity is a complex topic, we cannot rely only on the insights of one group, such as ecology experts; we need to learn to collaborate between disciplines in order to reach valuable outcomes and create interdisciplinary strategies to address the biodiversity crisis. We not only need to talk to each other in expert groups, but also to reach those who need to buy these strategies, to materialize them and bring them to life. In the previous round table, for example, the goal of reaching the right target group was mentioned. Antonio also referred to the psychological processes of how people receive news and place trust in various contexts, how large audiences evaluate new ideas and strategies that are communicated to them, and how they legitimate actions based on this new knowledge. We—or these audiences—do not do the right thing because someone tells us it is right; we do it because it is legitimate in our society and part of our culture, and it is broadly accepted. It is difficult to ask the right questions in a specific field. We think we know what the right questions are because they are framed by our background of education, profession, culture and society.

Bringing art into the mix can serve to introduce ideas, knowledge and strategies to overcome crises such as that of biodiversity into social awareness. By means of this process, a degree of legitimation of discussion and action can be achieved. Artistic projects that translate, integrate and engage a broad audience also help to create discussions on a level footing and offer insights through aesthetic experience. This is important leverage for the enthusiasm and buy-in of a large audience. Pure rational discussion or the presentation of scary facts in the media—the dangers of melting glaciers, wildfires, mass wildlife extinction, rising temperatures, extreme weather—bring up the issues, but do not help the audience to deal with the facts. Psychological mechanisms can even lead to misunderstanding, flight into alternative facts, disbelief or pushing it aside. Here, we need art to engage with the audience, to embed knowledge of this news in our social mechanisms and cultural background.

Art, then, not only communicates with the audience, it also collaborates with science and other partners to develop relevant strategies. Accordingly, art-science collaborations can contribute to the scientific process and the development of sustainable strategies, or even help to carry out thought experiments. This is not science fiction; it is the evaluation of possible strategies for helping to understand the complex mechanisms at work in strategies for combating the biodiversity crisis.

My work supports these collaborations, but it also researches the processes between artist and scientist, art and science, to help others understand and adopt these processes. I try to understand what these collaborations are: the process and the outcome, what the process does to people, what they feel when they engage, and what the organizations commit to. How can we then use the outcomes? What outcome are we interested in? Is it because it's an interesting artwork or because it reaches the audience in a specific way? Or is the art interesting because it is innovative and can be used in society for the greater good, or for something else? As we have all these different processes and dependencies for evaluating art-science collaboration, it is difficult to say that there always will be good communication and an innovative outcome, but the more we know about these processes, the easier it is to prepare the coincidences or serendipity that we want to make happen in art-science collaboration and create productive processes.

When I started this research about 15 years ago, the first step was to understand how art and culture engage with organizations, and vice versa. How not just to use the arts as instrumentalization, but also artistic and static experiences to challenge certain routines and understandings, and create new ways of engaging with the world. This can offer interesting contributions to the development of human resources, teamwork, organizational culture and organizational strategy, and processes such as creativity and innovation. Again, the aesthetic and experiential aspect of art is an important component in understanding why art in other contexts, for example an artistic intervention in an organization, is so powerful. Addressing the senses and experience, and connecting to cultural backgrounds and values are important factors for learning

processes, interaction and engagement.

As creativity and innovation will be needed to find new strategies to address the biodiversity crisis, I want to shift the focus specifically to these two phenomena. A vast body of literature investigates creativity and innovation as social scientific, organizational, economic, cultural and psychological processes and contextualized phenomena. Using the lens of existing theories in these fields helps to explain what happens between artists and scientists in their collaborative practice. It helps to understand how the friction in these interactions on the border between art and science feeds into the individual and social processes that are needed to make creativity and innovation happen. Only intense exchange and deep engagement in this joint process serve to enrich both perspectives and give artists and scientists new insights and hands-on learning to feed into their individual and joint creative process.

In my work, I like to research these processes, but I also like to apply what I learn to the art-science projects that I love to curate. As you see in this second image, I engage in art-science projects and bring them not only into organizations but also into the world. I want to sow a lot of seeds to grow roots in many different places, to guide these art-science processes.

These seeds also need to be sown in organizations. We should not forget that we often have to deal with organizations. We are either invited to carry out projects in or with the help of organizations: universities, scientific, political and economic associations, and funding bodies. We need to learn to apply what we find using different scientific perspectives and in art-science projects to their respective organizational logic. The logic of organization is also connected to the structures and specific goals in a respective field, such as efficiency, micro- and macro-political dependencies, and goals of both non-profit and for-profit organizations, etc. We therefore need to learn to communicate about shared goals, such as tackling biodiversity crisis, by connecting to these specific organizational logics. This is also an argument for supporting projects, strategies, or art-science initiatives. Ultimately, if they can be reached, they are stakeholders as well as impactful partners. Research in art-science processes based on organizational, social, cultural and economic theories enriches conversations

with organizational partners and provides vocabularies and access points to connect to organizational logics.

Question:

How do art and science collaborations help to promote non-anthropocentric views and practices? Can you give an example?

The Traveling Plant is a project by Tatiana Kourochkina, Annick Bureau, Robertina Šebjanič, Marta de Menezes and myself. The aim is to create a global network of projects on the theme of plants, which involves talking about plants and relating to them in a non-anthropocentric way. We invite projects, events and exhibitions based on ideas about plants, put them in their local context, share them with the global network, and facilitate a discussion without an anthropocentric or anthropomorphic bias. The project itself also tries to turn around typical curatorial and culture-consumption processes by creating new ways of organizing, distributing and curating projects in a global network on one theme.

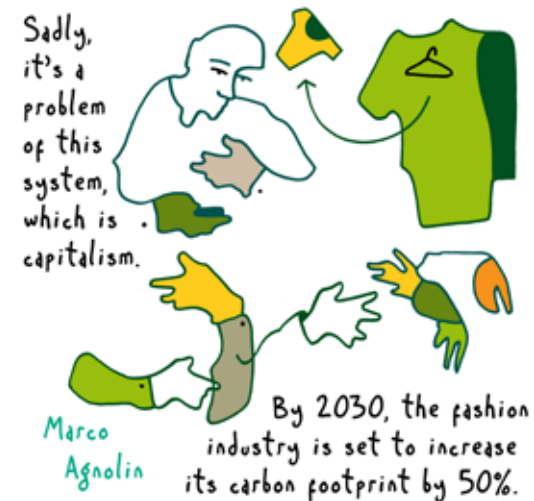
Another project, of course, is the *Roots & Seeds XXI* project. Meeting here, discussing a shared idea among all these disciplines, we are beginning art-science processes, getting inspired, sharing our disciplinary insights with others, but we are also integrating knowledge based on the logic of other disciplines into our own thinking. By finally sharing the art-science outcome of this project, we are reaching out to a broader audience.

III. SHIFTING PRACTICES

[RETHINKING OUR ENVIRONMENTAL IMPACT]

MARCO AGNOLIN (ITALY)

Economist that specializes in the textile industry and the fashion sector. Former CEO of Bershka and Diesel, he started A Better Mistake, a new sustainable fashion brand, far from the throwaway model.



The link between fashion and carbon is a vicious one, because we are used to seeing fashion in a very shiny bling-bling way, with catalogues, events, a lot of craftsmanship, and even a lot of art and creativity. But there is another side to the fashion business: a B-side, which is unfortunately the bad one. Most of you will know that the textile industry is the second most polluting industry after the petrol industry.

I'm just going to scare you with some figures that you already know, because everybody has heard the story of how many litres of water are needed, from growing the raw material to reaching the final consumer. We are talking about many litres and many kilos of CO₂ that is going directly into the environment.

In 2015, the oil industry consumed 79 billion cubic metres of water. I don't know what that is, but it is certainly a lot, and there has been no improvement despite the efforts of

lawmakers, institutions and governments. Even consumers have been more aware of these problems for many years now. This figure is increasing year after year, regardless of different policies, attitudes and methodologies. In fact, last year it rose from 79 to 93 billion cubic metres of water consumed. This is only one part of the problem, because we have many others and they affect us every day. If you buy a T-shirt you are consuming 2700 kilos of water from the growing of the cotton to its arrival in your wardrobe.

These are just some examples of how much this industry is affecting the environment. The fashion industry is responsible for 10% of the annual carbon footprint, more than all the emissions from aircraft and shipping companies in the world. And it's getting worse because of the growth in population, and is set to increase 50% by 2030.

This is really impactful. And it is not only a matter of water or carbon; it is also a problem of plastic, because we're always talking about microplastics in the ocean or in the earth, but we never think about the textile industry. We think about other sectors like food and beverage distribution, but the fact is that a third of the microplastics in the oceans come from the textile industry. It's incredible how many microplastics are contained in garments, and some 80% of them are released into the land.

I used to work for this fantastic group, Inditex, which besides Zara owns also Bershka, where I was CEO. I can ensure you that the group is very conscious of this problem and is investing in an attempt to improve and to diminish the group's carbon footprint. However, it is a difficult issue when you think that the Inditex Group distributes 1.7 billion items of clothing in the world market every single year. The clothing industry produces and distributes over 50 billion items every year. Imagine 80% of this being burned, put into land waste and causing pollution all over the world.

Something is changing. It is changing because lawmakers, governments and institutions are trying to make a change. But the most important factor is the customer. Younger millennials and the Z generation are the clients of the fashion industry, and they are very aware. They may not know the figures and processes, but they do know that what makes them choose a brand or a product is sustainability, followed by the style, look

and use of the garment. But first they want to know if your brand, your company, your product, is sustainable. This is the dramatic change, because all the rest is very difficult. Just two days ago we heard some great news: Maersk, one of the biggest shipping companies, is building the first carbon-neutral methanol container ship. This is great news, because in the value chain of the textile industry, 40% of emissions are caused by transporting billions of items back and forth from the Far East to Europe and the USA. This will help a lot, but it's just the start.

Big companies like Levi's, where 90% of products are based on cotton, are promising that 100% of their production is going to be made of sustainable cotton. This is the big problem causing the biodiversity crisis. Cotton is still by far the most important raw material in the textile industry. Despite the use of organic cotton or the Better Cotton Initiative, at the end of the day this plant consumes a lot of water, uses pesticides and devastates biodiversity. And it's not only because of the millions of hectares dedicated to cotton: they also absorb a lot of water from the surrounding areas, killing many species.

Of course there are many initiatives and a lot of associations, governments and companies trying to improve the cotton policy in terms of environmental preservation. For instance, last year, we recorded an improved organic cotton production. Organic cotton is, of course, the best in this sense. More of this fibre was harvested than ever last year, and many farmers are improving their organic cotton fields. Is this good news? I don't think so: only 4% of the world's cotton production is organic.

Beyond greenwashing—because this is the reality—what is the solution? It is very difficult. Many companies are trying to make changes; hemp is a fantastic opportunity. There is a US sustainable shoe company that has designed shoes using hemp. This material has a lot of advantages in terms of quality and it uses regenerative farming practices. All the advantages of hemp are well known and publicized, but we are still talking about just 0.2% of the industry's raw materials.

Other companies are doing interesting things, too. Adidas, along with other big groups, has developed the Infinited Fiber Company. They invented Infinna, a great material based on household textile waste. Old garments are collected and put

together to produce a yarn with fantastic qualities: it is biodegradable, contains no microplastics and is totally recyclable. The cycle can be continuous, which is why it is called Infinna: it is infinite. This is very interesting, but once again it is a drop in the ocean. Another interesting initiative is chitosan, made from the exoskeleton of crabs, lobsters and shrimps. Artists and scientists are studying fantastic materials, but it is a very long process.

Ultimately, the only thing that can prevent the textile industry from contaminating and devastating biodiversity is, unfortunately, to downscale. This means that each of us should buy a fifth of what we used to, and this is a dramatic change in habits. It is also possibly not sustainable economically, because behind the textile industry there are families, industries, money and social welfare. It is a very big problem and, unfortunately, I cannot see a solution in the next 20 years.

Question:

The UK government is raising the taxes paid by industry; do you think the change might be happening?

Actually, it is not only in the UK. The European Community is drafting a bill that would have a major impact on fast-fashion companies. It is a law that would make producers responsible for the whole lifecycle of their garments. If you produce and sell garments, you have to provide all the means and infrastructure to collect and reuse them. But again, considering the dimensions of the industry, it would be impossible to do this in a couple of years; it would take 10 or 15. Meanwhile, how many millions of items are going to be thrown out into the environment?

Question:

You say that big companies are aware of this problem but cannot stop the machine. Why do people in these big groups keep expanding and investing in an activity that they know to be harmful to the environment?

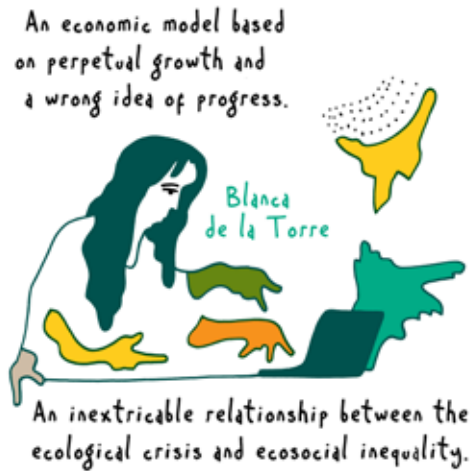
This is a more philosophical, ethical and social problem: capitalism. Companies—especially if they are listed on the

stock exchange—have to grow, and this is not a choice. As a society, we accept that we have to change our values and the entire social system. It is not a problem of big or small companies; it is, regrettably, a kind of law of survival—a company needs to grow. And if Inditex wants to change its policy from one day to the next by downsizing, it would probably have to lay off a third of its 180 thousand employees. But it has to be responsible for these families, so it is not a problem of one particular company or certain big corporations. I think that this is not the way to view it. Sadly, it's a problem of this system, which is capitalism.

There are other ways of thinking about capitalism. For example, Rutger Bregman, a writer and historian, theorizes about a different form of capitalism in a democracy, but in a very sustainable way. This is something that was even tried out in the Middle Ages: small communities with different values and different targets gauged people's wellness in a society based not on wealth but on welfare and other values. This is not a utopia; it is something that we can achieve and must really fight for.

BLANCA DE LA TORRE (SPAIN)

Curator who works at the intersection of art, cultural studies, ecology and sustainable practices. From 2020 to 2022 she was chief curator of the XV Cuenca Biennial (Ecuador) and responsible for the Aula Sostenible at CAAM, a permanent space dedicated to art and sustainability at the Museum of Contemporary Art in Las Palmas de Gran Canaria.



The 15th Cuenca International Biennale (Ecuador) will open in December with the goal of being as sustainable as possible, according to strict criteria of sustainability. The conceptual theme addresses some of the imbalances generated by the climate and socioecological crisis, based on three axes: ancestral and traditional knowledge, critical ecofeminism and possible futures.

For this presentation, I focus on my latest project at the MoCAB, the Contemporary Art Museum in Belgrade: *Overview Effect*, co-directed with Eric Zoran, chief curator at the Museum. The term overview effect was coined by Frank White in 1987 to describe the cognitive shift reported by a number of astronauts having looked back from space to Earth.

We thought this would be a good concept to explore the complexity of ecological problems and the inseparable links between them and issues such as corporate imperialism, indigenous sovereignty, gender, different kinds of extractivism and the importance of decolonizing not just history but also our concept of nature in order to shape an inclusive mindset akin to a post-anthropocentric world.

The curatorial strategy explores alternative exhibition-making formats and responds to the rhizomatic idea of ECO_LABS, with six realms representing distinct sub-themes, all interconnected.

GENDER, RACE AND THE COLONIAL TRACE

There is an inextricable relationship between the ecological crisis and the different forms of ecosocial inequality interlinked with race, gender and the trace of colonialism. It is therefore very important to decolonize our research methodologies, adopting new ones that acknowledge the voices of the historically oppressed others directly related to the exploitation of nature.

THERE IS NO EDGE!

We have entered the era of the limits of the Earth as a consequence of an economic model based on perpetual growth and a wrong idea of progress. Multiple forms of environmental damages are explored here, such as loss of biodiversity, massive extinctions, pollution, food sovereignty and different forms of extractivism derived from the climate crisis and other ecological problems that have led us towards a global unsustainable system.

WATERTOPIAS

Water will be a key protagonist of our world in the near future due to its scarcity, making it as valuable as gold, oil or life itself. By 2050, at least 25% of the world's population will be affected by the shortage of fresh water, triggering huge human exoduses and changing global geopolitics. Water scarcity, rising

sea levels, floods, water pollution, underwater life extinction, corporate control of river systems and the privatization of water resources, among others, are problems that need to be addressed urgently.

BEYOND ANTHROPOCENTRISM

Posthuman lines of thought question the anthropocentrism that focuses on the dualism of inside and outside nature. It is important to conceive alternative modes of collaboration between humans and non-humans that pay attention to multi-species coexistence. To this end, we need to envision symbolic and practical gestures that move towards new alliances with non-human entities, acknowledging the critical importance of interspecies dependencies as the only fair path towards a new post-anthropocentric age.

LEARNING FROM INDIGENOUS KNOWLEDGE

Environmental exploitation and Western forms of extractivism, of land and resources, raise the question of the immediate survival of entire communities. There is also a need to foster new social and aesthetic practices that go beyond the traditional Western system of thought and embrace other epistemologies based on or inspired by indigenous and first nation communities. We need to open up spaces for indigenous discursivity that negotiate different systems of knowledge.

BACK TO THE FUTURE

To respond to the anxiety caused by the perpetual possibility of ecological and societal collapse, we should reimagine the concept of future, connecting the past, present and possibilities based on uncertainty. In order to do so, we have to find the means to renegotiate collective present memory, but also the eventuality of a future memory as well as the construction of utopian and dystopian imaginaries to rethink the world we want to live in.

Each ECO_LAB will take on the role of a think tank for art,

action and knowledge production related to the sub-themes derived from the overall concept, within the overall methodological approach to the exhibition. The ECO_LABS will create a dynamic, revolving structure that builds on transversality as key way of thinking and establish a transdisciplinary approach, combining disciplines such as the arts, humanities and social sciences.

Our goal is to create an exhibition that is about ecology in both content and form. To ensure that the project is consistent with this aim, the curatorial proposal was deliberately guided by ways of doing, with a view to finding more ethical forms of consumption. A number of guidelines were established to control the carbon footprint of the whole show, avoiding pollutants, petrol-derived materials and air transport of artworks in favour of local production, and biodegradable, repurposed and recycled materials. A waste plan and a general plan to reduce energy were also drawn up for the museum. Aware of the impossibility of creating a totally sustainable exhibition and embracing all the attendant contradictions, we also offset emissions at the end of the project.

Question:

The general public doesn't usually associate art with waste, toxic elements or carbon footprints. Could you tell us about your sustainability guidelines?

The ones underlying this project are similar to those of the Cuenca Biennale, but in Ecuador we are working more with local artisans and communities of women, and we also drafted a stricter waste plan, among other things.

A crucial point is related to shipping, only using ground transport in Belgrade, and trying to avoid it as far as possible. We also try to produce everything locally; for instance, we asked the artists not to ship photographs and send digital files instead, and then produced and printed them with a local lab. We avoided any kind of pollutants or toxic materials, and tried to reduce materials to a minimum. We reused all the museography materials and infrastructures from previous exhibitions,

and used the original structure of the place instead of building new walls. We also designed a waste plan and an energy plan, and we will recycle and reduce the materials afterwards.

To me, it is about the importance of degrowth rather than trying to find amazing new sustainable materials. I think the cultural and art sectors are not aware of their carbon footprints. We still think that it's enough to theorize on political ecology, and that we are already doing our part just by sitting in our academic chairs, and simply researching and writing essays on the climate crisis. But this is not enough anymore; we have reached the point where we need to act, and the time is now. Culture has to be a call to action, not just a call to thought. Of course we have to change the narratives, but the discourse has to go hand-in-hand with action, otherwise it becomes deactivated.

We need to take responsibility, and this is something that goes far beyond the discourse and all those essays. It is quite pretentious to say that I'm doing my part just by telling you what to do, I'm a researcher on this, this is what is happening. Yes, but what am I doing to change it? That's what I am trying to do with my projects.

ROBERTINA SEBJANIC (SLOVENIA)

Internationally recognized artist, whose work revolves around the biological, chemical, political and cultural realities of aquatic environments and explores the impact of humanity on other species and on the rights of non-human entities, at the same time that she calls for emphatic strategies towards other species to be adopted. In her analysis of the Anthropocene theoretical framework, the artist uses the term "aquatocene" and "aquaforming" to refer to the impact of human beings on aquatic environments.



My head is full of responses to the speakers who have preceded me. I think that what is happening at this conference is that we are resonating with each other, and it is really great that we could come together physically and not just in the squares of a Zoom video conference. I work a lot with different interactions and try to understand what we are dealing with and how we deal with other species.

For seven years, I worked mostly in aquatic environments. In a way I was drowned in it. I feel very deeply connected to it and to the creatures that are beyond our perception—creatures we don't see every day. I always find it interesting to enter

levels that are a little more hidden, especially entering other spaces. My first encounter was very naïve, I have to say. This was when I began recording water sounds, starting with the idea of recording sounds of bioacoustics, like fish songs.

In 2014, while attending a residency in Izmir, Turkey, I found myself in the Gulf of Izmir with a hydrophone trying to record sounds of swarms of jellyfish and other marine animals living in this part of the Mediterranean Sea. Listening to the material I recorded, I was astonished to find that my hydrophone picked up so many sounds of boats, ships and other human-made artefacts. I tried hard to filter them from my recordings to get true, authentic sounds of marine life but did not succeed.

The recordings of this reality affected me deeply and left a lasting impression. The more I listened to the human tech presence, the more I realized it would make no sense to try and “photoshop” the sonic reality of the sea. I was interested in the real soundscape of the underwater world, biodiversity and our imprint on it. So I started to investigate the phenomenon of human-made underwater noise pollution, resulting in my ongoing sound artwork *Aquatocene/Subaquatic Quest for Serenity*.

The oceans are an industrial zone, and this is a huge problem. We still do not know how to get past this and understand that we cannot just use it for our own pleasure for holidays and surfing. Of course, this is good, because we are working with nature, but it is also important to understand how we do it.

For *Roots & Seeds XXI*, I decided to speak about a project that is like mine. In 2011, I started to collaborate with Doctor Špela Petrič, an artist, researcher and scientist. This collaboration was my first direct interaction with someone from the scientific world. We challenged each other a lot. It was a project in which I included myself, and my brain had to think about more than a human context and how to understand this kind of multispecies perception. With Humalga, we started speculating about humans having to rethink our bodily boundaries.

By working to prove a concept, we applied practical results to philosophical observations. In its conceptual framework, Humalga was a broad project and provided good points of

entry for understanding the human-plant relationship. Changes such as longevity are not just sci-fi; it is already happening in our society. Thanks to efficient medicine, more people live longer and better—those who can afford it; we still live in a world where the quality of life depends on geographical, cultural and social latitude and longitude.

Extending human life would also mean a watershed moment between the generations, because the age difference between parents and children is constantly increasing. Prolonging life would also create more time, which humanity needs when it comes to space travel. For now, travelling in the range of our solar system needs another generation and therefore seems impossible. However, that could change in future decades. New knowledge is always waiting to be learned, and new concepts and ideas to be accepted and critically rethought. I think that a state of constant curiosity is a driving force in my work.

It was an international project during which I met Annick Bureau and Manuela de Barros, and the initial presentation in France was curated by Ewen, who is also here today, so it definitely looks like an inside job! Then, when we developed the human algae concept, Ewen met scientist Doctor Xavier Bailly, who invited me and Špela Petrič to be resident artists in Roscoff, a marine station in France. There, we got to know a species called *Symsagittifera roscoffensis*, also known as the Roscoff worm, an animal that coexists with algae.

I would like to refer briefly to some thoughts that Marco Agnolin shared earlier on this panel. I am glad to be on the same panel because we share opinions about underwater/water industrialization. The number of goods being transported by sea is increasing every year, which contributes to the noise pollution of the world’s oceans and seas that I refer to in my ongoing project *Aquatocene*.

I would also like to highlight a new collaboration with the artists Sofia Crespo and Feileacan McCormick to produce a case study of the extinction of *Pinna nobilis*, a fan mussel in the Adriatic Sea. The project was carried out in summer 2021 at HEKA laboratory during a PINA residency in Koper. For the technical part we took remote sensing data from the last 30 years showing changes in temperature, salinity and TDS in

the Northern Adriatic and combined it with real-time research data that we collected that summer. We used machine learning and artificial intelligence technology, remote sensing technologies (EU Copernicus data) and real-time data.

I think using data to explain a narrative is a great use. With this project, we aim to show the large-scale changes in the marine environment caused by human presence, and imagine how the new conditions (rising sea levels and water temperatures, new chemical composition) are reflected in its inhabitants.

Thank you for listening. This is a great event and I am happy to be able to share my thoughts with all of you in this short presentation.

JORDI JUANÓS AMPERI (SPAIN)

Director of Plant for The Planet, an organization that aims to create awareness among children and adults about the problems of climate change and global justice. The initiative also works to plant trees, and sees this as a practical and symbolic action, in efforts to reduce the effect of climate change.



When you invited me to *Roots & Seeds XXI*, I immediately accepted. I work with the Plant-for-the-Planet Foundation in Spain, where we promote reforestation around the world as one of the best ways to meet the objectives of the 2015 Paris Agreement on Climate Change. We know that we need to reduce the effects of CO₂ emissions worldwide, and our aim is to do it through reforestation.

Promoting reforestation is one of the best ways to address the excess carbon dioxide in the atmosphere, and we work to involve communities and people around the world. Myself, Plant-for-the-Planet or the people here in this room today cannot do this alone. We need to share the idea with the whole world and its people. Which is why Plant-for-the-Planet decided to target children and young people.

Plant-for-the-Planet is working to encourage the planting of as many trees as possible. We have a huge worldwide project called the Trillion Tree Campaign to plant this number of trees

by the end of 2050. This is the best and maybe the cheapest way, at least for the moment, with existing technology.

But Plant-for-the-Planet also wants to plant another kind of seed, which is why we target children. Children are the next generation. In 15 years from now, those children will be here, in our places. This is not populism; it is true. In 15 years from now, they will be the leaders of companies, public institutions and NGOs. And if we can get inside their heads and teach them another way of understanding the world and their lives, it will be great for the future—and for the planet. This is why we are trying to educate them and help them to achieve their goals so that when they can make their own decisions, they include the environmental aspect. This is very important for us—it is our contribution to the future.

Plant-for-the-Planet is an intergenerational project. It is not for now, it is for 15, 20 or 50 years from now. It is the best way to contribute to the things we are talking about at this event.

When Quo Artis invited me to take part in this event, I accepted, because I have spent my entire life taking part in different actions for the same purpose. For instance, I spent a long time trying to involve artists and culture in environmental issues, because environmentalists are not great communicators. Of course, there are some very good exceptions, but we are always talking about the same things: figures, trees, technical issues. It would be great to include people from the arts and culture—singers, sculptors, painters—but also from the health sector, or any other field you can imagine, because these people think in another way. If you try to communicate the message about the environment in another, non-traditional way, from an artistic viewpoint, maybe it would be easier for people to understand.

This is the most important thing about this event for me. This is the first time in my life that I have been able to share it with artists and other sectors. And I strongly recommend including other sectors, such as health; health is the next frontier for environmental care and everything we are talking about, because health is the next topic to relate with reforestation.

These people will be the future—in fact, they are the future. I think that maybe the best investment for the future is getting them involved in both environmental and artistic issues.

Question:

Could you tell us about your work with companies that are trying to neutralize carbon emissions?

One of our main activities is to help companies—and public institutions and any other associations around the world—to become carbon-neutral, as soon as they can, or as soon as they want. We help by advising them about the best way to achieve carbon neutrality. A lot of companies consider becoming carbon-neutral as a commercial opportunity, and personally I absolutely agree; as Marco said before, a company has to have benefits. It doesn't really matter what the purpose of the company is (of course, yes, I am just joking); we just try to help through reforestation.

Some companies want to go a little bit further and become positive in their emissions. This means they calculate their emissions, then reduce them as much as they can. But there are emissions that cannot be reduced, so they have to compensate. If you compensate the total amount of your emissions, by planting trees, say, you become carbon-neutral. And if, for example, you plant a thousand more than the number of trees you need to become carbon-neutral, you become positive in your carbon footprint. This is a very new way of understand this situation. In Barcelona there is an organic supermarket called Veritas. It became positive in its emissions because it plants more trees than the number it needed to become carbon-neutral. This is a very innovative approach.

In Plant-for-the-Planet, we have a web app, at www.plant-for-the-planet.org, with over 165 different reforestation projects around the world. You can donate trees to become carbon-neutral, as a company or as an individual, because as individuals we also have the responsibility to contribute to the carbon neutrality of the planet. Each of us has our own carbon footprint. It is our responsibility, not just the government's or the company's responsibility, to contribute to becoming neutral, for the planet to be as liveable as possible.

IV. SUSTAINABLE ALTERNATIVES

[AGRICULTURE AND URBAN CHANGES]

NACHO PERES (SPAIN)

Farmer specialist in permaculture, biodynamic and regenerative agriculture. He investigates horticultural varieties and techniques around the world for their introduction into local productions. He is currently responsible for organic production at the Ferrer Sustainability Foundation.



As a farmer, imbued with the humility that comes from working with the land, I am going to share some reflections to which the ancient profession of horticulture has led me. The sweeping crisis now affecting the development of all human disciplines and activities, including agriculture, seems to stem from a crisis of values and the dehumanization of these activities.

We have to put human beings and care of their environment back at the centre of sustainable action in any undertaking or activity. We need ground-breaking ideas and projects based on what nature teaches us and shows us without words: the tendency to balance. We have to get our creativity going and propose useful solutions. Human beings have developed many

disciplines and technologies. One example is permaculture, which, rather than a technique, protocol or method, is a philosophy or way of devising and designing optimized ecosystems that meet their own demands and respond to the viability and maximum use of the resources available to them. Its maxim would be: Invest all your energy in what interests you and not in fighting against what does not interest you.

There are no certificates or regulatory bodies attached to a term like regenerative agriculture; rather it relies on ethics, morality and the knowledge of the person carrying out the activity. The degree of regeneration may be subjective, and the priorities of a personal nature, but I believe that this is the only agriculture that we humans can allow ourselves today, and that it should be a basic, hygienic factor for any farmer. The added values, in my opinion, should start from this base, not be the base itself, and much less aim to obtain maximum production at minimum cost. We have to go beyond the present-day paradigms of certified organic farming.

Regenerative agriculture aims to propose solutions to the problems that the activity entails, such as degradation of fertile land, excessive consumption of fossil fuels, use of agrochemicals, water wastage, contamination or alteration of peripheral ecosystems, loss of botanical diversity and many other consequences that common sense tells us are undesirable. And somehow, that which seems desirable and logical also seems unattainable due to the inertia of the huge entity that we call the free market, which frequently seems to view human beings on an Excel sheet where only figures and results are valued.

The solutions to the degradation of the occupation, and therefore of individuals and their environment, involve integrating animal life into horticulture, since this is the only way to generate self-sufficient farm organisms. Agriculture has to establish links and relationships between all the modules and elements that make up the project as if it were an organism. Not from a mechanistic viewpoint, where the whole is the sum of its parts, but as something alive and organic that fuels itself and is capable of adapting and solving its own challenges.

It is clear, then, that we are talking not about agricultural techniques or performance parameters of a given certification, but a holistic way of understanding the relationships that need

to exist between the different parts that make up an organism (company, farm, building, community) for its optimal functioning as an entity within an ecosystem.

So-called conventional modern agricultural techniques work in a way that aims to imitate stable, fertile soil (like that of a forest) using machinery, technology and chemicals, but this is like imitating the flight of a dragonfly with a helicopter: it is a crude approximation to something sublime. By means of regenerative agriculture we seek to achieve edaphic fertility using natural processes, so that nature can truly manifest itself. We have to be farmers of microorganisms and fungi. We cannot ignore the earth's metabolic system. The mineralization of cultivated land seems to be linked to what we might call the mineralization or cooling of thinking, incentivized by obtaining the most precious mineral asset: money.

Many ideas and proposals in the five continents respond to this form of interaction between humankind and our environment. All are valid and yet different according to their circumstances, such as available resources, climate, needs and real ecological possibilities. The across-the-board extension of techniques, technology and genetics to the geography of the planet is one manifestation more of the loss of wealth, diversity and organic projects capable of adapting to specific circumstances and local contexts. Food sovereignty and the legacy for new generations involves the empowerment of every link in the task of producing food.

One of the maxims for a modern farmer should be: invest less in machinery and fuel, and as much as possible in soil fertility. Leave behind a legacy of land that is fertile, useful and decontaminated. Do not limit equilibrium processes. Guard your seeds like treasure and celebrate diversity.

The excessive specialization required by the conventional and even organic markets forces companies and projects in the sector to concentrate on each of the links in the value chain, from seed generation to the distribution of produce. We then lose the global thinking and the local action of our work.

As a farmer, I've always known that I'll never be competitive with the prices and techniques set by super storage, modern logistics, F1 hybrids, hydroponics and globalized super production in general, but I am convinced that I'm competitive in

coherence, respect and values. This led me, over 10 years back, to work for slow food restaurants. Today I do this wonderful activity as part of the Fundació Ferrer Sustainability.

Green for Good: Fundació Ferrer Sustainability is a living example of regenerative agriculture in the Pedralbes district of Barcelona.

The idea for the growing beds in the garden is *parades en crestell*, a Catalan permaculture system that meets the criteria of vegetable garden, aesthetics, harmony, ease of use and maximum productivity per square metre in the framework of ecological agriculture. It is a very widespread cultivation system in schools as it works with pedagogical objectives and is very complete in terms of sustainable criteria of soil fertility, rotation, companion planting, etc.

THE PROJECT IN TWO WORDS

INTEGRATION is one of the words that come up when thinking about the different areas of this activity. Seed, compost, tillage, harvest and logistics.

REGENERATION means back to basics and recovering or regenerating the work of the farmer in every aspect. Agriculture must be regenerative in order to improve its environment by working with it in a healthy way.

MANUELA DE BARROS (FRANCE)

Philosopher, art theorist, curator, professor at the University Paris 8 and invited professor at the Faculty of Philosophy and Letters of the National Autonomous University of Mexico. Author of the books “Duchamp & Malevitch” and “Arqueología de los Medios”. Her research focuses on the contemporary issues, in which she mixes the aesthetics and impact of techno-sciences industries on our representations and ways of life, as well as their political, ethical or ecological implications.



BIODIVERSITY, A SCIENTIFIC AND POLITICAL CONCEPT Université Paris 8¹ / TEAMeD²

This text was written from an oral intervention and has not been rewritten in a more literary form for publication. The author wanted to keep the original intention.

1 <https://www.univ-paris8.fr/>

2 <https://teamed.univ-paris8.fr/manuela-de-barros>

Since 1992 (Rio Conference on Environment and Development), biodiversity has become one of the central references in the discourse and legitimization of the practices of most environmental actors, both at the local level, with the implementation of the Natura 2000 directive, and at international level (Cartagena Protocol, 2000).

Our civilization(s) depends on the soil-water-biomass interconnection; it therefore ultimately depends on plants.

Plant organisms, and particularly flowering plants, differ from most animal organisms in remarkable ways. Plants are practically immobile and fixed in the soil. As a result, they are dependent on the environment around them.

The excessive appropriation of biomass by humans indicates a lack of understanding of ecosystems' needs of soil and water for regeneration. Biomass, an inherently renewable resource, is becoming a limiting and exhaustible resource in the Anthropocene.

After decades of serving just short-term performance, now agriculture, science, and technology have turned to questions and solutions for long-term resilience, changing political and scientific agendas.

However, there are questions about the territoriality of international claims, including actions affecting southern causes and whether they meet their goals. Or, in other words, observing whether international scientific conceptualization provides a framework for understanding local specific demands and taking them into account.

The point is to understand how public policies conceived at the international level affect the actors' representation of their interests. How are local interests taken into account in categories produced by supranational institutions? How can we piece back together global and local interests?

The interpretive thinking that constructs responses is subject to a similar process of readjustment between imported and pre-existing frameworks. We need to examine how public policies designed at the international level work with the representation that actors make of their interests and combine them with local interests, and how local interests are considered in categories produced by supranational institutions that do not always understand them.

While it has made it possible to set up a framework of interpretation that offers a diagnosis of reality, how has biodiversity, a scientific concept (as is sustainable development) also helped to produce injustice?

Epistemology shows that scientific concepts also have an ideological and political foundation. It is what Canguilhem calls epistemological discontinuity in a text³ in which he examines the political use of scientific theories. He develops an important idea, which is that rationality lies not in essence, but in use, or practice. This explains why the production of objective knowledge in the sciences (especially in life sciences) takes place within a scheme of subjective values.

Ideology then makes up for the lack of precision and rigour in the definition by projecting onto it ideas and values that are foreign to it, but which in turn legitimize social practices, and political and economic order. This can lead to self-justification in the interests of a specific type of society. In the case of biodiversity, this is the industrial society, which conflicts with traditional societies.

Traditional societies are not only exogenous to industrial society, they can occupy the same territory and be parallel. One example is the closure of herbalist shops, considered illegal after a European Parliament decree in 2004 influenced by pharmaceutical lobbies. This is accompanied, in France at least, by attacks against traditional medicines, including those that have been known to be effective for thousands of years, such as traditional Chinese medicine (with, for example, febrifugine, a hydrangea derivative, or artemisinin, for malaria and autoimmune diseases).

The porosity between the interpretative frameworks of biodiversity arising in the wake of the Rio Conference and those of alter-globalists and anti-capitalism is undoubtedly a reflection of this tension between global and local.

In other words, even if we consider ecology to be the common political focus, it is clear that there are different and even opposing ways of looking at it.

3 Georges Canguilhem : *Idéologie et rationalité dans l'histoire des sciences de la vie*, 1977.

One question is notably problematic: Should social demands be integrated into environmental considerations?

Most NGOs in the environmental sector have long taken the view that they should not, since from the outset their aim has been to produce environmental public policy, often at international level, reflecting their primary identity as networks of scholars invested in the defence of a decontextualized, even universalized, idealized nature.

A contrasted example is ethnobotany, which aims to link the protection of plants and the interests of local populations, because this strategy would constitute the only real development policy protecting population as well as biodiversity, i.e., preventing the disappearance of plants necessary to the ecosystem, or even constituting a resource in medical matters.

But as ethnobotany has shown, things are even more complicated. While big companies have an enormous capacity for environmental destruction, local populations may also be at the source of excessive exploitation, such as the excessive gathering of medicinal plants in Himalaya due to international demand.

This probably means that other steps should be added to changes in political and scientific agendas, such as education.

There is probably no knowledge *per se*. The best way would be to compare and cross-fertilize knowledge and views: scientific rationality, fieldwork observations and vernacular wisdom. Because the world is not a factory, but nor is it a natural place anymore, and local and global have to deal with each other all the time.

ALEJANDRO RUEDA GÓMEZ

(COLOMBIA)

Environmental, Economic and Social Sustainability, new generation agriculturist. He is Strategy & Finances Associate of a vertical farming company based in Barcelona.



Let's start with the big challenge of the 21st century. We have a current food system that cannot feed our growing population within our planetary limits. I think by now we all know that agriculture is the biggest threat to biodiversity. It is the biggest driver of deforestation and is responsible for about one-third of global greenhouse gas emissions, as well as the biggest share of water consumption and pollution.

To add to this, climate change is going to decrease agriculture productivity, and we need to increase the amount of food we produce because we have both a growth in population and in income, calling for greater demand. The United Nations estimates that we need to produce almost 70% more than we are producing now. This is where we are heading; this

is the world with a three-degree temperature increase. We are on a fast track heading towards this. In this world, the tropics will have a temperature similar to the one that is only found in some parts of the Sahara. It means that many areas won't be able to grow food, and the people affected won't be able to survive. As Professor Julian Cribb says: "Food is the greatest weapon of peace available to humanity." We are at great risk right now, with an increase of just 1.2 degrees. Already we are seeing famine in Madagascar, a heat dome in the US West that is threatening the food system there, and crops collapsing in many parts of the world.

This will be intense especially in tropical cities, where 1.5 billion people live—85% of the world's poorest with a high urbanization rate. This will increase with the migration caused by climate change. This is a pessimistic view, but we can still stop this. The question, then, is: How can we feed a growing population in a healthy, sustainable way? I would say this is the biggest challenge humanity has faced. The *Lancet* Commission asked this question to a group of 60 scientists, and they developed a fantastic paper, in 2019, with the guidelines. They said that to feed a growing population within our planetary limits, we need to use no additional land, we need to save our biodiversity, reduce water use, reduce fossil use in the agricultural industry (which is highly dependent), reduce pollution of water sources and the oceans, and do this with zero greenhouse gas emissions.

This is quite a checklist. The Commission calls for a major food transformation to do this; many people and many tools would need to be involved. This is what I'm working on. Ultimately we need a food production system that produces more with fewer resources, less land and less water, and protects crops from major climatic variation. So, where I am working is one of the tools. You will hear a lot about vertical farming. It is not the silver bullet, it is not the only solution, but it is one of the tools. It is important to specify this: we need the collaboration of everybody, vertical farming, permaculture, and a conversation with traditional agricultural systems.

Vertical farming has many faces. It is very diverse at the moment. There are three types of vertical farming systems. One is a stacked system of food production; the second is food

production in terraces, and the third is, at present, only conceptual: buildings designed only to produce food, in cities. Broadly speaking, the simplest definition of vertical farming is growing food upwards rather than outwards.

There are a lot of talks, papers and research about systems that can bring food production back to cities. In a collaboration with the Institute of Environmental Science and Technology (ICTA, Barcelona), we did a conceptual design for the Wageningen University urban greenhouse competition. We won the challenge with this system, applying a lot of what ICTA has developed. It is food production using the building's resources and connecting them to the resources of the city. We need to create circularity in the food system, making a complete circle between food waste and food.

This is where I am currently working: a vertical farm near Barcelona, in Barberà del Vallès. It is food produced in a controlled environment with a hydroponic system. Using this system in a small warehouse, about 20 kilometres from Barcelona, in 300 square metres we produce the same as 1.2 hectares of traditional farm land. It increases productivity times and production per square metre, with some 40 times more production a year. Most importantly, especially for the Mediterranean region in the coming years, we would use 94% less water. There are already farmers in the south who are struggling with water scarcity and floods. This year, for example, we almost reached drought alarm, and this will be a regular occurrence in coming years. If we want to keep producing food here in the Mediterranean, we will need control and protection from the heat using far less water. This reduces pollution of water sources, protects biodiversity and avoids deforestation. It is a way to bring food production back into cities.

Question:

It is a very good point that there is no single solution, but that all sectors everywhere should combine different techniques. In vertical agriculture you also take part in the revolution of packaging materials. You are moving away from the model used in industrial agriculture and searching for more sustainable packaging.

The relationship between food and plastics is a difficult one; plastic has so far been one of the best ways to transport food and avoid waste. However, we did a lot of research and finally found two types of packaging with a sustainable source that can then be composted. Consumers have to realize the importance of breaking this relationship between fresh food and plastic. It is possible.

JOAN RIERADEVALL PONS

(SPAIN)

Doctor in Chemical Sciences (Chemical Engineering), scientific collaborator of the Sostenipra research group of the Institute of Environmental Science and Technology (ICTA) María de Maeztu Center of Excellence of the Autonomous University of Barcelona. He is the founding partner of Inèdit Innova and Tectum Garden, a spin-off from UAB.



This presentation connects with the last, by Alejandro Ruedas, just changing the scale to the city.

This image of coloured squares, like a Rubik's cube, is an example of a roof integrated into a building to produce food: a self-sufficient building producing food for the people who work and live there. Our project, Sostenipra, is a start-up created ten years ago to find a way of producing food in cities, analysing not just food, but also water, energy, waste and other aspects.

One of the biggest global problems is the one addressed by this event: the loss of biodiversity and its consequences. To explore these issues, we need to focus our attention, now and in the future, on food, cities and materials.

The image I'm showing you is a city observed by a drone. As you can see, cities are deserts. The majority of city roofs around the world are not productive, with just a few hotels using them for parties or swimming pools; 50% of the surface of cities is total desert. And our idea is to change that.

In cities, there is a lot of solar radiation and a lot of rainwater. This is the most interesting thing about cities: the rainwater that is not used. We propose a process to promote its use as the first step. It is one of the most important resource in a city, and the other is solar energy. By using them together, we can produce urban food, and the idea is to analyse the necessary systems. For instance, in the case of the roof, this means optimized integration and use of these different levels of the city.

The idea is to combine water, energy and food, and transform the city into a new model, with the aim of promoting social, economic and environmental aspects, and a more efficient future. So, what is the future?

XAVIER GABARRELL DURANY (SPAIN)

Professor of the Department of Chemistry, Biology and Environment Engineering at the UAB), is director of ICTA-UAB and Coordinating Scientist of SMARTER at ECIU University. He leads the Industrial Ecology research group called Sostenipra and the Fertilecity Project.



The future is like the present; we'll have the same problems. The last roundtable introduced environmental impacts, and, in this one, Nacho talked about permaculture and Alejandro about the vertical farm. We need resources to ensure life and biodiversity. If we have enough resources, water, radiation and nutrients, then we can enhance and improve biodiversity.

How can we do this? As we see it, rooftops offer us an opportunity, as Joan has said, with vast surfaces that have not been used up until now. Cities are the main producers of greenhouse gas emissions, half of which are due to buildings and food, for production, distribution, packaging, waste and so on.

We need to reduce greenhouse gas emissions in cities, so how can we do it? One way is to use the rooftops and harvest rainwater. In Barcelona, we have excellent solar radiation, so rooftop systems can be used to produce vegetables and increase biodiversity. The problem here is the lack of rain, so we would have to recirculate nutrients and wastewater; we can use nutrients from organic resources, but also from wastewater treatment plants. In our lab, for example, we are using struvite produced in an urban wastewater treatment plant from a precipitation process as a source of nitrogen and phosphorus.

The future means moving from a linear economy such as capitalism, as discussed in the last roundtable, to a circular model. This is the model we propose: To reduce resources, produce food and enhance biodiversity.



SHARED KNOWLEDGE

INTRO

Within this chapter, we incorporate two texts, which form a compilation of concepts, techniques, and methodologies put forth by *Roots & Seeds XXI* for the near and medium-term future.

What follows the introductory compilation of texts are “Methodologies” and “Collection of Art & Science Cases Addressing Societal Challenges” both texts authored by Claudia Schnugg

COMMON COOPERATIVE METHODOLOGY MANUAL

The field of art and science is more than an interdisciplinary field. It brings together various disciplines from the sciences and from the arts, but also includes technologies, thus engineering, perspectives from the humanities and social sciences, as well as the ambition to reach out to political actors and citizens in discourses that span nations and languages. Thus, it is interdisciplinary, intercultural and international, while it brings together a mix of ontological and epistemological reasoning at the same time.

Therefore, the partners of *Roots & Seeds XXI* (alias BioXXI) have come together to agree on a common cooperative methodology that represents their extensive experience in art and science projects. The methodology has been developed in the following steps:

- Development of joint values, methodologies, strategies and processes with contributions of all BioXXI partners at the kick off meeting as starting point for the cooperative methodology
- Development of internal methodology and external communication methodology based on the input of each partner in the project
- Feedback rounds on the draft methodology
- Focus groups that also invite the contribution and insights of external partners who are experienced in working at the intersection of art and science

The partners of the BioXXI project agree on the following methodologies: (1) common language as to what art and science practice is and what kind of impacts are expected, (2) the specific working methods, and how target groups can be engaged in (3) specific criteria for the open call selection (4) qualitative standards for the BioXXI co-created outcomes.

COMMON LANGUAGE AS TO WHAT ART AND SCIENCE PRACTICE IS AND EXPECTED IMPACTS

Art and science practices are characterized by bringing together perspectives, lines of thought, (research) methodologies, insights, and competencies from the arts and the sciences. Thereby, neither the arts nor the sciences are limited to a specific medium, method, or discipline when working together.¹

In the process of collaborative work, the arts and the sciences need to find strategies to work with each other, explore the collaborating partners' processes, insights, methods, and values, and find a common language. Thereby, it is essential for such joint practices that the collaborating partners take the time to get to know each other, learn about each other's approaches and perspectives, and find out about possible misunderstandings. Curiosity, patience, and openness to new

1 The following elaboration is based on the BioXXI partners' extensive experience with art and science practices, discussions between the team of Quo Artis and the BioXXI art and science practice expert advisor Claudia Schnugg, a focus group with contributions from Margherita Pevere, Maja Smrekar, Roland Aigner, Tatiana Kourochkina, Marco Agnolin, and Claudia Schnugg, and additional research by Claudia Schnugg as published in her book, *Claudia Schnugg: Creating ArtScience Collaboration – Bringing Value to Organizations*, Springer: Cham, DOI: <https://doi.org/10.1007/978-3-030-04549-4>.

knowledge and perspectives (as well as not being afraid not to know everything) are key traits in this process.

These key traits need to be supported by the collaborating partners' surroundings, for example, the organizations that they are embedded in, the expectations towards the collaboration process and the outcome, as well as the commissioning partners' expectations.

Scientists are usually embedded in organizations. Therefore, they do have a rather safe employment status and are paid for the time that they work. Organizations need to understand that collaborating with an artist is part of the scientists' professional work, which needs to be acknowledged within normal working hours within the scientists' tasks. Moreover, acknowledging the process and the outcomes of such collaborations in scientists' curricula or tasks is also an important contribution to successful collaborations, which are often impactful on a public engagement and outreach mission. It is important for organizations to understand this, as this will free up the necessary (time) resources of the scientist and help engage other partners or use resources such as laboratory time.

On the other hand, artists usually work self-employed. Thus, it is important for commissioning partners to acknowledge not only the outcomes, such as events, presentations, and artworks with a financial remuneration (production budget, budget for preparation and presentation), but also the artists' time engaging in such ongoing process with a reasonable artist fee. Especially, when the commissioning party is interested in supporting the process between artist and scientist, the time component is key, and thus artists need to invest time to make a strong collaborative process happen. For example, fair pay guidelines within the cultural sector or minimum fees for artwork presentation, and presence of the artist during events, can be used as guidelines, especially as these presentations, exhibitions, sales and commissioned works are the main source of income for artists. Within the field of art and science, much is expected from artists in the process stage, and concerning the production of challenging outcomes. So, especially organizations that aim at fostering these processes, should also set out in acknowledging the artists' efforts at the intersection of art and science at the financial level.

Due to the numerous expectations, languages (such as disciplinary jargon), organizational structures, and many entry points to the theme in this case biodiversity crisis– from artists and scientists, the processes between these two agents need to be guided. Best cases are those which have one curator and one or two facilitators/project managers supporting the collaboration.

The curator can work with the artists and the scientists on several levels, both on the content and their interaction:

- Translating ideas from artistic to scientific expression.
- Facilitating misunderstandings, intimidating situations, or when the collaborating partners do not find a common denominator in their conversation, talk past each other.
- Challenging them in their artistic and scientific thinking. The artist should not step back in order “not to scare” the scientist with their ideas; at the same time, the scientist should not shy back from diving deep into the scientific subject.
- Making connections within the field of art and science.
- Establishing connections among the artistic, art historical, and curatorial aspects.
- Establishing links with alternative scientific methodologies.
- Supporting the process that includes public engagement and outreach.
- Building trust.
- Forging links between cultural and scientific institutions.

The work between artists, scientists, and curators also depends on the experience² of the collaborating partners, previous knowledge on art and science processes and goals of the specific project.

2 Focus group member Margherita Pevere drew also from her research published in the article: Camilla Groth , Margherita Pevere , Kirsi Niinimäki & Pirjo Kääriäinen (2020) Conditions for experiential knowledge exchange in collaborative research across the sciences and creative practice, *CoDesign*, 16:4, 328-344, DOI: 10.1080/15710882.2020.1821713

At times, the curator may extend their reach to both the cultural and scientific partner organizations, aiding and expediting processes within them. The extent of involvement determines the level of tasks to be supported.

At the scientific institution, a project manager, facilitator, or scientific coordinator is needed to help connect to the organizational structures. The support that is needed ranges from practical issues such as organizing access codes, keys, laboratory time, official status to enter the organization, and security issues, to more fine-grained work such as establishing connections between relevant people, building trust to engage with the incoming artist or art and science project, creating awareness of the project within the organization, and raising interest. Moreover, slow processes and bureaucratic structures can lead to irritating situations for incoming people who are not used to them or who are used to working independently. The responsible person at the institution also helps in guiding through these situations and to explain them.

For example, one of the BioXXI partners underlined the importance of this facilitation process by citing one of the artists who was selected for two residencies with them at two different scientific partners. The two residency opportunities differed in the sense that in one place there was a strong facilitator who made sure that the organizational and personal dimension was supported in the process, and that the artist could meet as many relevant scientists as possible. In the other organization there was no clear responsibility for this, so the artist was very much on their own to push the process, and there might have been a lot having been missed out on.

On the side of the cultural institution, it is also necessary to have a project manager and facilitator. Mostly, the art and science collaboration does not directly take place at the cultural institution's sites, but there are organizational procedures that need to be taken care of and the cultural organization is often involved in the production and presentation of the outcome. For them, it is also important to get a good grasp on the scientific theme and context through broader discussions, in order to disseminate in a reliable and informed way.

Curators and commissioning partners need to be aware

that there is not one common language that can be relied on. A common language needs to be established in the process of each art and science collaboration. Artists and scientists do not only have diverse disciplinary backgrounds. Specific fields of science or of art also go along with fundamentally diverse ways of thinking, philosophical approaches to questions, ontological and epistemological differences in working and dealing with the world, scientific jargon and, above all, having diverse cultural backgrounds. Artists and scientists often work internationally, and so they cross boundaries of implicit cultural knowledge, deeply ingrained habits and even languages, as they often do not work in their native language. The following is crucial to create room for developing a shared language:

- Giving time to this process
- Allowing phases of reflection
- Giving space to facilitation and mediation
- Reflecting on the use of words (the word 'control' means something different in biological sciences than in political science or in vulgar use; the word 'interference' can be understood differently in software engineering, neuroscience, or media art, naming just two examples)
- Supporting personal openness for this process to find a common language
- Creating awareness of this process as something necessary

A few additional points which collaborating partners need to be aware of in art and science projects:

- Diplomacy is needed to bring together different actors
- Respecting the needs of the different actors
- Trying to engage everyone
- Making sure that every partner has a share in the common goal
- Not hesitating to start with seemingly impossible ideas, but try to find strategies to make them happen
- Regular feedback loops help stay on track and on a common ground

- Asking for support or clarification wherever and whenever necessary

2.

SPECIFIC WORKING METHODS

To guarantee a strong art and science project along the above mentioned values, the BioXXI project partners were be in regular exchange and gave feedback on the development of the numerous activities. Specific working methods include:

- Ensuring a diversity of perspectives in each activity, such as artistic, scientific, and art&science perspectives in the jury for the selection of the open call winners, or inviting artistic and scientific perspectives to the multidisciplinary garden cartography events and to the LASER events
- Regular feedback and input on the artistic and scientific perspective from experts
- Selection of an art and science expert advisor to work with the project team, to give feedback and provide additional insights
- Focus groups for the development of strong methodologies in each activity; these focus groups also invite additional external actors for their expertise
- External experts can contribute theoretically or methodologically and complement the BioXXI project partners' vast practical experience

- Engaging with the diverse backgrounds might lead to difficulties in understanding envisioned goals or methodologies applied. For external partners, who are not experienced in art and science practice, it often helps to experience such events or to be guided into some personal exchange in order to make art and science projects accessible for them (on a meta level, this methodology might sound difficult as it often defies categorization, and because art and science projects do not only tackle rational arguments, but also emotion)
- Thorough planning of dissemination events, including the connection to non-standard art and science platforms in order to reach out to a broad audience and allowing for the highest possible social impact
- Dissemination events are also designed for interdisciplinary and lay audiences, as well as audiences that come from either a scientific or an artistic perspective but do not have previous experience in art and science projects.

The focus group methodology was used in a diverse range of tasks: to develop the specific activities within the BioXXI project, to define the cooperative methodology within the BioXXI project and to develop the resulting toolkit. In order to produce a toolkit, the focus group technique was used in the most extensive way. Several rounds of focus groups were evaluated for the toolkit. The process was planned as follows:

1. Select a diverse group of people. In the case of the focus groups for the toolkit the final selection will include artists, art curators, scientists, researchers with experience in the art&science research and producers. Also other voices that relate to the matter in a more distant and free manner will be included, such as writers, directors of museums, archivists, etc.
2. Each focus group is invited to have an open conversation on the issue. The basis for this will be a written diagnosis, including the description of some

of the problems to be discussed, but also including some free-floating ideas and open provocations.

3. The conversation is moderated by the coordinator of the activity, which will happen in a very loose manner because it is important that the participants feel free to explore the matter in a very personal way; in a manner that is uniquely achievable with this specific assembly of individuals on this specific day.
4. Additionally, a rapporteur will keep track of the conversation. Their responsibility involves attentively observing the discussion and composing a depiction of the unfolding events. The rapporteur has the freedom to present the text in whatever manner they deem appropriate. The account is not intended to be objective, but is presented signed by the rapporteur, in recognition of their active participation as an observer and as a writer.
5. This process will be repeated four times: four distinct groups of individuals will deliberate over the same issues, and four separate rapporteurs will document the proceedings. The anticipated outcome is four unique collections of ideas, each elaborated in a distinct piece of writing, all centered around the same subjects.
6. On the basis of the four texts written by the rapporteurs, the toolkit will be developed, as a collection of ideas, strategies, diagnosis and techniques that might be useful to other similar endeavors in the future.

3.

ENGAGEMENT OF SPECIFIC TARGET GROUPS IN SPECIFIC CRITERIA FOR OPEN CALL SELECTION

To ensure a robust outcome of the open call selection process, the jury members will be chosen based on the following criteria:

- Are experienced individuals in their field of expertise
- Are representative of a diversity of perspectives:
 - Artistic perspective on the proposed project
 - Scientific perspective on the proposed project
 - Curatorial perspective on the proposed project
- Art and science practice perspective on the proposed project
- Biodiversity and sustainability aspects
- Core values of the BioXXI project

4.

ENGAGEMENT OF SPECIFIC TARGET GROUPS IN CREATING QUALITATIVE STANDARDS FOR THE BIOXXI CO-CREATED OUTCOMES

For the research and the established methodologies, external advisors and experts are brought into the project to develop strong methodologies and approach the field from an informed and theoretical perspective. This will support the development of the individual tasks and activities by adding a strong methodological and theoretical approach to the vast practical experience in art and science practices of the BioXXI project partners.

Moreover, additional target groups are engaged in the process of the development of the qualitative standards of the BioXXI co-created outcomes:

- Scientific experts in the fields of biology, biodiversity, ecology, botany, and environmental sciences
- Artists and art-science projects that engage with biodiversity and sustainability topics
- Art critics
- Policy makers
- Managers and industrial representatives
- Curators
- Environmental researchers and activists
- Social scientists
- Philosophers

OPEN CALL CRITERIA

FOR THE BIOXXI RESIDENCIES AND BIOXXI PRODUCTION OF WORKS

The collaborating partners of the BioXXI project aim to ensure the best possible outcome of the open calls by:

- Bringing together their vast experience in preparing open calls
- Writing a clear open call document that is explicit about the process and the expectations concerning submission details
- Being clear about the criteria for selection of the winners
- Putting together a balanced jury that can evaluate the interdisciplinary aspects of the submission
- Ensuring a fair and considerate selection process

The open call aims at enabling artistic and curatorial works that are *new* and that *bring together artistic/curatorial processes and practices with scientific knowledge and processes*. Moreover, the projects need to address the challenge posed by the biodiversity crisis. Incorporating a non-anthropocentric perspective that aligns with the core values of the BioXXI project, or engaging in a discourse on non-anthropocentric viewpoints, is encouraged. There is no limitation to artistic medium, discipline or scientific approach in order to be eligible for the open call.

The production awards are aimed at artists and artist collectives. The research residency is aimed at sciart artists and curators living in Europe.

The open call and the application forms that have been created by the BioXXI collaboration partners to meet these criteria can be found in the appendix.

THE PROCESS

All applications will be received via email. They will be handled and read by the BioXXI team members in order to get an overall understanding of the quality, eligibility, and completeness of the submissions. In the first round, those who are not eligible for formal reasons (i.e., not having new work, missing information, missing parts in the application form) are sorted out. In the second and third rounds, the team of BioXXI creates a long list of eligible submissions and a shortlists of the best and highly relevant submissions.

The international jury members will be presented the short list of 25 projects per category, 14-7 days in advance to the jury meeting. They will have the opportunity to read through all submissions on the short list and to evaluate them individually. Thereby, each jury member is asked to organize the shortlist individually in order of their preference prior to the jury meeting, and to note comments and reasons for their selection.

The jury will then come together in a jury meeting of about 1.5 to 3 hours. In this jury meeting, all the proposals on the shortlist are discussed and each jury member has the opportunity to make a strong case for their selection. This joint discussion will help find a common ground and understand the diversity of perspectives on the projects in the short list. The jury will vote on the final winners. In case there is no clear winner, the jury will discuss the remaining 2-3 proposals and do a second round of votes.

APPENDIX:

DETAILS OF THE OPEN CALL AND APPLICATION FORMS

OPEN CALL TO INTERNATIONAL
ARTISTS AND CURATORS
LIVING IN EUROPE
TO SUPPORT THE PRODUCTION
OF TWO ARTWORKS AND ONE
RESEARCH RESIDENCY

DETAILS

Launch of the open call: December 15th 2020
Deadline: February 15th 2021
Results: April 15th 2021

GUIDELINES

Roots & Seeds XXI. Biodiversity Crisis and Plant Resistance is an international cooperation project developed by Ars Electronica, Leonardo/Olats, University of Barcelona and Quo Artis as lead partner.

Roots & Seeds XXI aims to promote sustainable habits through the use of Art & Science approaches and practices. The project wants to encourage audiences to take better care of the environment, and more particularly of plants. We understand the botanical world from a non-anthropocentric perspective, and we aim to present it as a model for a more sustainable future through our activities, workshops and this Open Call for the production of two artworks (organized by Quo Artis) and a research residency (organized by Leonardo/Olats).

THIS OPEN CALL WILL SUPPORT:

TWO ARTWORK PRODUCTIONS

Aimed at international sciart artists or artist collectives, both established and emerging, living in Europe and working with any kind of media and formats.

One 12.500€ Production Award
One 5.500€ Production Award

ONE RESEARCH RESIDENCY

Aimed at international sciart artists or curators living in Europe, to start, pursue or close a research related to the biodiversity crisis and plant resistance, without an obligation of production or predetermined outcome.

Applicants in both categories must address the biodiversity crisis focused on the botanical world. Their projects have to be developed in direct collaboration with scientific professionals and/or institutions.

In addition to the production of the artworks and the residency, the authors of the three selected projects will benefit from participating in some of *Roots & Seeds XXI*'s international training and exchange of knowledge events (LASER Paris meetings, Multidisciplinary Garden Cartographies and Art-Sci Forum, among others). All the travel costs related to the participation in these activities will be covered by the *Roots and Seeds XXI* Consortium.

The two produced artworks and the result of the research residency will be presented and exhibited at Ars Electronica Festival (Linz) in 2022. The transport of the artworks and the artists to Ars Electronica will be covered by Quo Artis. In the residency's case, the format of presentation will be agreed between the project representative and *Root & Seeds XXI*'s partners.

The Call is open to applicants of any nationality, but based in Europe, including non-EU countries.

HOW TO APPLY:

- Entries will be submitted exclusively by email to opencall@rootsandseedsxxi.eu. Please state "Category - Artist Name" (for example: 'PRODUCTION - Artist Name' or 'RESIDENCY - Artist Name'), as the subject of the email.
- Fill out the application forms: for PRODUCTION ([link](#)) or RESIDENCY ([link](#)).

- Send a PDF with the proposal (maximum 5 MB).
- Only one project, which must be new, will be accepted per person or group. Nevertheless, the applicants are allowed to submit ONE proposal for both categories (production and residency).
- There is no limitation on the medium/technique, both scientific and artistic ideas and collaborations must be represented.
- The application must be written in English.
- No entry or administration fee is required.

- Lucio Montecchio, Researcher and Professor of Forest Pathology at the University of Padova and member of the Board of the Botanical Garden of Padova (IT).
- Aliya Sakhariyeva, Art historian, Director of the Art & Science Center and Master Degree Program, ITMO University (KZ/RU).
- Vid Simoniti, Lecturer in Philosophy at the University of Liverpool, Director of MA in Art, Aesthetics and Cultural Institutions (SI/UK).
- Nicola Triscott, Curator, co-founder of Arts Catalyst and the director of FACT Liverpool (UK).

JURY:

The projects will be selected by an international jury.

MEMBERS OF THE RESIDENCY JURY

- Roger Malina, Astronomer, Executive Editor of the Leonardo publications at MIT Press, President of Leonardo/Olats (US)
- Ramuntcho Matta, Artist, Founder and Director of Lizières Cultural and Resource center (France)
- Victoria Vesna, Artist (USA)
- Claudia Schnugg, Curator and Researcher in Art-Science (Austria)
- Oriane Hidalgo, Botanist, Botanical Institute of Barcelona (Spain)
- Annick Bureau, Art Critic, Curator and Director of Leonardo/Olats (France)
- Tatiana Kourochkina, Co-founder and Producer of Quo Artis Foundation (Spain)

MEMBERS OF THE PRODUCTION JURY

- Valentino Catricalà, curator at SODA Gallery Manchester and lecturer at Manchester Metropolitan University (IT/UK).

SELECTION:

ARTWORK PRODUCTION VALUED IN 12.500€ OR LESS

In this category, the selected artist or art collective will receive a maximum of 12.500€ (fee included). VAT is excluded and will be covered by Quo Artis in addition to the net amount. Quo Artis Foundation will manage the production amount in common agreement with the artists and will pay the suppliers directly after receiving the corresponding invoices.

This sum can either cover the total or the partial amount of the production costs. If the latter, it must be detailed in the submission form, specifying how and who will cover the rest of the production expenses.

The project must be completed in a maximum period of twelve months, starting in May 2021.

ARTWORK PRODUCTION VALUED IN 5.500€ OR LESS

In this category, the chosen artist or art collective will receive a maximum of €5,500 (including fees). VAT is excluded and

will be covered by Quo artis in addition to the net amount. Quo Artis Foundation will manage the production amount in common agreement with the artists and will pay the suppliers directly after receiving the corresponding invoices.

This sum can either cover the total or the partial amount of the production costs. If the latter, it must be detailed in the submission form, specifying how and who will cover the rest of the production expenses.

The project must be completed in a maximum period of twelve months, starting in May 2021.

14 DAY RESEARCH RESIDENCY IN THE FRAME OF LEONARDO/OLATS PROGRAMME “MM - MAISON MALINA RESIDENCIES”, PARIS- APRIL 2022

In this category, the selected artist or curator will participate in a Research Residency at the Malina House in Paris, assisted by Annick Bureaud, director of Leonardo/Olats.

The “MM Residencies” offer time and a space for reflection, meetings and exchanges without any production obligations. This residency will be focused on research – please bear in mind there will be no workshop space available.

The selected person is encouraged to suggest or propose a person he/she wishes to meet and with whom he/she wishes to build or develop a project - or simply engage in a dialogue with.

The person will be accommodated at no cost in Malina's House. The selected proposal will receive a grant of 1.400€ (1.000€ as a grant - 400€ for total daily subsistence). This Open Call will cover travel costs.

GENERAL

An official schedule will be set after the announcement of the selected projects.

No additional benefits or extensions may be requested.

The author or authors must mention *Roots & Seeds XXI. Biodiversity Crisis and Plant Resistance* and the Support of the Creative Europe Programme of the European Union every time the artwork and research outcomes are exhibited or advertised by any means or in any other field.

REPRODUCTION RIGHTS

The participants must cede the texts and images reproduction non-exclusive rights to Roots & Seeds XXI, to be used for the sole purpose of non-profit cultural dissemination.

ACCEPTANCE OF THE CONDITIONS OF ENTRY

All applicants, by virtue of their participation, fully accept these rules. Any issue not covered by these guidelines will be discussed and agreed between the authors and the Roots & Seeds XXI organizers during the execution of the projects.

QUESTIONS

opencall@rootsandseedsxxi.eu

COLLECTION OF ART & SCIENCE CASES ADDRESSING SOCIETAL CHALLENGES

Quo Artis
May 2022
Report written by Claudia Schnugg

Team of contributors to this report:
Tatiana Kourochkina, Claudia P. Machuca Santibáñez, Marta
Jiménez, Gala Alferova, Mireia Molina Costa, Aitana Bellido
and Claudia Schnugg.

IDENTIFYING ART AND SCIENCE PROJECTS ON BIODIVERSITY AND SOCIETAL CHALLENGES

How can artistic practices contribute to raising awareness on societal challenges, such as the biodiversity crisis? How can they provoke an attitude change, affect behavior and trigger action of citizens in order to live sustainably and actively support positive change? And above all: how can projects be organized at the intersection of art and science to maximize their impact?

The diversity of projects bringing together art and science with a focus on biodiversity, sustainability, and global challenges is inspiring, and there is much to be learned from their experience, processes, and organizational structure. Roots & Seeds XXI (BioXXI) wanted to specifically investigate cases that work with the arts and sciences, may it be in collaboration between these disciplines, as foundation for the projects' or organizations' endeavor, or as method in knowledge production, public engagement, or other forms of outreach. This investigation aimed at creating an overview of ongoing projects, an understanding of the diversity of approaches, sharing best practices through 15 case-studies in the form of project fact sheets, and to present three outstanding practices that *are innovative* in their process, approach, or structure, and *promise strong social impact*.

The research and selection process were conducted in several steps: first, based on an intense research process, a comprehensive list of cases was generated; second, cases for interviews and fact sheets were selected; third, based on the analysis of the cases, three BioXXI Champions were selected.

The research team at Quo Artis explored potential cases and interesting methodologies by reviewing the following sources and engaging in conversations with diverse partners. The departing points were:

- List of relevant projects from Quo Artis database
- Creative Europe programme results database
- Partner networks
- EACEA network of National Contact Points
- Partner organizations in the Roots & Seeds XXI consortium
- Art & Science Expert advisors at Quo Artis for the BioXXI research

OVERVIEW OF IDENTIFIED ART AND SCIENCE PROJECTS

In the following table you will find the comprehensive list of 56 art and science projects that have been collected by the Quo Artis' team in the course of their research within BioXXI:

Name	Country	Website	Mission
ANAT Synapse	Australia	anat.org.au	Providing space and funding for art-science processes
Anthropocene Project	Canada	theanthropocene.org	Art-science work on human influence on the state, dynamic, and future of Earth
Art & Biodiversity	UK	artandbiodiversity.org	Raise public awareness on art and biodiversity
Art, Science & ecology in the Anthropocene	Italy	digicult.it	Project by DIGICULT on environmental crisis and climate change
Art+Science Juniper Harrower	USA	juniperharrower.com	The Algae Society Bioart Design Lab, and SymbioArtlab
Arte+Ciencia	Mexico	artemasciencia.org	Open art&science exchange at UNAM university
artEC/Oindustry	Austria	artecoindustry.com	Artistic intervention in mining industry, including local communities and landscapes

ARTPORT_ makingwaves	International	artport-project.org	Sustainability and education in arts and culture with special focus on oceans and waterways
Arts & Climate Initiative	International	artsandclimate.org	Theatre to foster dialogue on climate change
arvae	Switzerland	arvae.ch	Gathers artists, scientists and regional environmental experts for creating solutions
Atelier Meld	Spain France USA	meld.cc	Creative production and consulting studio on climate-related issues
Biofaction	Austria	biofaction.com	Interdisciplinarity, art, and synthetic biology
Bio Friction	European	biofriction.org	Art-science exchange on European challenges
Biosphere 2	USA	biosphere2.org	Center for research, outreach, and education about Earth and its living systems
Biotoopia	Estonia	biotoopia.ee	Educate and inspire action on/for biosphere
Biotopia	Germany	biotopia.net	Museum on life, nature, and the future, including artistic approaches and events
Cape Farewell	UK	capefarewell.com	Cultural response to climate change
Climate Art Project	Italy	climateartproject.com	Raise awareness on global warming

COAL	France	projectcoal.org	Mobilizes artists and cultural actors on societal and environmental issues
Creative Climate Leadership	Sweden	creativeclimateleadership.com	Take action on climate change and resilience in the arts and culture
CreaTures	European	creatures-eu.org	Power of creative practices to move towards socio-ecological sustainability
Cultural Adaptations	European	culturaladaptations.com	Action-research to adapt to climate change
Environmental Justice	International	envjustice.org	Environmentalism and (social) justice
Forensic Architecture	UK	forensic-architecture.org	ArtScience research agency pointing out human rights violations, including violations that result from climate crisis
Greentrack Gent	Belgium	greentrack.be/gent	Sustainable transformation in culture
Home	UK	homemcr.org	Contemporary art center housing bees
Julie's Bicycle	UK	juliesbicycle.com	Inspire art and culture to act on climate crisis
Laboratorium	Belgium	laboratorium.bio	Wet-lab for art-design-science, focus on colors
Laboratory for Aesthetics and Ecology	Denmark	labae.org	A platform for art-science projects that deal with environment and non-human ecologies

Minkalab	Colombia	minkalab.org	Agro-cultural project, support of local communities, act against marginalization
Nature in the City/Non-human hereterotopias	Nordic Countries	cityscrepy.tilda.ws/nonhuman/eng	Non-human heterotopias research laboratory
Nature in the City San Francisco	USA	natureinthecity.org	Project to educate about, explore and protect urban biodiversity and habitats
Oceanic Global	International	oceanic.global	Inspire ocean protection
Ocean Memory Project	USA	oceanmemoryproject.com	Interdisciplinary network at the intersection of Ocean and Memory, advancing Ocean Memory
Ocean Space	Italy	ocean-space.org	Contemporary art organization led by TBA 21, focus on ocean health, promotion, education
Phytology	UK	phytology.org.uk	Artist-led research and medicinal garden
PolARTS by Pro Helvetia	Switzerland	prohelvetia.ch/en/2021/10/polarts-call-for-proposals	ArtScience tandems to collaborate within the field of polar science, including effects of climate crisis, glacier and biodiversity research
Project Vortex	International	projectvortex.org	Art-culture collective focusing on the global problem of plastic pollution

Propositions for a poetic ecosystem	Switzerland	artistsinlabs.ch	Art-science project and exhibition by Artists-in-Labs
Re_Build Project	Spain, Italy, Greece	rebuildeurope.eu	Improve migrants and refugees integration processes in Europe
Resonating Bodies	Canada	resonatingbodies.wordpress.com	Artist-led project on native bees
RIXC	Latvia	rixc.org	Center for art, science and technology
STARTS Regional Centers	European	starts.eu/starts-regional-centers	Develop local network and support at the intersection of art, science and technology
Studio for Urban Projects	USA	studioforurbanprojects.org	Collective working on the intersection of art, architecture, urbanism and social activism
Studiotopia	European	studiotopia.eu	Art-science exchange with a focus on SDGs
Symbiotica	Australia	symbiotica.uwa.edu.au	Art-science exchange at university
The Arctic Perspective Initiative	Canada, Slovenia	arcticperspective.org	Research and complex interrelations in the Arctic
The Center for Genomic Gastronomy	International	genomicgastronomy.com	Artist-led think tank examining biotechnologies and biodiversity in human food systems
The Center for Sustain-able Practice in the Arts	Canada	sustainablepractice.org	Sustainable transformation and practice in arts and culture

The European ARTificial Intelligence Lab	Europe-based, international	ars.electronica.art/ailab	Art-science exchange on AI-related scientific and technological topics
The Green Arts Initiative	Scotland	creativecarbonscotland.com/green-arts-initiative	Network for Scottish green arts community
The Tara Ocean Foundation	France	oceans.taraexpeditions.org	Organizes and supports field trips for research on the ocean, including artistic research
Trans-Making	International	trans-making.eu	Research program and creation of spaces to contribute to democratization and access
Valley of the Possible	Chile	valleyofthepossible.com	Art residencies, local communities, activism
Vienna Biennale for Change	Austria	viennabiennale.org	Exhibition, events, and conference to promote ecosocially sustainable societies and economy
Vienna Textile Lab	Austria	viennatextilelab.at	ArtScience laborator that investigates biomaterials to color textiles

The collection of these cases already shows an interesting diversity of approaches: there are artist-led initiatives, research-led initiatives, projects led by organizations specialized in art and science activities, exhibitions and public engagement programs, networks, projects supported by the Creative Europe program, scientific research connecting to the arts, and projects that focus on themes, such as ocean, local biodiversity, empowerment in regions with diverse indigenous population, or making the artworld and cultural organizations more sustainable.

As presented above, the list contains mainly art and science projects that are focusing on the biodiversity crisis. Other than that, the aim was to present the widest array of options possible to show how these projects can work on many different levels: they can be worldwide or local, be developed in organizations, as networks, by freelancers, or artist-run spaces, they can be temporary or permanent, they can be led by a scientific endeavor, or driven by public engagement goals. To make this diversity a bit more accessible, fact sheets that offer insights into the array of possibilities at hand.

RESEARCHING THE DIVERSITY REPRESENTED IN THE LIST

In an open process of the research team, nineteen cases were selected for interviews and in-depth research. This resembled a curatorial process, as it took into account how the projects complement the BioXXI project, how they give new insights, cover a certain diversity on the level of organizational structure, theme, global distribution, and unexpected ways of working with art and science. All nineteen cases were approached, and fifteen agreed to be part of the Roots & Seeds XXI research. In 2021, these fifteen cases were interviewed. Depending on the leading organizations or managers' availability, the interviews were led as semi-structured interviews via online-meeting platforms, or the questions were sent out for written answers.

The interview was based on a questionnaire that aimed at the following general themes: a) project identity and core values, b) methodological approaches, c) co-creation, target groups and public engagement, d) role of the arts and interdisciplinarity in the project, e) funding structure, f) challenges to be met, g) high impact outcomes, and h) evaluation of results.

The questions posed were:

1. How and when did the project start?
2. Which were the problems that you wanted to tackle with this project?
3. Are they the same today?
4. Tell us an interesting fact about your team/project?
5. How have strategies changed over the course of your work?
6. What is the biggest challenge that you have to face to keep your project alive?
7. Do you have partner institutions or communities with whom you work in your action territory?
 - a. If yes, how do you collaborate with them?
8. Do you involve external agents during the creation of the projects/programs?
9. Do you work with agents from outside the art world?
 - a. If yes, with whom?
10. In your experience, what are the major difficulties that you have to deal with when working with people not specialized in the arts?
11. What are the most interesting results?
12. Why is an interdisciplinary approach to the problem important?
13. How do you evaluate the importance of the art component?
14. From where do you get your main financial support?
 - a. Public
 - b. Private investors
 - c. Donations
 - d. Commercial activity, such as _____
 - e. Other
15. How do you define your target group?
16. Which strategies have you created to reach them?
17. Highlight one of your initiatives that you think represents the core of your project
 - a. Do you have to share a link?
 - b. When was it realized?
 - c. Why is it representative or interesting?
 - d. What was the main result of this initiative?

e. How are the results disseminated?

f. Have you replicated this initiative or used it as the inspiration for a new one?

18. OPTIONAL: How can the practice of realizing exhibitions be rethought in an ecological way?
19. OPTIONAL: Is the task for the component “art” in the project mainly described as making the scenarios of the future more tangible, so that people can relate to such images of the future?
20. OPTIONAL: How do art and an interdisciplinary approach help to broaden the understanding of ecology in an era of radical climate change?

Based on the in-depth interviews, written answers to the questionnaire and the materials provided by the projects online, fact sheets of each project were produced. These fact sheets give a general overview of the project, project structure, funding situation, their approach to interdisciplinarity and art and science collaboration, goals and core values, activities, co-creation, and target groups, as well as intended, reported, or documented social impact.

The fact sheets showcase the best practices observed among the researched projects, aiming to inspire future endeavors. They demonstrate how interdisciplinary collaboration can evolve into ecosystems where multiple disciplines contribute and audiences engage. The diversity in the presented cases shows that art and science projects have the potential to deeply engage with diverse audiences, reach out to policy makers, create strong experiences, and work in-depth with scientific research. Whereas the fact sheets will give a structured overview of a few selected projects, the full list will allow a glimpse on the rich diversity of projects that are ongoing at the time this publication is being produced.

THE FACT SHEETS

On the following pages you will find the fact sheets of the selected fifteen cases of Art & Science projects with social impact tackling sustainability & biodiversity issues, or societal challenges. The fact sheets are presented in an alphabetical order:

- ANAT Synapse
- Art & Climate Initiative (formerly The Arctic Circle)
- ARTPORT_makingwaves
- Biotoopia
- Greentrack Gent
- Laboratorium
- Minkalab
- Nature in the City / Non-human Heterotopias
- Resonating Bodies
- Studiotopia
- SymbioticA
- The Center for Genomic Gastronomy
- The Center for Sustainable Practice in the Arts
- The European ARTificial Intelligence Lab
- Valley of the Possible

ANAT SYNAPSE

Adelaide, Australia

Project Info at a Glance

Project type

Artist-in-residence program to support creative research collaborations between artists and scientists

Started

2004, from a previous program that started in 1999

Project organization

One major pillar of ANAT, an organization to support artists working with the sciences and technology

Funding

Governmental funding, some commercial organizations provide support, ANAT's own resources

Webpage

<http://www.anat.org.au/program/2021-anat-synapse-residencies/>

Contact

anat@anat.org.au

• Art & Science Statement

When artists involve ecology and climate change within their practice as a focus, the art itself becomes a conduit for broadening the understanding of these issues, as these concerns are provided to the public in a creative, cultural context. This allows for greater understanding by its very nature.

The most interesting aspect of providing support to artists undertaking art+science+technology residencies is that many of the projects and partnerships are just the very start of a much longer, detailed project. Unfortunately, there are still misunderstandings of what artists can do beyond science communication. When this is understood, incredible things happen.

• Project Goal & Core Values

The program brings artists and scientists (research partners) together and facilitates their partnerships for creative research to generate new knowledge, ideas, and processes beneficial to both fields. Each artist in the program tackles different problems, many address societal challenges.

• Activities

The program supports art-science collaboration through calls for artists and research partners. Up to date, the program has supported more than 100 artists and research partners.

• Co-Creation and Target Groups

Through regular open calls the artists are invited to apply for participation in the ANAT Synapse program. The artists investigate and reach out to the research partners they would like to work with in order to investigate the suggested problem. These research partners may be individual scientists, researchers, or host organizations, such as laboratories or scientific groups. The personal discussion between both partners prior to the submission increases the value of the contact and heightens the quality of the submission, but also starts to build a relationship prior to the artistic residency. With some partner organizations spin-off programs to the Synapse residency program have been created.

• Social Impact

The program focuses on supporting the art-science process, not its dissemination. Individual outcomes that are presented widely and propose interesting ideas or solutions can be impactful.

ARTS & CLIMATE INITIATIVE

International activities, based in New York,
USA

Project Info at a Glance

Project type

Organization for artistic initiatives that tackle climate crisis and climate change issues

Founded

2008 (originally named 'The Arctic Cycle')

Project organization

Focus on storytelling and live performances initiatives

Funding

A combination of public and private funding

Webpage

<https://artsandclimate.org/>

Contact

info@artsandclimate.org

• Art & Science Statement

Artists have much to offer to the climate change conversations, there is no one solution to such complex projects. Artists can also do more than presenting dystopian and utopian futures.

There is a greater recognition from scientists, researchers, and scholars, of the specific role that the arts have in helping us transition to a more just and regenerative future. After 50 years of scientists trying to jolt people into action through the dissemination of scientific data, it has become abundantly clear that other communication strategies are needed. There is more impact if art is included. A play opens people's hearts and hopefully makes them curious.

• Project Goal & Core Values

The Arts & Climate Initiative uses storytelling and live performance to foster dialogue about our global climate crisis, create an empowering vision of the future, and inspire people to take action. Theatre initiatives are realized to invite audiences to reflect on the many impacts of climate crisis, and to be a catalyst for action. Thereby, theatre is also brought back to the forefront of social change.

• Activities

Theatre events, theatre production, workshops, development of new theatre plays, regular publication of theatre pieces as anthologies, recordings and evaluation of the events, biennial worldwide events, and intensive workshops for artists, activists, scientists, and educators on public engagement through the arts.

• Co-Creation and Target Groups

Collaboration with diverse groups and organizations on a project-by-project basis. These organizations can be schools, universities, environmental organizations, faith groups. Arts & Climate Initiative also works with artists to develop strategies, learn about interdisciplinary engagement in their practice around climate crisis.

• Social Impact

More and more artists are working at the intersection of theatre and the climate crisis, reaching more audiences; hundreds of stories are put out into the world and provide an antidote to the constant barrage of negative news and dystopian art; and communities have conversations about the climate crisis where they can bring their whole selves (not just their intellect, devoid of any feelings) to the table and take action.

ARTPORT_MAKING WAVES

International, Europe and US locations

Project Info at a Glance

Project type

Curatorial collective at the intersection of art, climate change and sustainability, realizing numerous projects

Founded

2005

Project organization

Network of international curators and collaborators

Funding

Diverse funding through public support, private investor, donations, and scientific partners; mainly growing the number of relationships with smaller amounts of funding per partner

Webpage

<https://artport-project.org>

Contact via webpage on

<https://artport-project.org>

• Art & Science Statement

ARTPORT_making waves started as a curatorial collective at the intersection of art, climate change, and sustainability in New York, Valencia, Spain in 2006. Its purpose was to draw attention to the causes, consequences, and potential solutions to climate change through themed exhibitions, film productions, workshops, conferences, and educational programs.

Today, they have evolved into a network of international curators and collaborators located in various parts of the world.

• Project Goal & Core Values

To address the complex issues of ocean protection and to make visible to civil society how important it is to understand the ocean, to share how everybody can come on board of ocean protection worldwide.

• Activities

Connect interdisciplinary projects through the arts to science and sustainable developments. A focus is on collaborating with scientific institutions, supranational organizations, museums, educational entities, international conferences, governments, and private foundations in order to diversify the agendas connected to the project goal and to contribute to a society that takes sustainable and ecological development seriously.

• Co-Creation and Target Groups

For each project ARTPORT works with local partners. Artists and curators are protagonists, but scientists and policymakers have become important partners in order to make a shift from pure awareness-raising activities to contributing to change in actions and policies.

• Social Impact

ARTPORT is overwhelmed by the educational outcome, the reactions and involvement of young people, their creativity, engagement, and good energy. They are amazed by the extraordinary response from partner organizations, civil society in general, and the number of people who want to come on board because they see the urgency in acting for the ocean.

This fact sheet is based on our interview with ARTPORT co-founder and CEO Anne-Marie Melster.

BIOTOOPIA

Estonia

Project Info at a Glance

Project type

Series of conferences and art events

Realized by

The Estonian Anthropocene Center, NPO

Started

November 2020

Advisory board delegates from

University of Tartu, Art Museum of Estonia, Tallin University, Viinistu Art Harbour, Republic of Estonian Environmental Board

Funding

EU funding, governmental funding, ticket sales, support through private companies

- **Art & Science Statement**

An artistic programme is supporting the core values and project goals of Biotoopia. The art programme is spread throughout diverse gallery spaces, theatres, and concert venues.

The biosphere is not the realm of a single discipline or group, it is a complex subject that needs to be discussed from diverse angles. Art is valued in the communication with the public, and to present outcomes of research and to express possible solutions the public could take up in individual behavior and values. Art has an important role to visualize a sustainable world and to give thoughts on diversity a prominent space.

- **Project Goal & Core Values**

Biotoopia aims to raise awareness of all terrestrial life forms and to find new patterns of thoughts about saving and restoring the biosphere. Additionally, Biotoopia aims to engage young creatives in this process, and to develop study materials for actual impact on behavior of the local public. An international audience targeted through online and hybrid events that combine artistic and scientific insights.

- **Activities**

An interdisciplinary forum is realized as an annual event at Viinistu Art Harbour to bring together artistic and scholarly approaches for three days, including a conference, art displays, discussions, nature walks and concerts. Between the annual events, activities like Biotoopia Talks, Biotoopia Walks, and interactions with students take place. Biotoopia Art Programme includes galleries, theatres, and concert venues.

- **Co-Creation and Target Groups**

Biotoopia collaborates with scientists and entrepreneurs and presents artworks (all mediums). Local partners are key for the project realization as the ultimate aim is to affect behaviors in a positive way in respectively to the biosphere. Target groups are artists, natural scientists, philosophers, teachers, students, and parents.

- **Social Impact**

Within the first year, Biotoopia has published over 80 articles and press releases globally. Biotoopia aims to impact the target group through education, shared experiences, ongoing discourse, art, and information.

GREENTRACK GENT

Ghent, Belgium

Project Info at a Glance

Project type

Action network for sustainability in art and culture

Started

2012

Project organization

Non-profit run by two freelancers Eva Peeters and Nathalie Decoene

Funding

Currently funded by about 40% public funding and 60% membership fees; previously also diverse funding for specific projects through foundations, public bodies and the Creative Europe programme of the European Union

Webpage

<http://greentrack.be/gent/home>

Contact

eva@greentrack.be and nathalie@greentrack.be

• Art & Science Statement

Art and culture bring imagination and enhance empathy. Art broadens people's minds, their scope, it can gather people behind common goals, bring them together in these challenging times by pushing people outside of their regular thinking patterns, envision futures and bring that future closer to people's imagination and living reality by making scenarios more concrete and realistic.

Also, cultural organizations need to become more sustainable. The cultural sector can even be a testing ground for experiments with sustainability, and for innovation in the field.

• Project Goal & Core Values

The goal is to share strategies of arts and cultural organizations that aim at becoming more sustainable, to grow expertise and share this knowledge, but also to support organizations in becoming even more sustainable. Thereby Greentrack Gent aims at connecting actors, and to collaborate on challenging sustainability themes such as international mobility.

• Activities

Network exchange, workshops, talks, educational meetings for members, to share expertise and knowledge, to connect actors, to research to realize sustainability strategies and to disseminate results among the network. Additionally, Greentrack Gent helps to find funds for sustainability endeavors.

• Co-Creation and Target Groups

The target group is defined as cultural organizations in Ghent, cultural organizations as defined in Flanders including art, the socio-cultural sector, and heritage. In order to tackle the needs of these diverse organizations, Greentrack Gent invites experts for workshops and meetings with the network members, e.g., on renewable energy, waste, facility management, divestment and fair banking.

• Social Impact

The network counts around 56 cultural organizations in Ghent that want to become more sustainable as an organization and want to contribute to a more sustainable city as well.

LABORATORIUM

Ghent, Belgium

Project Info at a Glance

Project type

Laboratory accessible for artists, students, researchers

Started

2016

Project hosted by

School of Arts KASK

Funding

Public research funding and arts research funding

Webpage

<http://laboratorium.bio>

Contact

info@laboratorium.bio

• Art & Science Statement

Interdisciplinary projects involving artists and designers make aspects of ecology more tangible for a broader audience, they often raise questions that are generally not on the table when discussing ecology and they propose speculative scenarios that help visualize and understand the effects of the climate crisis.

By building a laboratory infrastructure in the art academy to develop this project, many students, researchers, and professional artists got access to new methodologies, materials, and tools. They were intrigued by the possibility of working and exploring practices within the field of biotechnology.

• Project Goal & Core Values

Laboratorium is an experimental biolab in art and design that focuses on exploring different interactions between art, science and technology. A main strand of research explores contextualization of color in contemporary art and design regarding environmental issues (through questions around color industry, sustainability in color, or exploring alternative materials for color). Practical core values of Laboratorium are to give access to artists and designers to a laboratory infrastructure, and to continuously question materials and methods, and to prioritize the process over the outcome.

• Activities

Providing the facilities to the main target group and to pursue research projects on rethinking color in interdisciplinary approaches. Moreover, Laboratorium provides a 'Color Database', conducts workshops, educational programs, connects to international art and science projects, organizes conferences, and provides texts for magazines.

• Co-Creation and Target Groups

The main target group consists of artists and designers with an interest in science and biotechnology, as well as scientists seeking a research space that diverges from traditional academic standards.

Located at the art university, the facility welcomes students and projects to participate and utilize its resources.

• Social Impact

The work is regularly communicated on diverse platforms, such as social media and websites. The processes and results of the projects have been presented in several exhibitions, workshops, and lectures for an artistic and non-artistic audience.

MINKALAB

Colombia

Project Info at a Glance

Project type

Artistic and research-based project, organic farm, nature reserve, and community meeting space

Webpage

<https://www.minkalab.org>

Contact

info@minkalab.org

Founded

2014

Project organization

Founded as a project by artists and environmental activists

Funding

Support fees to participate in activities, crowdfunding campaigns, donations by organizations, income through sales of agro-ecological products and tourism projects for rural re-integration

- **Art & Science Statement**

Interdisciplinarity is an integral part of Minkalab, starting from the interdisciplinary core team that has developed transdisciplinary practices. Not only art and culture play an important role, but also indigenous perspectives and leaders.

Minkalab experiences a strong impact in working with indigenous leaders and cultural agents as art inspires, attracts generations, and can bring innovative results. Art is the basis of culture and culture comes from cultivating life. Returning art and culture to the countryside is the basis for strengthening communities that care for the environment and achieve a harmonious and sensitive relationship with it.

- **Project goal & core values**

Main goal of the project is to provide space, exchange and support to local communities and topics raised by them: loss of biodiversity, cultural disappearance, unequal distribution of land, difficulties to access knowledge and culture, new technologies, and incomprehensible information transmitted by technicians advising them in monoculture agriculture.

- **Activities**

At the heart of the lab's practices is the dedication to reframing work with the lands as a profound cultural task that has direct impacts on health, environment, and community. The local network started with personal interaction and personal experiences that are key to build a relationship, such as festivals, community meetings, educational experiences, artistic interventions, workshops, markets, also ceremonies and Mingas.

- **Co-Creation and Target Groups**

The main beneficiaries are local small agricultural producers, indigenous communities, and artisans. Activities focus on interconnecting them with people on a national and international scale (artists, designers, cultural and environmental activists, and theorists) who engage in issues of regeneration and who take a great ethical interest in sharing traditional knowledge, skills and know-how in order to (creatively) find new forms to commonly work on a healthier and multi-diverse planet.

- **Social impact**

Local groups and actors on a national and international level benefit from the activities. The diverse activities reach out to the local communities and support them in their daily life.

NATURE IN THE CITY

NON-HUMAN HETEROTOPIAS

St. Petersburg, Russia

Project Info at a Glance

Project type

Laboratory exhibition and ongoing program during The Nordic Weeks international art and cultural festival

Webpage

<http://cityscrepy.tilda.ws/nonhuman/eng>

Contact

cityscrepy@gmail.com

Started

2021

Project Organization

Museum of the History of St. Petersburg

Funding

Supported by The Nordic Weeks, an international non-commercial art and cultural

- **Art & Science Statement**

An interdisciplinary approach was the most important part of the 'Nature in the City' Laboratory. This way the participants had a chance to get scientific information about plants, insects and birds from specialists. Then it was important to dive into the philosophy of nature from Plato to Rosi Braidotti and to assess the human's history of thought on this matter.

Also, participants could talk to artists and discuss their practices. So, the experience was enriched by different kinds of knowledge and approaches to the non-human topic and became tangibly multilayered and tridimensional. Thus, the quality of works and concepts of the participants were solid and proficient.

- **Project Goal & Core Values**

The goal is to put a spotlight on cities as non-human heterotopias, atypical environment for a large number of biological species that do not belong to the genus Homo, but have been brought there by humans, followed human cities, or existed on the city territory before the city. Thereby, the project also aims at a non-anthropocentric approach to reconsider the human as part of natural relationships.

- **Activities**

The research laboratory offered an intensive interdisciplinary and hybrid on-site and online program for participants, who then presented their individual project outcomes in an exhibition and an art zine.

- **Co-Creation and Target Groups**

For the laboratory, it was important to work with participants as a group, to keep the group dynamics healthy, and individually with each participant, so they could work on their personal project for the exhibition. The target group of the exhibition was people interested in philosophy of nature, ecology, art&science, art practices, plant and animal studies, poetry, and dramaturgy.

- **Social Impact**

A first step to explore more-than-human entanglements in city environments through art and science and make the outcome accessible to an interested audience through diverse presentation formats.

RESONATING BODIES

Toronto, Canada

Project Info at a Glance

Project type

Long-term series of projects

Started

2008

Project organization

Series of art installations, community outreach projects and a webpage initiated and led by artist Sarah Peebles

Funding

Commissions by venues that receive public funding, other commissions by venues and private foundations, donations, personal investment and contributions of project actors and artists

Webpage

<https://resonatingbodies.wordpress.com>

Contact

info@natureinthecity.org

• Art & Science Statement

For the project art is integral for in-depth audience engagement, both with installations and other related artworks by the artist.

Interdisciplinary approaches are utilized to inform about biology, to raise the bar of public scientific literacy and to create a mental image of biodiversity. This is facilitated by an experience that draws upon multiple senses, and this leads to a deeper engagement with the subject (native bees) which is at once emotional and intellectual, by opening doors to science through art and tell stories that facilitate beauty and knowledge.

• Project Goal & Core Values

Our goal is to highlight the complex and diverse biology of native bees in North America and their roles in ecosystems, pollination ecology and human land use choices. This should be reached by creating a mental image of this biodiversity through art.

• Activities

On the premises of project partners with serious intent for long-term commitment, permanent outdoor installations for sensory observation of solitary nesting bees, titled 'Audio Bee Booths and Cabinets', are installed. In-person science-based interpretation of the cabinets by developing 'Wild Bee Clubs' for adults and older youth in Toronto in coordination with a local bee PhD candidate have been facilitated at two locations. All these installations are open to the public and supporting material is provided through 'video poems' and online documentation.

• Co-Creation and Target Groups

The artist works with scientists, botanists, ecologists, and structural engineers to develop the art installations and educational material. The venues that commit to long-term engagement through the activities contribute by taking part in activities with the visitors, educational support, but especially non-art venues need to be supported in utilizing the rich context of the arts/science work. The target group is defined as the general public with an emphasis on adults, university students and ages 16+.

• Social Impact

Education, experience and broadening the perspective of the target audience. Over the years many scientists from diverse countries have learned about the project by word of mouth.

STUDIOTOPIA

Europe, coordinated in Belgium

Project Info at a Glance

Project type

Collaborative project by cultural and research organizations

Started

September 2019

Project partners

Center for Fine Arts (BOZAR), GLUON, Ars Electronica, Cluj Cultural Centre, Laznia Centre for Contemporary Art, Onassis Stegi, Vrije Universiteit Amsterdam, LABoral Centro de Arte y Creación Industrial, Gijón

Funding

Co-funded by the Creative Europe programme of the European Union

Webpage

<https://www.studiotopia.eu>

Contact via webpage on

<https://www.studiotopia.eu/contact>

• Art & Science Statement

To break up the bubble individuals are used to act in and where they evaluate issues, and challenges, it is important to collaborate across fields and to challenge one's own views. As artistic work often is political or takes strong positions on global challenges and pressing issues, Studiotopia aims at giving grounds to artistic production by supporting a long-term project development based in a fundamental exchange and ongoing dialogue with science.

In this light, Studiotopia worked with artists who tackle important issues with elaborate questions and offered them the opportunity to find scientists to elaborate on these issues.

• Project Goal & Core Values

Support artistic development on solid scientific ground tackling a number of Sustainable Development Goals.

• Activities

The project supports collaborations of 13 teams of artists and scientists at 8 partner organizations over a period of 17 months to develop solid artistic projects based in scientific research. The results will be presented in a traveling exhibition at three partner organizations in three European cities. Moreover, other partner organizations engage in outreach activities and promote the art-science projects.

• Co-Creation and Target Groups

The project is co-created between the official project partners, but there are also additional collaborations with scientific institutions, outreach activities at research centers, invited consulting artists, invited curators, or bridges to European premises, embassies, and other official institutions. The main target group of the project are artists and scientists to enable them to collaborate, the target group of the outcomes are the public that engages with the exhibitions and workshops as well as collaborating institutions to learn from the project's outcomes and experiences.

• Social Impact

The joint traveling exhibition subsequent to the art-science processes will expose the public to the scientific and artistic approaches developed during the residency program. The exhibition is shown at Laznia Centre for Contemporary Art (Gdansk, Poland), Cluj Cultural Centre (Cluj, Romania) and BOZAR, Centre for Fine Arts (Brussels, Belgium).

SYMBIOTICA

Perth, Australia

Project Info at a Glance

Project type

Research laboratory

Started

1999

Project organization

Artist-run research laboratory based at University of Western Australia

Funding

Government funding in Australia, federal Australian art funding, state funding; funding from organizations and companies with a strong agenda has been rejected; consultancy by the heads of SymbioticA also supports the laboratory; the residents need to bring own funding

Webpage

<https://www.symbiotica.uwa.edu.au>

Contact

sym@symbiotica.uwa.edu.au

• Art & Science Statement

Art is not just something decorative. Scientists need to be educated about what artists are doing, e.g., that they are using methods and techniques that are commonly used in the lab, also by scientists, and that artists are engaging in deep research practices and philosophical and ethical questions around the science and research being done.

Art plays a crucial role in connecting with fresh perspectives on the world, fostering the development of novel ways to perceive it, and introducing new vocabularies. It extends beyond the limited 19th-century notion of art, which was primarily associated with painting and vague imagination. In contemporary times, art also involves critiquing ideas, proposing innovations, and utilizing scientific insights to fuel imagination.

• Project Goal & Core Values

As an art-science organization, SymbioticA tackles the uneven relationships between artists and scientists. At this research laboratory, artists are treated on the same level as scientists and researchers. A strong thematic focus lies on artists investigating biological technologies and connecting to research in life sciences.

• Activities

An artistic research laboratory that invites artists and researchers to engage in wet biology practices embedded in a biological science department. SymbioticA hosts artists as residents and supports them to connect to the life science department, provides workshops, delivers exhibitions and symposia.

• Co-Creation and Target Groups

Artists and researchers are invited to work with the team of SymbioticA and at the laboratory. The main target group is defined as scientists, though, as they aim is to help them understand art-science practices, artistic research methods, talk about philosophical and ethical questions.

• Social Impact

Artists coming to SymbioticA generate rich artworks and outcomes that are presented worldwide. SymbioticA creates access for artists to undertake residencies at their laboratory at the University of Western Australia. The program facilitates connections between artists and scientists, with a significant emphasis on life sciences and natural sciences. The laboratory's directors actively disseminate strategies, insights, and ideas on a global scale through presentations and consulting activities.

THE CENTER FOR GENOMIC GASTRONOMY

Headquarters in Europe, global activities

Project Info at a Glance

Project type

Artist-led think tank that examines the biotechnologies and biodiversity of human food systems

Started

2010

Project organization

Artist-led independent research institute

Funding

Public and commercial activities, commissioned projects, arts funding, private money, philanthropy

Webpage

<https://genomicgastronomy.com>

Contact

info@genomicgastronomy.com

• Art & Science Statement

Interdisciplinary approaches to problems are important because the world is interdisciplinary. Moreover, food, food production, tastes, ingredients are grounded in culture and local environment. Thus, it is not only important to work interdisciplinary, but also interculturally, site-specific with local communities and people.

The importance of art in the mix can be seen in the engagement and excitement of the audience. For the Center, art also adds another component: it provides an excuse to experiment beyond scientific research questions, to experiment what might be interesting, strange, new and to see what comes out of it. And it invites to focus on the aesthetic experience.

• Project Goal & Core Values

Starting from research into taste of and cooking with 'un-

expected ingredients', such as 'Cobalt-60 Sauce' (creating a recipe that highlighted Mutagenic varieties of plants) and 'Smog Tasting' (smelling and tasting the atmospheric environment, including air pollution), the Center went on to celebrate complexity and agricultural biodiversity, and the biodiversity in the kitchen. The Center has started to wade into the challenging aspects of taste, place, ecology and belonging. The aim is to tease out ecological and regional particularity of food systems, even in conditions where they may be rapidly changing (due to climate change), as well as the rise of de-globalization, a desire for localism and an unfortunate rise in xenophobia.

• Activities

The Center presents its research through public lectures, research publications, meals, and exhibitions, does commissioned work, continues independent artistic research, and curates themed presentations.

• Co-Creation and Target Groups

The artists at the Center are collaborating across artistic disciplines and bring in local actors to work with for site-specific projects. Moreover, they work with various cultural organizations, food NGOs, media organizations, subject matter experts, the community of art design and food creatives, and an interested global community online and at locations they've realized projects.

• Social Impact

Their work is presented to political actors, such as the Scottish Parliament or the World Health Organization, but also at museums, science galleries, local communities, biohackers and interested individuals, such as local groups in India. Thereby, the Center reached out to do work in more than 20 countries and realized meaningful collaborations with experts (scientists, chefs, biohackers).

THE CENTRE FOR SUSTAINABLE PRACTICE IN THE ARTS

York, Canada

Project Info at a Glance

Project type

Think tank providing research, training and consultancy

Founded

2008

Project organization

Federal non-profit organization in Canada

Funding

Primarily public funding (Canadian Council for the Arts, dp. Cultural heritage), some private foundations giving grants to partner organizations in North America, publications and subscriptions (minimal)

Webpage

<https://www.sustainablepractice.org>

Contact

contact@sustainablepractice.org

- **Art & Science Statement**

No one field has a comprehensive meta-view on problems like climate change. Working on saving the world impacts everybody and we need everybody to be involved. There's no real boundary between disciplines, both artistically and scientifically, they are interconnected.

Any point at which perception is relevant, the arts are important. There is a real danger in efforts for arts and sustainability to reproduce systems of inequity. That is, it is easy for an artist to present themselves as a model or to reimagine the future, but art can also serve as a cultural and diplomatic bridge, create new materials, heal trauma, honor indigenous cultures, and listen to communities.

- **Project Goal & Core Values**

The main goal is to address how artists and cultural institutions can work and make work in more sustainable ways, related to practical matters of the environmental impact or in terms of resources, but also sustainable development and broader issues such as building structures and biodiversity.

- **Activities**

'CSPA Quarterly', a quarterly publication that started in 2009, an online platform that also provides comprehensive resources and tools for artists and cultural actors, 'Climate Change Theatre Action' as a worldwide series of readings, performances, and plays presented biennially, a project partnership with 'Edinburgh Fringe Festival' that rewards shows as 'Fringe Sustainable Practice Award', and annual convergences that gather industry leaders, educators, students and the general public to share ideas and celebrate innovations.

- **Co-Creation and Target Groups**

The target group is defined project by project, but primarily it is the cultural sector in Canada, especially cultural organizations, but also sustainable-engaged artists. For them the center wants to build infrastructure and support to create sustainable initiatives.

- **Social Impact**

CSPA offers evaluation tools to artists and cultural organizations to evaluate their impact, socially and environmentally, such as environmental footprinting, intrinsic impact analysis and critical accounting, guidelines, invest practices guides, comparative value and building value.

EUROPEAN ARTIFICIAL INTELLIGENCE LAB

Europe and beyond, coordinated in Austria

Project Info at a Glance

Project type

Large scale collaborative project by cultural and research organizations

Started

2018

Project partners

Consortium: Ars Electronica, Center for Promotion of Science, Zaragoza City of Knowledge, Laboral, Kersnikova, Science Gallery Dublin, Onassis Cultural Center, GLUON, The Culture Yard, Hexagone, SOU Festival, le lieu unique, Waag; Scientific partners: SETI Institute, Muntref Centro de Arte e Ciencia, Laboratorio di Neurociencia de la Universidad Torquato di Tella, Leiden Observatory, Edinburgh Futures Institute and Bayes Center

Funding

Co-funded by the Creative Europe programme of the European Union

Webpage

<https://ars.electronica.art/ailab/en>

Contact

info@ars.electronica.art

• Art & Science Statement

Bringing art and science is an integral part of the project, which is also based in the collaborating and leading organizations' nature and mission to do. Art is the essential component of this project. The idea is based on the question how artists can help to understand huge societal, political, and environmental challenges. In this project, the artists also help us to talk differently about AI, to demystify it and to bring more critical and reflective positions into the discussion.

The questions the artists were bringing into the scientific projects and organizations were diverse: experimental, talking about a broader context, informed by diverse perspectives.

Moreover, the project aimed at supporting capacity building on AI technology in the arts in order to create stronger artistic positions, artworks, and discussions.

• Project Goal & Core Values

The goal was to create an art and science network, especially with a focus on experimenting with AI as an artistic medium. Thereby, a main core value was to unpeel AI technology for a broader audience through artistic investigation and artwork presentations.

• Activities

Main activities were the artist-in-residence opportunities at scientific partners and art-science project production. Additionally, a network across partners in Europe was built, exhibitions, workshops and events were organized and staged.

• Co-Creation and Target Groups

On a production level, target groups and co-creators are scientific institutions and artists; target groups of the outcomes are artistic and scientific communities, the broad public, as well as people of all ages.

• Social Impact

The project is extensively disseminated among project partners, as well as through the central dissemination activities of Ars Electronica, thereby reaching diverse local and international communities.

VALLEY OF THE POSSIBLE

Chile, The Netherlands

Project Info at a Glance

Project type

Refugio for Art & Research in the Chilean Andes

Founded by

Olaf Boswijk and Mirla Klijn

Started

2019

Realized in the organizational form of

Cultural non-profit foundation ('stichting')

Funding

Donations, private sponsors, and own resources

Webpage

<https://valleyofthepossible.com>

Contact

info@valleyofthepossible.com

• Art & Science Statement

Interdisciplinary, intercultural, and interhemispheric exchange to foster responses, reflection, and critical questions to most pressing societal challenges. Artists, guest speakers, curators, ecologists, indigenous leaders, community members, scientists, visionaries are needed to explore themes around ecology, biodiversity, and sustainability.

The relation of art and nature is often surprising to the public as a dualistic mindset can be strong and rigid. Creating experiences and deep conversations helps to overcome this and can lead to amazing changes in (a part of) people's worldview.

• Project Goal & Core Values

The project was initiated to facilitate artistic responses to most urgent issues, such as climate crisis, loss of biodiversity and living in an age of ecological collapse. Valley of the Possible tackles ecology, nature and indigenous culture in order to shed light on a counterweight to the devastating effects of Western lifestyle and worldview. The project gives space to artistic responses, questions, and facilitates reflection.

• Activities

The NPO has several residency programs and facilitates artistic, and research stays at their space in Chile. Moreover, research, bio-cultural conservation, and artistic projects are facilitated through their work. Through activities such as workshops and volunteer programs, issues such as organic agriculture and the regeneration of land and soil are addressed.

• Co-Creation and Target Groups

The independent cultural NPO offers artists, scientists, thinkers, and makers a place to reconnect with nature, time for research and space for artistic development. In a bigger community of organizations, Valley of the Possible works with partners under the umbrella of GALA, Green Art Lab Alliance, where they develop strategies and processes, such as joint methodologies and open calls.

• Social Impact

Establish relationships with local, regional, and national stakeholders, engagement of grassroots initiatives and indigenous communities, but also through educational activities and public engagement.

THREE BIOXXI CHAMPIONS

COMPOSED BY TATIANA KOUROCHKINA,
LLUÍS NACENTA AND CLAUDIA SCHNUGG

Continuing the line of thought in the ongoing process, the assigned BioXXI jury applied specific criteria to evaluate the examples of what was known as the "BioXXI Champions". These criteria included assessing the diversity of project structures, the variety of themes addressed, and the utilization of creative strategies in art and science to tackle challenges related to biodiversity or other societal issues. Additionally, the jury considered the potential and demonstrated impact of the projects on their designated target audience(s). The evaluation and decision was taken based on the interviews, answers to the questionnaire, materials available online and references provided in the interview.

All selected projects presented in the fact sheets are of high quality and carry out exceptional work within their field and self-set goals. Given the high standards of all the projects presented, the jury decided to give the stage to three projects that display a clear concern to address the emergency in biodiversity, sustainability, and connected global challenges by stepping outside of the closed artworld, connect art and science, and develop strong concepts to use art and science. Thereby, all these project also understand to take citizens and well-selected target groups on board in order to be impactful in a sustainable way, going beyond the display of alarming scenarios or science communication. They interweave artistic research and expression with care, connecting people through culture, and scientific insights into long-standing and growing initiatives. The three selected BioXXI Champions, best practice examples that fit the ideas of Roots & Seeds XXI, are:

The Art & Climate Initiative impressed with the way they use theatre to address climate change and resulting impact on biodiversity and the environment. From an artistic endeavor over the years a substantial organization grew that reaches out to citizens, children and young adults through storytelling, emotional, and educational work. Additionally, they support artists and theatre makers in developing their own stories and theatre activities tackling the climate crisis.

The Center for Genomic Gastronomy convinced as an artist-led think tank that focuses on a theme that is connected to sustainability, biodiversity and global challenges in a complex way: food. Through their artistic research they deliver thought-provoking work that is presented to very diverse audience groups, thereby impacting thoughts or behavior at local levels, broad audiences through technical or arts museums, as well as in NGOs, political organizations, and in academic environments.

ARTPORT_makingwaves convinced with their strong projects, including exhibitions, educational materials, and network for curators to make the artworld more sustainable. Thereby, their focus on the oceans, their educational and awareness raising activities in the international art and curatorial world, and their aspiration to contribute to action through research and mobilization of actors stands out.

All interviews have been transcribed by Judit Pujibet Semis and edited by Auri Carballo.

INTERVIEWS WITH BIOXXI CHAMPIONS

INTERVIEW WITH CHANTAL BILODEAU FROM ART & CLIMATE INITIATIVE BY LLUÍS NACENTA

LL *The first thing I would be curious to know is your insight about the problem with the autonomy of art, because we find that discussion a lot. You are using art in a way that is not how it was meant. So, my first question is very general but very important. What would you say to someone that would argue 'the only purpose of art should be art itself'? Why are you using art for another reason, for another justification? As if art required that.*

CH Well, first I'd say, when art first appeared, it was not for its own sake. It was used to decorate bowls and pots to eat or collect water. It was connected to something that had a purpose. Even cave paintings were recounting stories, potentially for the artists themselves or for others. So, I think it's a fairly modern concept that art should be just for itself. And even that idea is debatable because art is often used as an investment. It makes some people very rich. And on the other side of the spectrum, there is art that takes the place of social work, which is problematic on many levels. In short, I think it's a false dichotomy to say: 'art for itself or not for itself'. There's a gray area between the two.

LL *I agree. This is a modern perspective. Perhaps that might be one of the symptoms that allows us to say that the modern era is over. We cannot take the luxury anymore of being romantic about art and saying art should be a completely autonomous activity that has nothing to do with anything but itself. There are a lot of things that allow us to consider the crisis in a broader perspective. I don't think we are only in a climatic crisis, we are in a crisis of civilization, somehow. I don't want to be dramatic, but...*

CH Art for itself is very privileged. Like, who does that? You know, very rich people who can afford to go to very rarefied spaces and pay a lot of money.

LL *To this respect, I think in the visual arts it's very difficult to reach an audience beyond the visual art professionals. I mean, here in Barcelona, the contemporary museum is almost always empty. And this is okay, that's amazing for me. I mean, if theaters were empty, if cinemas were empty, that would be a problem. But the Contemporary art museum is always empty, and this is okay. This is perhaps why theater is more suitable to address these kinds of problems. I mean, you can reach a big audience with theater. Is this correct?*

CH (Laughs) That's funny. We all have our problems, and we tend to view other disciplines as doing better. I would never qualify the theater audience as being big (laughs). Theaters tend to be small, so you get an audience of 100-200 people. Excluding Broadway venues and their really big rooms. I know a lot of people who go to the theater but that's because I'm in the theater myself. If I look beyond that circle, if I meet people randomly and I talk about theater, the only thing they know is Broadway. For them, theater is Broadway. And Broadway is not where you're going to address complex social issues. Broadway is mostly for tourists. It tends to present stuff that everybody agrees on. It's not that it's just fluff, it can be profound, but it's not going to be controversial because it's a commercial art form and they have to sell tickets and fill these really big rooms. On the other hand, you can take theater outside, you can have theater on the street, you can have theater in the park. That's a different way to reach people.

LL *What is your experience with young writers? I mean seeing your calls, and the way you promote a lot of creative writing, what is your experience from the perspective of the artist? I imagine that it must be a very creative trigger and a very good creative impulse, to have that need to address a very important issue. Is this correct?*

CH When I started almost 15 years ago, not many writers were tackling climate issues. Now, there are a lot more, especially among the young generation. These are writers who don't know any different; they were born in a crisis. For them, it makes no sense to ignore it, especially since we've spent the last 30 years saying: "We need to worry about the next generation." They are the next generation. So there's very interesting work being done. However, I don't know if it's true in Europe, but in North America there's still a tendency to write about the apocalypse – all of the ways in which the world is going to fall apart – and not so much about how we might succeed, or the difficult decisions we'll have to make. That's the next step, I think. Now that we've gotten more writers to write about this topic, we need to change the focus. Otherwise, we are just reinforcing what we hear in the news.

LL *I think this is very important. My impression is that we are giving small children the idea that there is no hope. My eldest son is 7 years old now. And now I'm quite worried about the discourse that he learns at school because it's very negative. He says things like, «Hey dad, cars are awful. Why is the city filled with cars? We are destroying the Planet» And he's right, of course we should not be using so many cars, but it worries me. We are telling them that the world is doomed, and there is sadness there. I think that it's very important to change that approach. But then, what about science? The scientific discourse is very pessimistic. We need to be coherent with scientific discourse. Of course, we need to maintain hope and be realistic and talk to young people that life is worth living. What do you think about that?*

CH I had an interesting conversation with creative writing students at a university recently. The students were very, very depressed, very worried. They tended to focus on the negative, feeling the weight of the climate crisis. And then I got together with a friend whose son just started studying engineering, and we had a completely different conversation. I asked him "How do you feel? Because I've just talked to students who were very depressed." But in his world, there is a clear path to action. He

said: “We're getting ready to do something! I want to figure out what I can do, how I can contribute, and my peers at school are the same!” It was interesting to see that his discipline made a difference in how he envisioned his life. He could see how he might be able to help. But people in the arts, in creative writing – maybe it's not general, maybe it was just that class – they couldn't see how they could help. And yet, they can because we need to change the story! That's what I was trying to tell them! We need to have a vision of where we're trying to go if we want to get there.

LL *This is a key idea: “to change the story”. It's a difficult approach. I also wanted to ask you again about creative writing. Is there a way in which scientific input, scientific knowledge, the fact that you accept the challenge of addressing something that comes from science that is politically engaged has an innovative and creative impact on how theatre is written? Is art having a benefit? I mean from a strict artistic point of view. From intuition, I think that this is the case. I don't know if you agree.*

CH Yeah, definitely! (laughs). In the US, we're coming out of 50 years of teaching drama that focuses on the individual and the dysfunctional family. Science can open up our narratives. It's like, “Oh my God, let's put humans into perspective! Enough of ‘My mother screwed up my life!’” We can tell different stories, more inclusive stories where we get off our pedestal for a bit, so we're not constantly the hero or even the smartest species. If we can reposition human beings within a larger web of life in our stories, we might start to embrace more inclusive values. And it's not just the hard sciences that can inform our stories, the social sciences can too. It's a matter of seeing the world as a bigger and more complex organism than just a background to our human dramas.

LL *That is so interesting. And what is your experience with the ‘scientist’? I mean, how close are they to the creative process that you do? Do they contribute ideas, do they get involved somehow? or is the information there and then the artist uses the information just for the creative*

process? Have you had the experience of bringing the scientists into the process and having a conversation with them?

CH In several of my projects, I have talked to scientists – sort of interviewed them – and use what I learned to inform what I was writing. I have also involved scientists directly in panel discussions. I have never had any scientist really be part of a project from beginning to end. They're usually unable to commit to projects with long timelines.

LL *I know.*

CH A big discovery when I started reaching out to scientists, was how receptive they were to having a conversation. It was such a novelty for them to have an artist interested in their work and they couldn't quite figure out how that might translate into art. Everyone I have reached out to has always been very encouraging, saying: “We need artists. We've gone as far as we could go in terms of communicating the urgency of the climate crisis. We need artists to help us.” So, I've always had a really positive experience. I love theater and working with theater people, but the theater is so saturated that the experience of a theater artist is often one of closed doors: “Please, don't contact us.” With scientists, it was more encouraging.

LL *Sometimes the holistic approach of art is also interesting. For example, the problem of “prioritizing”. In the pandemic, that was very clear. If you focus just on the number of ill people or on the collapse of hospitals, those are very clear parameters. In Europe that was the parameter, so let's try to not collapse the hospitals. But then, what about mental health? What about education?*

Then when you talk to scientists, they say, “It is true that art somehow could be even more realistic in the sense of how you manage a complex situation”. In the end, what was done was just to focus on that parameter: the collapse of hospitals, that's the main thing. And now? We are talking about other things. Here in Europe we talk a lot about mental health! Mental health of university students, and of high school students,

that were put in a very difficult situation because of the lockdown. So I think that we, the art and culture people can contribute to that. I think that we can provide scientists with that. Of course, this is not a scientific experiment, but in a way, perhaps it is experimental data. Somehow, we need to establish a parameter that brings all those things together, and that parameter should have a value, it should be considered by scientific research.

I'm just thinking with you here, for instance the idea of health: what it is to be healthy? Well, you can just think that all the parameters are OK, your blood pressure and so on. But of course it's not only that. And I think in the pandemic it was very clear that we were not healthy. Even if you didn't have the virus and you were safe, your health was strongly affected. This is just a suggestion for the future. Perhaps we can think of something where scientists approach the creative artistic world just to learn some methods. I know this is very difficult because the scientific world has a huge pressure to produce papers and results. But here we are working in that direction with no success.... I think it's important to make that feedback of art into science.

CH Theater is used for conflict resolution. I think that's a science-based application, so there must be other ways to use the arts to do similar things. I don't know what it would look like.

LL *(Laughs) It is true that in this case, visual arts are ready to be very experimental. Perhaps in the visual arts we have more chances to do that. Because the language is more open. Perhaps I don't know enough about theater. Theater is more fixed to the language, - perhaps this is my ignorance of the language - but I have that impression. That would be a nice project for the future to try to bring scientists to the theater as data for their research. I don't know if we are close to getting that done. (laughs)*

CH (Laughs) –I think in health, just like music induces health, theater can be used to process trauma... and that's being done in

some places. Beyond that, it would be interesting to see what is possible.

LL *And you mentioned the story-telling and how to deal with a story. It's interesting how even with digital technology, it seems that it makes us think that it's all about numbers. But I think that we live in an era where story-telling is absolutely fundamental. I would like to know what you think about the influence of digital technology on storytelling. There is now all this huge debate with ChatGPT and it seems that machines can write. I mean, I think they are just very good at copying humans, but do you think there is some kind of influence either good or bad, from the digital media in the way we write stories?*

CH Yeah, there's definitely an influence, and I think it's both good and bad. If you put a story online, you reach a lot more people than if you tell a story in a theater, for example. At the same time, we have seen the rise of false information. If a story is good enough or presented in a compelling way, people will believe it. Not to mention that we are inundated with stories. I'm thinking about influencers. Clearly, online stories have had a lot of impact on young people, and a lot of negative impact. But at the same time, I do like the fact that anybody can tell their story. I don't know how we deal with that, or how we regulate or control what is being told. There is the phenomenon of people being able to share videos, about police brutality or revolutions, for example, which has completely changed the public conversation. And then there are extremists broadcasting executions. It's really, really complicated and I'm not an expert in those things but I know something needs to be done.

LL *Why is fiction important? Or how useful is fiction to explain political problems? I mean, you could argue that it would be better just to write an essay that's about telling the truth, so why are we writing fiction? Why is fiction useful?*

CH It's true that in an essay, you can explain things very clearly. That's the purpose of an essay. But fiction doesn't exist to

explain problems. Fiction invites people to question. It invites readers to interrogate something and, in certain cases like in science fiction, it offers a different path: “If we take this question and go in this direction, where might it lead? And what are the ramifications or the consequences?” In addition, in the theater, it’s almost like you get to try someone else’s life (laughs). It’s like, “Oh, let me see how this feels. Let me try on those values, those decisions, and see if I would do the same thing.” It’s a way to see through the eyes of someone who might be very different from us, and gain a bit more understanding of this difference.

LL *What is your experience with the work of actors? Do you just write the text or you are also interested in engaging with how the actors take that text into their bodies, their voices?*

CH The theater world here is slightly different than in Europe. Playwrights write a script and then nothing can be changed without their consent. Nobody can cut or rearrange lines; the script has to be performed the way it is. But playwrights are always involved in the first production of their work. They attend rehearsals every day and make changes in collaboration with the director and the actors.

LL *What about the process of reading theater, which I personally like a lot, but probably for professionals this is not the way it should be done?*

CH No, we like reading theater! You mean reading a book?

LL *As if it was a novel.*

CH The problem in the US is that plays are rarely published. They have to be a commercial hit first. An obscure play – and a lot of the time, those are the most interesting – won’t get published because the publisher can’t make any money from it. However, there is something that has been in existence for maybe 10 years called the National New Play Network (NNPN). It’s an online membership-based platform where playwrights can

upload their plays and members can read them.

LL *Interesting. And back to the climate change crisis, what is the role of guilt? Because guilt is the first thing that you have on the table: “okay, we are all doing it wrong, we are guilty of that, we deserve to disappear as a species”.*

OH I’ve been told that guilt can be the result of understanding the science, but making individuals feel guilty is also a tactic from the fossil fuel industry. I know I certainly feel guilty at times because it’s so hard to figure out what the best decision is. But at this point, we don’t need more guilt – guilt is paralyzing. Yes, there has to be a recognition that we’re all contributing to the accumulation of carbon dioxide in the atmosphere. But at the same time, it would be easy to just sit with guilt and do nothing. Maybe we can’t avoid the guilt, but we need to do whatever we can to give it its right place and make room for more generative emotions.

LL *I agree. What play would you recommend if I say, “Could you please just say one thing that we should read, that we should go to the theater, say, hey, this is something different, please recommend us something”. What would you say, would you say just one thing? No one will be mad (laughs).*

OH (Laughs) The one thing that immediately comes to mind is not a play; it’s a new opera by Gelsey Bell titled “Morning/Mourning” that I recently saw in New York City. The show wasn’t billed as being about climate change, but I think it was! It was an adaptation of a book called “The World Without Us,” which starts on a day where humans have disappeared and looks at how the world changes over millions of years. It was so extraordinary and so moving! And of course, it made me think about climate and biodiversity the whole time. It was poignant, but also joyful and hopeful. I mean, it was everything that a piece of art should do in tackling some of our crises today.

LL *How beautiful! I mean, it sounds promising. Was it an opera?*

CH It was billed as an opera, but it was not operatic in the way we usually understand it. The music and the voices created soundscapes. The performers sang acapella and played with sound and unusual instruments. It was very unique.

INTERVIEW WITH ZACK DENFELD FROM GENOMIC GASTRONOMY BY LLUÍS NACENTA

LI *We have been researching and interviewing organizations that work with scientists from the perspective of art, and that's what you do. If you can, please describe how you work with scientists. How do you involve them?*

Z We engaged scientists and science maybe in three ways. We do have direct engagement with scientists, so for example, we've worked with Dr. Wendy Russell who works on the stomach and gut microbiome and nutrition in Scotland. We did some residencies with her and made some collaborations over the years, a few different times. So that's the kind of scientists that we formed a relationship with and have maintained contact with. And then other times, there's a specific visit to a lab for a specific project. For our smog tasting work, one of our members went to a smog synthesis lab at University of California to understand how they both synthesize and study smog. We wanted to be able to do that from the perspective of taste and flavor.

So the first one is more of a personal relationship, and the second one is more of a technical relationship. And then I would say there's a third way that we interact with scientists, which are people that are really at the periphery of contemporary scientific practice. These are people who are doing permaculture or regenerative farming, or biohackers. They're really engaging with the life sciences, but they're not currently at the university or their training might have been extended by real world practice. Those are three ways of engaging with the scientific community: connections with individuals, visits to lab or technical knowledge and then working with people who are at the edge of science. And then in general, we're often reading papers or engaging with ideas and research.

LL *I imagine in the third group is where the stronger collaborations might happen, meaning that those are people trained as scientists and active professionally as scientists, but that do have an interest in other approaches to knowledge.*

Z Wendy Russell, for example, who's an amazing scientist and in university does big research grants. One of the reasons we already connected with her is because she has a broad interest outside of science, and that's what keeps her fresh and innovative. But that third group, it's not only that they have a wider aperture, maybe of epistemologies or approaches, but because they're not usually directly connected to or burdened by the institutions. They may have more time, their projects are smaller, more localized or taking a different approach rather than a big lab.

LL *In my experience, we work on numerous projects, and it is very rare for collaboration to flow in both directions. I haven't come across a single instance where a scientist, who isn't inherently interested in the artistic aspect, acknowledges at the conclusion of the project, "That collaboration has impacted my work as a scientist." Although this is a goal we strive for, it proves challenging due to the scientific protocols. I don't know if you have the same impression.*

Z I think it goes both ways because also you could say some of the protocols of contemporary art can feel a bit constraining. Food and farming helps us meet halfway. For example, I remember we did a live cooking show with Mark Post who was quite a prominent tissue culture scientist looking at lab growing meat. Mark Post was trained as a chef, which was amazing. We did this performance, a live cooking show in front of a studio audience and it was very, I would say, unusual and maybe a bit out of his comfort zone, but there was already a public that was welcomed in and it was more live and interactive. That's quite different than when you're making an exhibition or installation. When an audience enters these more formal white cube spaces they think, "Okay, what is this?", and then actually

we just have that interaction with an alternative farmer who was very kind to work with us. I think that at the exhibition he was wondering "Wow, art is very strange!". That was very unusual, I think it can definitely be both ways. Having a third domain, such as cuisine, gastronomy or farming, almost means that these two communities can meet in a safer space.

LL *That is very interesting. So what you're saying is that in a context like cooking and eating together and thinking about recipes and ingredients, perhaps it's more well suited for hybrid approaches. It is true that the protocols and forms and the politics of contemporary art are almost impossible to grasp if you don't belong to that world.*

Z It's very exciting to do art with science, we've been doing it for 13 years and we're passionate about it. But sometimes there might be a little bit of overemphasis on the scientists that just come and want us to design their graphs or make stuff look better. Those conversations do happen and you have to bring people along. But on the other hand, I wonder about the reason farming, let's say, your food is maybe a nice space because it's a small space. It's not like the big politics of technoscience. And it's not the big cultish world of contemporary art which is very closed off. It's these smaller spaces where you're able to do things aesthetically and politically, but actually because they're ignored by capitalism, - farming is not very sexy, it's not very exciting, and to a certain extent of food as well -, and it almost gives you more freedom to take on those things because you're not constrained.

LL *You know, here in Barcelona, there is a growing intersection of art and science. It's a topic that everyone is discussing, and there are even dedicated grants for such collaborations. I'm curious, do you have a similar impression of Amsterdam?*

Z Well, I'd say a few things. One of the members who, sitting behind me here, curated an exhibition at the Contemporary Cultural Center of Barcelona (CCCB) IN 2015, HUMAN+.

LL *HUMAN+. The future of our species! That was a beautiful show! You were involved in that exhibition!*

Z In addition to our art making, Cat does some curation and exhibition design. I'm sure she'll be very happy to hear that you saw it. Already a decade ago for us, it felt like Barcelona had a sort of energy around art and science because we came to do some small other projects, for the Barcelona Science Festival and then we were always going to Medialab Prado. So when we tell people about art and science and new media in Europe, we say the Netherlands is the best and most sort of rich place for us, then it's quickly followed by Spain and the UK. So it's interesting that those are the places we identify. I think maybe we're not the best people to ask because we've been involved in our science for a long time, so it feels lost, like the energy has been there. But I can say that one of the stories that we tell is that in the 2010s, one of the cultural bargains that we saw in Europe, is that a lot of new media organizations said "Okay, we're gonna do this theme thing. Science, technology, engineering, art." And then, "Okay, we're going to get some money from the state, from the EU, from the local community, and then we're going to match up scientists with artists and technologists. And the reason you should give us money to justify this, is because of innovation for science and, you know, schemes." And artists took that a bit seriously, but they also understood that that was a way that they could get some resources for artists to work, and that didn't always have to match with what the funders wanted. I think that was the deal in the 2010s that we always talk about, the way neoliberal states could justify arts funding was to say "It's to inspire the technologist, the economy, blah blah blah." But in the last 3, 4 or 5 years, what we've seen is that that started fading as the neoliberal consensus is just being turned upside down. A lot of these institutions are really trying to be quite serious and diligent about ecology, sustainability, regeneration and decoloniality... but all of those activities are very slow. We saw that there was a move from these kinds of things: we could put some artists and scientists, technologists in the room for a weekend and they could make a prototype. If you're working with plants, if you're working with forests, if you work in general with life, with organisms, you have to act

much slower. We see now this is a bit of a challenge the last 3 to 5 years. Because these guys are used to giving three month grants or six months grants. But if you want to do something serious with plants, you need a minimum of 1 year. That's the big transition we've seen over the last decade, I would say this art-science space, especially when it comes to moving away from sort of the digital.

LL *I think that art could benefit from that. As you were saying, it's like art institutions were "hacking" some of the innovation money just to do their projects and then the public administration was just greenwashing, somehow, some innovation money. But if you look at it from the perspective of art, I think that that situation might have been positive in the sense that you push art to go beyond its comfort zone, which I think art really needs. So I've seen very interesting projects in that respect, I see that you also work a lot with designers. In a way, design, perhaps it's only that: it's art without the very strict form of art-making.*

Z I have two small comments: we have a pretty fluid relationship between art, design, technology and science. For us it's taken seriously that these are pretty artificial barriers. I hope we don't look down upon design! On the other hand I would always consider what we do 'arts', but why not borrow many tools from design? Or it doesn't actually matter what we call it in some way. In the past we used to say we were 'cultural producers' to get away from this sort of conflicted conversation. The other thing is, I think you're right, that the art industry or the contemporary art world has a huge problem like, "Okay, we do these biennials, we drop a bunch of people in for two weeks. Then, we...". You know, what is that relationship? And I think there's two solutions. One solution is that you keep revisiting places and have a longer term connection in small bursts, and that's what we managed to do because we were younger, we were traveling a lot and we were getting to know a network of people around Europe and I think US and Asia. I think we really enjoyed being able to do these quicker things that are supported by the art industry for two weeks, two months, but

then to come back and reconnect with those communities in a regular interval. And the other way is to re-localize these practices, because then you're really dealing with events on the ground over time. Whether that's a garden, or a forest, or a farm. It's a different connection when you are there in a place. Deep globalizing or relocalizing the art world... I think it is exciting, it allows us to slow down, but then we should be careful that it stays hybrid and cosmopolitan, and it doesn't become reactionary and xenophobic.

LL *I see that you tend to use a light tone or humor. Why is that? You find that useful?*

Z I think partly it's personality and partly it's ideological. I think that we enjoy what we're doing. I think in some parts of the art world, being serious is seen as a positive or something to be celebrated. We're serious about what we do, but we wanna make sure that we're laughing, finding joy and finding moments of pleasure and conviviality. I think that's really important to us as individuals, but ideologically it's important because if there's some humor, they're able to move beyond the assumptions of the things that are not more obvious. So those are probably two reasons why maybe that mood is lighter. I think the topics are obviously serious, and I also think that things like humor, and joy, delight, these things are pushed aside in the arts, whether it's literature, theater or visual arts. I feel they're often, unfortunately, associated with the feminine. We really try to embrace those aspects of life and culture, even though we're taking very seriously what we do. Delight is very underutilized and an under-respected aspect of culture. Joy, wonder and curiosity, well, these are all why we're doing this.

LL *Now there is a lot of criticism that we should abandon the threat or the fear of a climate collapse. I would be interested to know your thoughts regarding that. You have a little kid, right? From my experience, we have a seven-year-old son who has learned to parrot the discourse, often saying, "But cars are terrible, and they are destroying...". He doesn't know what this really means and then he has a very scary idea that things are not gonna*

last. I'm not sure that this is positive, kids have the right to be joyful, as we were saying. How can we have a positive discourse, if you think this is necessary?

Z It's a little bit of this "What are we fighting for?" question. Yes, there is a climate emergency, it's a biodiversity crisis, these are generational, planetary, unimaginably huge and real. But if we're not building in moments of joy, pleasure and conviviality within that, what's the purpose? I think it's important to keep those other modes in mind to feed our sense of hope and courage about the future. Otherwise, why are you having a child? This is a question and I think Catholics chime in (laughs). I don't know but I think we are maybe a little bit earlier in the journey than you are. Our child was just 5 years old and we talked about these things in some way, but hopefully didn't overburden him yet. His middle name is Atlas, but hopefully he's not gonna feel like the earth is on his shoulders. (laughs)

LL *(laughs) That's a beautiful name!*

Z It's a very tough question and it does make me think about the need to really include parents, and especially mothers in the arts. And I feel very lonely as a new parent that I think especially as a mother within the arts or at least within contemporary art, which seems to really, you know, celebrate the young and the untied-down. I think part of taking seriously the need to be rooted in place on our planet, not necessarily in one town or village or city, but to be rooted in the places is to include the experience of mothers and parents more generally in cultural production. That's maybe an important voice that starts to get harder to be in the mix.

LL *We also have a 5 month old, so we are now revisiting the reason why we should keep hope.*

Z Maybe we're also a bit blindly optimistic, I think we chat and I think quite seriously about the reality of the world. But on the other hand, we moved to the Netherlands by choice one year ago, so we must think about something...

LL *Something can be done.*

Z Yeah, something can be done.

LL *Yeah, but that also happened with the pandemic. That kind of work, working with science or working with scientific ideas, but not only within the science protocols. When you discuss those problems, such as the pandemic or climate crisis, you realize that science also needs that kind of input. The pure rational approach in a way is meaningless, it doesn't make sense to the human species because we are living creatures. There's a group in Barcelona called 'Mothers of science', that's just scientists with kids. The input of art is important here, because those are complex issues and complexity cannot only be addressed with probability and statistics.*

Z One of the academic or intellectual communities that we kept running parallel to for 15 years is like science, technology and sociology. It's like a brutal actor and so many others. You see a lot of artists drawing from that because they really investigate this at a quite deep level. Going into "Okay well actually what is science? What are its constraints? How do we compute other epistemologies?" This idea of a purely rational science is, so whether we want to start to look at human emotions or even our ego, I want to get this paper published or the other, the non human actors that influence things. That is one way to open the field up, and they can make some more room now, I think, with this Decolonial approach also... Yeah, those are different domains in a long journey for a lot of thinkers and practitioners in the sciences and arts and, to be quite precise about the different ways of being in the world, that can be different kinds of communities. And how to have those conversations and make that work? It's hard work. It will take some time, but I think that's gonna be one of the places where something comes out of and transforms science.

LL *What are your thoughts on odd cuisine? What do you think about it? How do you relate to that?*

Z None of the main members of the group are trained chefs, but we are interested in food and probably good home cooks by now. We've collaborated with a lot of chefs and people who really know food. I think a lot of cuisine was originally like a mask we could wear to do some of these projects, that are very resource and labor intensive. We could wear that mask for some of the work that we do. When we do pop ups, food events, like when we made a restaurant in Portugal called the Planetary Sculpture Supper Club that was inserted in an old palace, that was a certain way of approaching food. But then we also do like a lot of these food carts or more on the street events, which is not Hope Cuisine but sort of still shows a contemporary edge, you know, food culture that's quite urban and, let's say, trendy or attractive? We're also doing these things that are about working in people's homes and doing more of one-to-one, or family or community setting events. Being able to have those different registers within food culture is like having a paint box where you can find those things that are most helpful.

Yet, as we have developed genomic gastronomy, cuisine has changed a lot. When we first started, molecular gastronomy was kind of quite big in the fancy restaurant world. We knew about those things, but we never got to eat in those restaurants. At that moment we said "Instead of molecular gastronomy, which is breaking things down and building them back up, maybe we could look at the entire food system on a plate, that entire ecosystem." And that's where genomic gastronomy started, applying the life sciences. But that was also the year Noma came up in Copenhagen and you saw 'farm to plate', and a lot of the different high-end restaurants moved away from this kind of modernist molecular gastronomy to this more post-modern, critically regional cuisine.

That was very funny because we were doing that as artists, but it was also happening in the restaurant world. You have three or four big movies that have come out that are using high end restaurants as a satire of the end of neoliberalism, this end of capitalism. For us it is also very interesting to see that. We've tried to not reproduce the kitchen hierarchies, to really put labor in the foreground, not to keep it in the background. When we're doing these shows, we really want to make sure that the people visiting understand the amount of human labor that it

takes to process and translate, let's say, well selected regional products that are grown well, into a small bite of food you can take, because that labor is often pretty hidden at all stages within the industry. So that's important for us to put that on display and let people get a sense of the scale of those human hours. We are also doing a lot of workshops and interactive things where people are participants, also engaging with multiple steps themselves, which makes them happy.

LL *I recently had a conversation with Paula Bruna. She's an artist and she works with plants a lot. She was saying that we have to remember that plants don't need us at all. I mean, if humankind would disappear, plants would be perfectly okay. But it doesn't work the other way around, we need plants. So that was an interesting approach. Related to that, as an expert on food, what is your take regarding veganism? What would you think about it? Should we all do that huge transformation? Thinking also about the biodiversity crisis and climate crisis and so on.*

Z Why not? Cuisines always change. This is why things like joy and beauty and taste and delight are important because if we say "Oh, you know, you're going to have to eat vegan and it's going to be gray and sad." Well, nobody wants to do that and they shouldn't. But actually, you know, if you look at really rich culinary traditions like the South of India, where it's vegetarian, there may be some dairy but no meat, and it's very rich in biodiversity. The agricultural biodiversity that we call the "biodiversity of the kitchen" is amazing. If you have thali in South India, there are probably like 60 organisms just in one meal. I think, yes, why not? But let's make it joyful and beautiful and delicious. That's maybe the way that we will get there.

And I also think that, for some people, eating vegan cuisine is great. For others, I think it's being more thoughtful and celebrating plants, in this "plant-forward cooking" way. It sounds a bit pretentious, but I think it's useful saying "Okay, how do we put the plant at the center of this cooking?" Sort of focuses on the plants. I think for a lot of eaters even that would start to be a step in the right direction. For all the research we've done

about technical innovations in terms of fake meat, lab grown meat, or these other industrial processes, I think a much more exciting future is one that is plant based and is very biodiverse. The sort of industrial solutions to less meat are pretty sad, right? But that means that we're gonna have to spend a lot more time and energy and human resources on it. So that's maybe the bigger question to me than the cultural constraint. I think most eaters, if you give them delicious plant based food or mostly vegetables with a tiny bit of meat, they could very happily think it tastes good.

INTERVIEW WITH ANNE-MARIE MELSTER FROM ARTPORT_MAKING WAVES BY TATIANA KOUROTCHKINA

T *You are certainly a “person-institution”: curator, producer, writer. How do you present yourself when introduced to the audience that doesn’t know you?*

AM That’s a good question since we are all used to putting people into boxes and I don’t have a box you can easily put me into. I created my own profession, I think. I see myself as an interdisciplinary curator-educator-writer-environmental advocate.

T *You created ARTPORT_making waves when the health of the Global Ocean was not such a widely discussed topic. Did you have to go through the hard time of not being understood or supported, intellectually and financially? What helped you to overcome these barriers?*

AM I co-funded ARTPORT_making waves in 2005/2006 dedicated to the topic of climate change, at a time when only Al Gore was really speaking about it. And yes, I had a hard time convincing people that art at the intersection of science and education to sensitise towards climate change was to become a game changer. People from the contemporary art world said that we were populist. And people from the science world said that contemporary art was not serious enough to collaborate with the sciences. But I am perseverant, stubborn and always believed in what I was doing. As a pioneer in your field you have to be firm. The first years were challenging because I didn’t only have to create ground-breaking projects with almost no budget, I also had to be patient and find other sources of income while building ARTPORT. I worked as an advisor in the art world, I was the director of a language school and I helped set up, as a freelancer, a foundation dedicated to higher education in sustainability, I was also teaching at university. Juggling all

these very different occupations was taking a lot of my time, but I never lost my focus on my baby, my vision: ARTPORT. And the reason was that ARTPORT actually gives me the opportunity to do what I always wanted to do: To connect all my expertise, experiences and university studies into one meaningful work contributing to a positive societal change. And now almost 18 years later I was proven right: It is worth defending your dreams and your vision for a better good, for a higher goal. I have to admit that my big love, the ocean, helped me also to achieve what I wanted to achieve. Since establishing the WE ARE OCEAN Global Program in 2019, my work with ARTPORT has become more impacting and successful. And this is not only based on patience and perseverance, but also because of swimming regularly in the ocean. This kept me strong and healthy to pursue my dream.

T *Even now, despite all the alarms, there’s a discourse in some art circles that Art becomes less “arty” if it has a purpose, like raising awareness about certain uncomfortable issues, for example, the loss of biodiversity. What would you answer to the artists, curators and museum directors who use this argument to defend “pure art”?*

AM Yes, of course. But I don’t enter into discussions anymore because everyone has a specific opinion and I try to be less judgemental. And I and ARTPORT strongly believe that education, art, culture in general, the humanities have a huge responsibility to find solutions for mitigating societal challenges and the ecological crisis and making people more responsive and resilient. Art is a perfect mediator and translator between the disciplines and societal stakeholders. We decided to step out of the ivory tower of contemporary art and take over this responsibility. Since 2005 many more people and entities have decided to take this path. Art is not all about intellectual silos, it is also about planet earth.

T *ARTPORT_making waves is a regular participant in the UN COPs Conferences of the Parties on Climate Change like COP15, 16, 21, 23 and 26. Do you consider yourself an*

advocate or rather an activist? If so, did the perception of art activism change during the past few years?

AM I always saw myself as an advocate, for me the term “activist” has a certain connotation of “fighting”, and I don’t want to take the role of a warrior. I believe firmly in education, and not only in schools and universities. You can learn in all environments, at all ages. Long-life-learning. We work not only with school children and teenagers, but also with university students, policymakers, scientists, corporate leaders, philanthropists and other groups. Change doesn’t only come from the bottom, but also from the top. Each citizen has to drive the change. And the CEOs of multinational corporations, as well as local and international policymakers, are citizens as well, just like you and me.

Many people in the arts, artists, curators, collectors, museum directors, have become more sensitive and active in regards to environmental thinking. Some of them are respected activists. Some of them just “jumped on the fashion train” (I am saying this with a twinkle in the eye). The term “activism” has unfortunately been turned into something negative, mainly by the ones who are denying the need for change regarding our behaviour towards nature (human beings are included in this term by the way) mainly out of specific political or economical interests. But I believe that everyone who is working on this topic, be it climate change, ocean protection, medicinal plants, healthy food, no matter if they are activists, advocates or following thematic trends, are strong supporters of change, positive change for a healthier planet, ocean and human life.

T *How important is the participation of scientists in your projects?*

AM Just like artists, scientists are our protagonists. Without them we could not create the valuable content for our projects, without them we could not raise awareness for those topics in a serious and credible way. Scientists are our motivators, the experts who fuel us with knowledge and enthusiasm for the protection of the ocean, in the case of WE ARE OCEAN. Scientists, all of them, no matter which gender, age or field, are stimulating me,

inspiring me, not only because they are all dedicated, engaged and convinced by what they are doing. They are also sacrificing a lot for their chosen career. Being a scientist today, means being resilient and perseverant. Scientists are my role models and best practice examples.

T *How is your relationship with scientists? Is it easier for you to find a common language with a bigger number of artists or scientists? Does it happen to you to act as a mediator or facilitator between both communities and its representatives?*

AM To be honest (I always am, and this sometimes causes friction...): To work and communicate with scientists is sometimes much easier and more stimulating than with professionals in the arts. And the reason is clear: There is less egocentrism, less narcissism in the scientific world, because the people work dedicated towards their chosen topic and field, not towards the representation of themselves or their chosen topic. Of course, those cases exist as well, but I rarely met them so far. They want to be valued and respected for their input, not for their person. I am generalising, but these are my experiences in 80 % of my working situations.

T *Who is your audience, and how do you interact with them? I assume that your interaction has been increasing year by year. What are the signs of this growing interest?*

AM We have several types of audiences: There is first the youth with whom we are working as active participants in our project. Our main goal is youth empowerment and we work with them in an interactive and participatory way. They engage actively in creating the project with us and through this they learn how to discover themselves, their capacities, the ocean and the environment, and also how to take over responsibility towards their behaviour and the ocean.

Then there is the general audience, the people who attend our public outreach event, who read our social media posts, who read our books, who read the articles published about our projects. We tend to also include them actively in our events by

inviting them into the open fishbowl discussions from the first moment on, not only at the last 10 minutes of the discussion. They have a voice and can share them with us in the form of questions or statements, to animate the discussion. Like this we empower them but we also learn from them.

And last but not least there are the policymakers and corporate leaders, who are important actors for solutions. They are our participants when it comes to our fishbowl discussions and publications, but also knowledge bearers. And they are our audience during our public outreach program which very often happens as part of large-scale international conferences. We always try to include their voice in our work, not only through their highly valuable expert input, but also through their feedback on our work. And we always followed the goal that a top-down-approach is as important for positive change as the bottom up approach. By showing the leaders what the young people reflect on ocean protection, what their questions, doubts and proposals for solutions are, we have the possibility to engage them for real in societal change, we take them out of their silos and connect them with the “real world” which sometimes can be really funny and relieving for everybody. The youth sees that leaders are just normal people whom they can reach out to to propose improvements or to simply ask questions, they are accessible. And the leaders are astonished about how smart those young people are and they are touched about how easy change could be if they just engaged on a local scale sometimes.

T *We live in a world where data, numbers and statistics are highly important and often seem to be the only reliable way to validate initiatives of any kind. Though, the impact of cultural events and activities on the population is hard to measure. What can you say in this respect? Is there any way for you to be aware of the impact ARTPORT_making waves produces on your audience?*

AM Measuring the impact of our projects, like you say, is challenging. But there are always ways, we just have to be creative. In cases where we have enough funding, we work with an evaluator. This also depends on the country and the project. Because

it is not always possible to find somebody, like for our project in Honduras with a remote community on the Caribbean coast. First we didn't have enough funds, second there was no evaluator existing in Honduras who could put together the right evaluation system and second we didn't have any electricity or technical equipment to be able to run a German-style evaluation.

But then there are other ways to measure our success and impact: First: How many young people have we directly and actively worked with since 2005? More than 80.000! This means that something might have stayed with them. Of course, we can not keep in touch with all of them regularly. But sometimes the school teachers engage in a feedback process and send us letters or emails from the young ones, or we go back to the schools to show the results of their work. And we can prove that they changed something in their life, they convinced their parents to live a healthier and more ecologically friendly lifestyle (we have examples but this would be too abundant here right now).

Second: How have leaders in the international policymaking and corporate context experienced our work? The best way to prove this is by showing the amount of collaborating partners in this section which have been working with us in a growing number over the last years. UNESCO trusts and admires our work, because we walk the talk. We obtained their endorsement for the UN Ocean Decade until 2030 and they clearly see that with WE ARE OCEAN we are consistent in setting up up to 4 projects every year globally. People and organisations want to work with us. The budgets have been steadily growing which also reflects our success.

Third: The audience numbers speak for themselves: Over the last 17 years since our foundation we reached around 5 million people worldwide and the ones we spoke directly with always told us: “We learned so much through your project and have been following your work since then. Bringing artists and scientists together to work on a specific topic with young people, makes everybody understand a complicated scientific subject so much easier.”

T *How difficult (or easy) was it for you to establish and strengthen such a meaningful organisation, considering the fact that you are a woman and have always lived in countries that were not your place of birth?*

AM Thank you for this necessary question. A lot of times people, particularly men, look at me, thinking “Oh, she must come from money because running a non-profit in the arts means that she is rich. And she is a woman, what else shall be behind?”. Prejudices and judgements. But I am used to this since I started my career in the art world. When I explain that I started ARTPORT and am still running it because I am convinced that an interdisciplinary work like this is important to contribute to societal change (which is my engine in life, I am a change-maker), people are astonished but after showing them what I have been doing since 2005, they understand and believe me. Raising funds was close to impossible in the first 4 years, but after the first commission by UN related organisations for our exhibition “(Re-) Cycles of Paradise” to be part of COP15 in Copenhagen (it then travelled to Mexico and LA), it became easier. Not only because the topic of climate change entered the art world, but also because people understood that our work was serious and credible. We were not just curating fancy art shows, we were doing social-educational work with and for young people. I tell you very honestly: The first years were very difficult, because I had to earn my money somewhere else, but I believed so much in what I was doing that I became resilient and perseverant, maybe even stubborn.

And living in foreign countries didn't make it easier. People think, when you are living abroad, you are seen as somebody exotic and interesting and everybody wants to work with you. But it actually is just the opposite. The first years in Spain, I had to do mainly with male stakeholders and in order to secure a minimum funding, I always had to go for lunch or dinners with them or introduce myself to international experts. They didn't see me as somebody equal, but as an attractive German woman with a great international network. And not only men but also women had this position. At a certain moment it was becoming boring and annoying. Living in Paris as an interdisciplinary curator being a woman, non-French,

non-aristocratic and not wealthy excluded me from the inner circle as well. Since I was not even exotic, I was not interesting for being hired for special projects either. I understood that very quickly and set up my own programs without being dependent on one collaborating or funding organisation. As part of COP21 in Paris in 2015 we were maybe the organisation with the biggest and most wide-ranging program in the city of Paris as part of the maybe most impacting Climate Conference. We collaborated with the Swiss Embassy, a Parisian based PR Agency, several other funders and set up the “ARTPORT COP21 Art Satellite Program” with Barthélémy Togu and students from the Maximilien Vox Lycée at the Grand Palais with the project Bandjoun Station, Little Sun and Olafur Eliasson at the Ecole Massillon, George Steinman and his project “Symbioses of Responsibility” at the COP15 Conference Center in Le Bourget and the Grand Palais. A public outreach program was hosted at the Musée de la Chasse et de la Nature, the Columbia Center and the Grand Palais. Despite the challenges I was able to set up a strong and impacting program with a small budget. We worked with more than 200 young people from the age of 8 to the age of 22 years.


T *What would be your advice to someone who would like to speed up a social change through culture related activities?*

- AM
- Create your own non-profits or define what you are (curator, artist, entrepreneur, writer, collector, etc.).
 - Collaborate with other nonprofits, like-minded people to speed up change. A rhizome of partners is stronger than a thin vertical stem which tries to grow on its own. First find out who you are, where you come from, where you want to go (objectives, goals, and vision are pivotal for a successful life, particularly in culture).
 - Then set up a strategy of how you want to do that (what are your personal skills, what are you capable of handling?) and use your ideas and engagement, be perseverant and resilient in difficult times.
 - Find allies, mentors and like-minded people, never run after the fancy ones, or the ones which think and work in a

very different way, never run after the ones who don't want to speak with you. Perseverance is good, but follow your intuition and then hang in there.

- Stand in for yourself and always try to stay independent somehow: This is not only entrepreneurial, it is also creative, engaged, and empowering others.
- Always act in the way that you are a best practice example for others (the ethical approach is very important, because ethics are pivotal for long-term success).

TOOLS



GUIDELINES FOR AN EMOTIONAL CARTOGRAPHY OF A GARDEN

This DIY kit was developed after a methodology created by Quo Artis in collaboration with Gabino Carballo, who was in charge of writing the texts.

This kit has been developed to allow everyone to explore any green area from a different, emotional perspective.



The PDF of this publication can be found on this QR Code.

Credits

Cartography 01

An emotional & multisensorial, not scientific, cartography of a garden.

Dérive cartography

An unforeseen possibility of chance encounters, of meetings with strangers.

Proposed by

Quo Artis. Art and Science Foundation
Roots & Seeds XXI. Biodiversity Crisis
and Plant Resistance.

Texts:

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Illustrations:

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INTRO



Imagine that you can never leave where you are standing. Imagine that you can see without eyes, listen without ears, speak, and scream without a mouth. Imagine that your brain dwells underground. Imagine that your mind is not one but thousands. Imagine that you are not one single self but a colony of selves. Imagine that you could copy yourself until you cover a continent. Imagine that parts of you die every year. That you are eaten, trampled, and burnt and yet you are whole, still. Imagine that you can live for thousands of years. Imagine that you need to die every single year. Imagine that you can reproduce the shape and colour of animals you have never seen. Imagine that you are the tallest living thing and that most of you will never be seen. Imagine that your skin, your surface, aligns itself with the sun, constantly finding the best exposure. Imagine that you need both sunlight and darkness to exist. Imagine that your very existence is the basis for the existence of almost all life on planet Earth.

Now Imagine that you are a plant. How would you feel if you could never leave where you are now? How would you survive?

It would be rather difficult: we cannot afford to lose a chunk of our body just because another living thing is hungry. We are very concerned about retaining our integrity and we need to move to stay alive.

If there is anything you do not like, or something that calls your attention, we can choose to move. We do not need to keep our head underground; we can have a good look around and choose a better prospect. We are not plants; we are animals, and as such we can see with our own eyes, hear with our ears, and smell the scent of plants with our noses.

We can traverse the landscape and be curious about things, investigate, and ask questions about things that have always been right in front of our own eyes but that we have never seen until now.

We can even connect to plants emotionally and they can evoke memories and sensations in us.

AN EMOTIONAL & MULTISENSORIAL, NOT SCIENTIFIC, CARTOGRAPHY OF A GARDEN

This activity has to be done with a group of friends and/or family members, as one of its nicest outcomes is the conversation and exchange of ideas that is generated at the end of it. It can also be performed with just one dialogue partner, or even by one single person; in this case, be ready for the “introspection discoveries”: write down your thoughts and discover the surprising conclusions that you will arrive at.

The emotional multisensorial cartography consists of finding one or two plants in the garden, park or forest and drawing them. You can also draw any interactions or processes related to your chosen plants. Do it by yourself or in the company of your life partner, child, grandparent, colleague, or the person you just met. Choose your plants based on the feeling, memory, or association they evoke. Go back in time and find plants that were once relevant to you. Find new ones with the memories they elicit, and what new thoughts they suggest.

You neither need to know their scientific and common names, nor the family these plants belong to. You can search for this information on a specific application but, if you wish, you could just make new names up for them. Remember that, before Linnaeus started classifying all living beings, the same plant could have many different names and the connection between humans and plants was a closer one, based on need and experience.

Do take your time to sketch the selected plants. No matter how “bad” you are at drawing, you will see how rewarding this effort is. Bruno Munari, one of the most creative people of the 20th century, said in his book *Drawing a tree*, that all of us have the potential to do this. You will see how right he was!

Re-group and discuss “your” plants and the reasons why you chose them.

WHAT YOU’LL NEED:

- Something to draw on: a notebook, exercise book, drawing pad, etc.
- Something to draw with: one single pencil could be enough, but, of course, you can use as many (and as colourful) materials as you want.
- Free time and an open mind.



ANOTHER OPTION: *DÉRIVE* CARTOGRAPHY

There exists an unforeseen possibility of chance encounters, of meetings with strangers.

This possibility of transient passage and chance encounters makes us very different from plants. Whilst they are deeply rooted, we have the opportunity to drift, to *dérive*, a chance to be unconsciously intentional.

One can drift and investigate alone, but we tend to go further when meeting people who have reached the same level of awareness. Then we can cross-check different impressions and reach deeper into our observations.

The most fruitful numerical arrangement consists of two or three people working together in a loose arrangement, with some time for individual work and some for working together. Depending on our inclination and the nature of our quest, it may be preferable to change the compositions of these groups from one *dérive* to another.

However, group structure and the issue of how many people should perform a *dérive* is less important than the overall aim and strategy of the activity itself and what it discovers about the plants it is examining. It is worth remembering that savouring time and taking an existential detour to encounter a better self at the end of the travelled path is more important than reaching a specific destination. Imagine that better you.

Should you wish to *dérive* with us, we have several delirious strategies on offer.

THINK UNDERGROUND

Our brains are formed by a mass of cells called neurons. these cells have extensions called dendrites that are designed to receive communications from other cells. They resemble a tree-like structure, forming projections that become stimulated by other neurons and conducting the electrochemical charge to the cell body. Their name comes from the greek word *dendron*, for “tree”. Until recently, we thought that this was just an analogy for the shape of cells, but we are starting to discover that trees have their own kind of nervous system capable of facilitating reactions, memories and learning. Plants seem to have their own kind of intelligence: they can make decisions and are even able to cry out in pain. this underground network connects plants in such a way that has been named the “wood wide web”. It relies on complex relationships with fungi and bacteria to provide plants with a sophisticated awareness of their environment and of each other, allowing them to communicate what they sense, retain some forms of memory, and maybe even pay attention to what we do around them. Just below the surface, plants hide almost as much mass as they display above.



Imagine that you can see clearly underground. Choose a group of plants, maybe two or three. Sketch the connections you imagine exist between them, how they might relate to each other. Try to imagine their conversations. Would they use pulses of electricity or chemicals? Or maybe some kind of radiation in a spectrum imperceptible to us... Can you imagine their “voices”?

FIND THE MINARET

The Horsetail (*Equisetum*) is a plant considered to be a living fossil. It has a structure that is very similar to that of a minaret: a kind of telescopic series of towers with a pattern of spacing nodes wherein those toward the apex of the shoot are increasingly close together, each with a narrower diameter than the last, piled on top of each other, finally ending with a tiny little turret at the topmost point. The minaret is not a copy of the plant: it is a human creation that has adopted a form that nature developed millions of years earlier. In nature, matter adopts modes that are inherent to certain molecular structures subjected to stress. Observing the geometry of plants, flowers, or fruit, it is easy to recognize the presence of recurrent structures and forms that appear to our eyes as different forms that have regularities and symmetries. These have several advantages, as they result in forms that are more compact, homogeneous, interchangeable, and efficient when interacting with the environment.

The study of the arrangement of leaves, branches, flowers or seeds in plants, with the aim of highlighting regular patterns is called phyllotaxis. The various arrangements found in nature follow surprising mathematical regularities, and the plant kingdom has a curious preference for closely related numbers and spiral geometries. Leaves spiral around the stem in a regular pattern determined by a fraction with the numerator being the number of turns around the stem and the denominator being the number of leaves it takes to return to the original leaf position.

Nature has adopted many different methods of survival, but the most common pattern usually follows a sequence which is thought to be the design of least resistance to define the density of branches up a tree trunk or the arrangement of leaves on a stem. This may mean maximum exposure to sunlight for leaves or most effective seed arrangement. The reason why certain forms of art adopt nature-like forms without imitating anything found in nature is because the artist is true to the properties of the material it works with and the underlying laws of our world.



Find artistic forms and movements in certain plants. Urban design forms in the bark of trees, architectural shapes in the form of plants and painting periods in the colours of flowers. Try to spot them from a distance and from up close, using a magnifying lens if necessary. What plant offers the most varied repertoire of art-like shapes, patterns and colours?

BE ULTRAVIOLET

Insects' vision generally overlaps with our own, except that insect's eyes are sensitive to different energy frequencies from sunlight than ours are. We can see light in the energy spectrum from red through orange, yellow, green, blue, indigo, and violet; whereas insects cannot perceive red light but can see ultraviolet light, an electromagnetic energy between 40 and 400 nanometers in wavelength, which we cannot normally detect because our eyes have shielding pigments.

As a result, insects see the world differently than we do, for vital reasons. Ultraviolet light is commonly used to cause visible fluorescent patterns in objects containing special pigments. Many natural objects from rocks and minerals to hard corals and crustaceans fluoresce under ultraviolet light, though its exact function in nature is still insufficiently studied. Researchers have suggested a correlation exists between UV-dark areas of flowers and pollinator navigation, but this has not been completely proven. Research into ultraviolet patterns in the flowers of temperate species has shown that the flowers of about 33 percent of all species strongly reflect this kind of light. About 7% of all flowers show floral patterns that are not evident in visible light.

Certain chemical pigments both absorb ultraviolet light and reflect yellow light, causing ultraviolet-absorbing areas in flowers and making them seem totally dark to insects. These flowers are usually yellow in the visible spectrum, thus making them seem very bright to us, even though they will be invisible to most insects. Whilst we see flowers as ornamental, insects seek flowers for food and survival. Some species need to consume pollen and nectar before they can fly or become sexually mature. Many flowers rely on insects to be able to produce viable seeds. Hence, plants use a variety of strategies to attract pollinators, such as nectaries and floral scents to attract pollinators, because pollinating insects may have visual memory lapses and rely on chemical cues to find their way to them. It would seem that some plants have garish and elaborate petal colour patterns that are invisible to humans but that work as landing marks to guide airborne pollinators.



What would the world look like if flowers were vital to our survival? Imagine that you can see and be seen in the ultraviolet spectrum of radiation. Attempt to draw plants and flowers as you think they look in this fluorescent dimension. Imagine and draw flowers as an insect would see them, or as you think they should look to make them more appealing. Perhaps you can draw yourself and others in this spectrum too.

ALL GRASS IS FLESH

Every species is linked with a multitude of others in an ecosystem. Plants get their energy directly from sunlight, provide food, shelter, and nesting sites for other organisms. Animals consume foods synthesized by plants in the form of fibres and fruits. Many plants depend upon animals for help in reproduction and for certain nutrients. We are all part of food webs that include plants and animals, and diet is as important to us as it is to animals. Most cows, sheep, and goats are herbivores, which means that they are raised on forage and fodder, a diet based on grass, legumes, and silage, which is a form of preserved forage for animal feed in winter. In fact, most cattle are raised on pasture from birth in the spring until maturity, and only some animals are raised on a diet of grain, such as corn or soya beans. Not all herbivores can eat all vegetables, and their diet depends on their ability to digest cellulose and lignin, and also on the structure of their digestive system. Cows, sheep, and goats are known as ruminants because they have a four-chambered stomach that can digest grass and hay. These chambers are called the *rumen*, *reticulum*, *omasum* and *abomasum*. The name “ruminant” comes from the rumen, which has been compared to a large food processor because millions of tiny organisms that live there naturally help the animal to get the nutrients it needs from the vegetable fibres. Herbivores mostly eat grasses, but also legumes such as clover, alfalfa, lentils, and beans. The nutritional value of vegetable fibers varies substantially with the seasons and weather, and animals will use them up immediately or turn the carbohydrates they contain to fat for storage.

After a particularly long winter or extremely dry spring, grass will not have the nutrients cattle need to stay healthy, and that is the reason farmers will turn to supplements rich in carbohydrates or proteins to increase their weight. In a push to increase productivity, the farming industry started giving herbivores feed with animal protein, a practice that has proven to have some risks. 1986 saw the outbreak of the Bovine spongiform encephalopathy (BSE) epidemic in the United Kingdom.

BSE belongs to a group of deadly neurodegenerative diseases that affect humans and animals, called transmissible spongiform encephalopathies caused by the abnormal form of an animal cell protein called prion. It became a global problem, and epidemiological studies suggested that the source of the disease was feed containing BSE-infected processed proteins, such as meat and bone meal. Since then, the practice has been stopped or severely limited.



Draw stems, seeds and fruits and other edible parts of plants that you see. Choose a plant unknown to you that you would like to be edible. If you were to cultivate it for people to eat, what should an edible plant smell, taste or look like? If you were an edible plant, how would you defend yourself against animals? Would you grow thorns, or suffuse your flesh with poison?

THE WRITING TREE

Paper is omnipresent in our daily lives and allows us to communicate, teach, illustrate and create in an immediate and simple way. The word “paper” derives from the ancient Greek and Latin name papyrus - *pápuros* and *papyrus*- an omnipresent plant in Lower Egypt and vital as a writing support, probably the first vegetable fibre obtained for this purpose. The invention of paper as such, made from plant fibres, is attributed to China some two thousand years ago.

From its first invention until the manufacture of paper reached Europe, a millennium passed; and by the twelfth and thirteenth centuries, Spanish and Italian papermakers dipped macerated linen and cotton rags in a solution of animal-derived gelatine to form an opaque, impenetrable surface that was perfectly suited for quill writing and drawing. An 1840 German patent for a shredding machine that would produce paper from wood pulp made the phenomenal growth of the paper industry possible. From then on, trees have become an essential raw material and forestry the basis of the printing industry: one in each three trees felled is pulped to make paper.



The trees felled for paper are mainly softwood, especially spruce, pine and larch, with the notable exception of Eucalyptus, which is a hardwood. Wood pulp contains cellulose fibre, the most important component of paper, the presence of which determines its quality. It is a long-chain polymer that can be considered the basic structural material of trees and plants and, therefore, of nature. Its chemical structure comprises a repeating chain of carbon-hydrogen-oxygen units that is indigestible for most organisms, apart from some bacteria, and is also used to make forms of plastic. Cellulose content in softwood ranges from 50-90%, which makes it ideal for papermaking, but cotton is almost 100% cellulose and therefore makes the best paper for fine art papers. Before the digital age, most of our writing, reading, and drawing was done on paper, or other vegetable fibres such as wood or linen. In a sense, our entire culture, especially our literature, rests on the plant fibres that we have used throughout the centuries. We write on trees.

Choose a tree or a large plant that seems special to you. Imagine that it is trying to preserve some form of knowledge or memories for future generations. What kind of means would it choose? What material would a tree write on? How would it feel about writing on paper? What colour ink would it use? What kind of symbols would be preferable when conveying meaning to writers without eyes? What kind of stories can a plant tell and to whom? Take time to reflect on what we owe to the vegetal world and what it could tell us if it were able to write.

THE POSSIBLE RENDEZVOUS

Humans share the planet with millions of different forms of life, according to what is being billed as the most accurate estimate yet of life on Earth. However, almost an astonishing 90% of all plants and animals have yet to be named and catalogued. Of what we do know, three-quarters of species, the majority of which are insects, are land dwellers; and only one-quarter live in the oceans. We know little about what is out there, especially about which plants and animals will become extinct before we can even record their existence. Since around the time when Linnaeus devised his method of cataloguing and naming living things, 250 years ago, people have been trying to count and catalogue the living world. The Swedish biologist devised a hierarchical, tree-like structure where each individual living species was classed in a series of progressively larger groups, culminating at the kingdom level.

The idea of classification and definition of species goes back a long way, to the first formal attempts to precisely define life by ancient philosophers. For a long time, there has been this need to discern what is alive from what is inert, because on the most fundamental level, the difference between an inanimate object and a living one is not so evident, and all matter that exists is an arrangement of particles. We have not managed to define and compile a set of physical properties that includes all things alive and excludes everything labelled inanimate. Seen at the atomic level, life does not actually exist. A dead body and living one contain the same number of molecules. Some exceptions challenge our perception of what being alive means. Mineral crystals are not generally considered to be alive, yet they have a highly organized structure, and they grow. Fire consumes energy and can grow, jumping obstacles even.

In contrast, living organisms such as bacteria, tardigrades and some crustaceans can enter long periods of dormancy during which they are not growing, metabolizing or changing at all, yet are not technically dead. Defining life as a self-sustaining system capable of evolution implies that certain computer programs are alive. Certain algorithms imitate natural selection to arrive at the optimal solution to a problem, exchanging bits of data, growing, and even reproducing themselves in computer systems. When attached to a tree, a leaf is alive, and its cells work tirelessly to photosynthesize sunlight, carbon dioxide and water into sugars that feed its metabolism. When the same leaf detaches from the tree, its cells do not instantly cease their activities. In fact, one can grow a new tree from a single leaf, or even keep cloning the same plant again and again from a single cell. One could say that life is an invented concept used to simplify an immense spectrum of complexity. In doing so, we have separated ourselves from the universal truths of existence.



Imagine that you have been sent on a rendezvous mission to meet a new form of intelligent life in the form of a tree. Use the plants you know as a reference to draw what it may look like. How would you salute a tree? Would stepping on its root zone be considered polite or rude? What about collecting a flower or picking a fruit? What would be proof of intelligence? How would you exchange information? Draw diagrams and sketches that show the possible interactions.

This kit was developed by Gabino Carballo, a landscape architect and project manager with extensive experience in the application of nature-based solutions, the promotion of urban biodiversity, and the design and management of green spaces. For more than sixteen years, Gabino has worked as an in-house consultant for the municipality of Barcelona, where he was involved in the implementation of naturalisation policies and techniques. Previously, he worked on the design of public, corporate and private gardens and landscapes, both in Spain and the United Kingdom. He is a regular guest lecturer at various academic institutions and author of numerous technical publications, articles and essays. He is also a board member of the Spanish association of parks and public gardens, with responsibility for communication and international relations. He has a long-standing interest in art and design and their relationship with urban design and the environment.



CLOSING EVENT

PRESENTATION IN
ARS ELECTRONICA



INTRO

The final event of Roots & Seeds XXI consisted of the presentation of a series of artistic pieces, talks and workshops at the Ars Electronica 2022 festival, that took place from September 7 to 11 in Linz (Austria). In this manner, the ideas, methodologies, prototypes and artistic essays resulting of two years of collective efforts could reach the audience of one the most important festivals of art and technology in Europe.

The artworks presented in this event were *Feral Automated System "ULTB-1"* by the collective Posthuman Studies Lab and *Living Dead: On the Trail of a Female* by Laura Cinti, both selected and produced through the project's Open Call.

What follows are the descriptive and reflective texts that accompanied and put into context these artistic presentations.

FERAL AUTOMATED SYSTEM “ULTB-1”

POSTHUMAN STUDIES LAB



Credits

Concept:

Nikita Sazonov, Ekaterina Nikitina, Ippolit Markelov, Masha Molokova

Computer architecture:

Dmitriy Lobanov, Andrew Adamatzky, Sergey Pavlov

Design:

Sofa Karavaeva

Front-end:

Artem Masoshin

Exhibition architecture:

Yulia Filatova

3D:

Roman Solodkov

Cinematography:

Nikita Sazonov, Irina Petrova, Vera Vishnevaya

Science supervision and support:

Natalia Alatorseva, Mike Petrov, Andrew Adamatzky

Printed forms:

Daria Trubarova

Network:

Daria Okhrimenko, Roman Solodkov, Daria Trubarova, Alina Brovina, Evgenia Bezginova, Ksenia Ruban, Evgeniy Khlopotov, Irina Gulyakina, Anton Kraftsky, Maria Alexandrova, Natalia Alatorseva, Natalia Kuzmina, Tim Nosov, Altyn Mustafina, Lluís Nacenta

Collaborators:

EMCPS Lab, Mendeleev University of Chemical Technology; Faculty of Contemporary Art, the “Sreda Obuchenia” Higher School

Technical supervision:

Boris Shershenkov

Special thanks:

Hansi Raber (OsciStudio), Peter Fisher, SDVIG Studio, Vita Shakhnovich, Dmitrii Olgin

Creative Europe Project 616712 Roots & Seeds consortium: University of Barcelona, Quo Artis, Ars Electronica, Leonardo/OLATS.

The artist's publication can be found on QR code.



In the 1940s the USSR launched an experiment to introduce a wild plant species into agriculture. Vegetal life had to stand shoulder to shoulder with people and help them to replace the irreparable military losses: humans, animals and plants. By engaging in the recovery of the state and its economy, plants became a living material to fill the oikos, devastated and outfitted by the war. Taraxacum was used to make rubber, Lupinus and Heracleum Sosnovskyi — as silage plants and fertilizers, Populus became one of the strategic trees due to its ability to absorb heavy metals in urban areas and households. The active use of plants turned them into equal workers—green proletarians—and independent actors of the interspecies body of soviet society. According to Valentin Mindovsky, the famous experimental gardener of the time, plants taught humans about communism: “love for green” is an important element of communist education. As the main participants in green building, plants brought new types of connections into society. However, after the USSR collapsed, many of the introduced plants became feral and invasive, picking a fight with humans and creating their own non-human politics.

During the 1960s, computing machines were actively introduced into the agricultural processes with a global and futuristic purpose to create an automated system of economic management (OGAS, the so-called “soviet Internet”). The system was meant to eliminate the locality of communal households while connecting the fragmented body of communism into the unified whole. The body itself became a non-human, cybernetic system with the ability of self-organization and fast adaptation. The previous management systems (five-year plans and a big part of Stalin’s plan for the transformation of nature) were human-sized: they were limited to bureaucratic apparatus with paper reports and approvals performed by humans. OGAS attempted to take humans out of management service while entrusting these processes to computing machines.

Quite ironically, the soviet internet was mere ink on paper. By our research we create a new vision of automated systems: we are reenacting a networked body of communism composed from different vegetal, digital and engineering layers. Wi-fi hubs, digital and vegetal protocols, as well as different

materials mined and crafted from plants, were unified into the might-have-been agricultural soviet internet. Plants here are a pure hyle, that is, a scaffold of the project—both the material of the network, its exchanging information (vegetal cryptocurrency) and the very protocols of exchange (derived from the real mechanisms of vegetal communication). Our network rethinks the ecological status of vegetal biodiversity as a legacy of the agrobiological experiments: plants created in the soviet laboratories and communal households (Heracleum, Lupinus, Populus) still do their labor as green proletarians and accumulate toxic resources on the edge of abandoned industries. By Collecting the products of their labor into the power source (redox flow battery), we are using it for starting and maintaining the network. This is how we find a friendly appliance of toxins that were accumulated within feral and invasive species in order to reconstruct the idea of common as interspecies communist – always unstable – connections.

CARTOGRAPHY

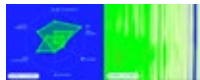
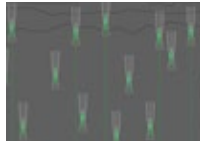
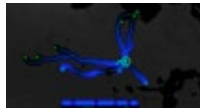
The geography of the project is composed from different places with which the participants are bound constantly or temporally. Every place is a web of the destinies of humans, plants, territories, resources, and factories forming each other and sharing a common. Each point of the map tells a story combining archives, artworks, observations dairies and testimonies of locals.

OIKOS

Connections are vital for the ULTB-1 system. Its internal structure is a whole network of relationships. Each point of the system represents oikos — ‘home’ that purpose does not lie in “the unlimited acquisition of money” but pursues a forming variable, even unstable, ecological relations between different agents and inventing various new ways of using the same resources. On the screen you can see oikoi in the digital forms, how their plexuses poietically and aesthetically look from the inside.

LABOUR

Participants arrange inside their oikoi distributed labour networks. Plants, humans, weather conditions and ecosystems are integrated equally into the ULTB-1 as labour agents which have a common measure of economic productivity and contribution. The collecting data — calculated by different parameters such as temperature, humidity, plants’ flowering speed, etc. — compose the overall productivity of oikoi with their coherence and effectiveness aiming for the final task of the Feral Automated System, the task which no one knows.



HARVEST

Plant and human labour forms a peculiar harvest — the tokens of Vanadium cryptocurrency generated inside the ESP8266 microchips used widely in the agricultural IoT systems. Each token is a special numerical record (1237813624:64409:24:1237791581, for instance) which can be converted into exact Vanadium quantities based on experimental data of plant phytomining abilities. To integrate the Vanadium quantity into the ULTB-1 system, participants send tokens to the chat bot that translates them into the cryptocurrency.

SYSTEM

All the processes inside the ULTB-1 are managed in a certain logic provided by the star topology — a manner in which all points are connected via the central one. We are rethinking this model of connection in a plant way, by imagining all nodes and edges of our system as a hogweed umbrella which also contains the difference between center and periphery. In the hogweed topology of ULTB-1 all points are connected to the central point in a certain moment, that is, all the connections, transfers and accumulations of resources became an organised system.

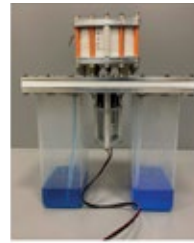
AUTOMATION

Plants have a mechanism of electrical impulses transmission that is very similar to the basis of animal nervous system — action potential. Plants use this mechanism for transmitting electrical impulses inside their body. Based on this mechanism and the principle proposed by Andrew Adamatzky, we have implemented an unconventional plant computer. Applying an

electrical impulse to the electrodes stimulating different parts of the hogweed leaf, we register evoked action potentials. Depending on the number, shape of action potentials and the geometry of the signal propagation pathways, we create a table of Boolean logical operators — AND/OR, etc. The table contains the logic/circuitry of the plant computer. This logic routes resources within the system, as well as sets labour tasks for individual *oikoi*.

OIKONOMIA

ULTB-1 is organised as a crypto-economic model. It accumulates Vanadium, a cryptocurrency of our system. Plant-human labor and unconventional plant leaf calculations are responsible for generating the resource. Referring to Vanadium, we are trying to reuse what is hidden — a rare element in the earth which is also distributed widely as industrial waste but may be used for generating power. Treating Vanadium waste as a base for the economical model we include a thing marked as 'waste', 'weed', 'unecological' into our *oikoi* to create new relations with toxins, 'unnatural', 'other'. The ULTB-1 doesn't aim to accumulate resources but rather multiple ways of organising relations between different beings. Thus, domesticated waste and reused toxins may become a part of our ecological and economical nets again.



MINING

Cultural fugitives — giant hogweed, yarrow, orach, sorrel, knotweed, gumweed, etc. — grow on the edges of *oikoi*, the former factories. Introduced in the culture as super-productive green organisms and subjected to botanical experiments during the Soviet period, they capture abandoned territories now. Their strong roots, stems and leaves accumulate from soil diverse industrial waste, including heavy metals in concentrations hundreds or even thousands of times greater than their content in the environment. Such peculiarity of some plants is used in phytomining — a process of extraction of chemical elements for the purpose of reuse, for example, to employ Vanadium in redox flow batteries. The fuel for our redox flow battery courtesy by The Fraunhofer Institute for Chemical Technology (Dr. rer. nat. Peter Fischer). The battery powers one of our network's wi-fi hubs to which you can connect to and contribute to the Feral Automated System.

FIELD

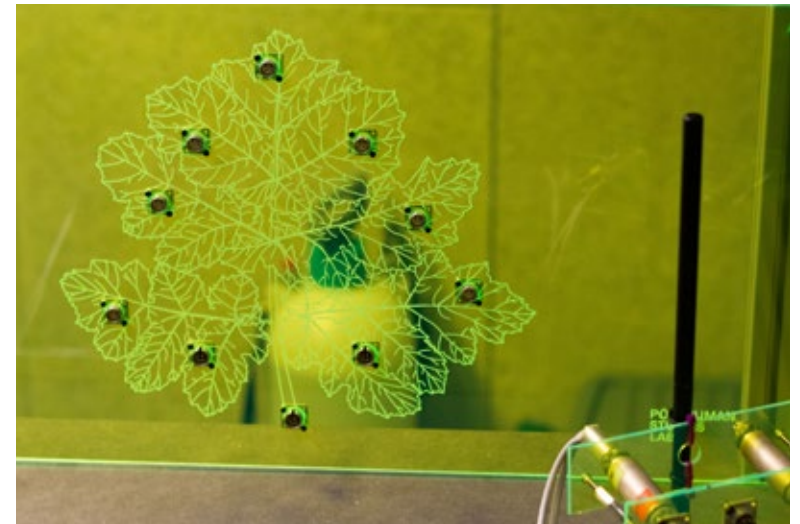
Each ULTB-1 participant has a deep field experience from collecting samples for phytomining experiments, capturing abandoned buildings to talking to locals and gathering myths and stories bound with their *oikos* and its inheritance. All actions inside the system are field-like in a sense of methodological framework of DIY and citizen science. Creating stories, participants attempt to understand the place where they live and belong to. Their fields, *oikoi*, are ruined idealities, still alive on the extremes of marginal spaces — industries, waste deposits, sinkholes, cataclysms, wars.

PACO CALVO ON FERAL AUTOMATED SYSTEM “ULTB-1”

The romantic English poet John Keats suggested, over 200 years ago, the need to cultivate what he dubbed a “negative capability”. In his own words, when we are (sic) “capable of being in uncertainties, Mysteries, doubts, without any irritable reaching after fact & reason.” In modern parlance, Keats is warning us to avoid overinterpreting the data at our disposal, only to find out, alas, that we are underdelivering or failing to deliver the promised results (climate and ecological crises?, we may add). Exerting such a negative capability has a downside: it hinders communication and potential, agreed-upon solutions between scientists and actors in the arts and the humanities. The work by the Posthuman Studies Lab provides an instance of the way to go. By transcending the traditional boundaries of mainstream biology, and integrating its object of discourse more holistically, their work can inspire a new generation of creators to begin asking new transdisciplinary questions; questions that will probably never be raised from the—once privileged, but today’s stagnant—reductionist scientific discourse. Gaining new insights, without any complexes with an eye to thinking alternative futures, requires that we look at the interconnections between natural and artificial systems with a fresh eye. The artful interconnections between vegetal and computing systems, as explored by the Posthuman Studies Lab, provides the means to avoid intellectual shoehorning, turning our potential ‘negative capabilities’ into promising futures; helping us to identify and sharpen the type of game-changing science that can hint at novel lines of engagement to confront the climate and ecological crises.

Credits

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LIVING DEAD: ON THE TRAIL OF A FEMALE

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Project website:
www.c-lab.co.uk/projects/living_dead



Encephalartos woodii, Temperate House, Royal Botanic Garden, Kew, September 2021. Photo: Laura Cinti. The *Encephalartos woodii* in Kew Gardens is an offset of the only plant of this specimen ever found in the wild. It was sent to Kew in 1899.

ABSTRACT

Living Dead: On the trail of a female is a biodiversity focused art-science project using drone technology and aerial mapping to locate a female partner for one of the rarest plants in the world, the *Encephalartos woodii*. Although an *Encephalartos woodii* was not located, it highlighted the promising possibility of using drone technology to locate rare and endangered species. Future scopes include expanding the search area, aerial mapping and analysis with machine learning. The outcome was a series of maps and a documentary of the process that was used to create a video artwork to highlight the impending biodiversity crisis (using this species as an example). It is hoped that the work and the process behind it will be beneficial for species conservation in the future.

The project is inspired by the story of the loneliest plant on Earth, the *Encephalartos woodii* and draws attention to plants unable to survive in the wild. Isolated from their habitat; these 'extinct in the wild' plants are no longer reproductive members of their population - they are the 'living dead'. Cycads are the oldest surviving seed plant that appeared before the age of dinosaurs around 300 million years ago. In spite of their incredibly long legacy, cycads are now the most endangered living organisms. Rare cycads have also become subject to a thriving illegal market worth millions of dollars annually.

In 1895, a single male tree was discovered in the Ngoye Forest Reserve, South Africa by John Medley Wood. No other specimen could be found and though several expeditions have since explored the forest, this lonely male remains the last of its wild ancestors. It was feared that this plant would be destroyed so it was removed and propagated in botanical gardens. All existing specimens are clones of this plant and all are male. As both sexes are needed for reproduction, without a female, it may never naturally reproduce again. It is one of, if not the rarest, and possibly most sought after species of cycads.

The Ngoye Forest is vast with many areas inaccessible by foot leaving acres and acres uninspected and a possibility for a female to be hiding amongst the dense canopies. Historical archives, research papers and correspondence with those who have themselves been on the trail of the female revealed a diverse set of approaches from forest expeditions, to hopes of

creating a female through induced sex change and hybridisation with closely related species.

Starting with the idea of accessing inaccessible parts of the Ngoye Forest, I wanted to explore how remote sensing technologies could provide an alternative approach to mapping this space. While sourcing papers where remote sensing technologies had been specifically used in cycad identification, I came across an interview with Dr Debbie Jewitt who expressed an interest in using drones to count threatened species, mentioning cycads as one example. Jumping on this opportunity of using drones as a visual search and mapping tool I immediately got in touch, which was the seed for our collaboration. Debbie works as a conservation scientist and drone pilot for Ezemvelo KwaZulu-Natal Wildlife, a provincial conservation agency that manages both the Ngoye Forest Reserve and 120 other protected areas in KwaZulu-Natal.

To conduct the drone search, the project was officially registered as a research project with the organisation and an application was also put forward for a manned flight with The Bateleurs, a non-governmental organisation who provide aerial support services to environmental missions in South Africa. One of the pilots, Steve McCurrach, offered to fly over the Ngoye Forest. An initial aerial search provided a view of the forest from above and allowed us to assess the viability of future missions and define search areas for drone flights. Larger tracks of the forest were covered using aerial imagery taken from a manned aircraft (Cessna 182) by using two camera operators: one east and the other west facing.

The drone mission took place over two days in the North East area of the Ngoye Forest Reserve. On one of the days, the weather conditions had worsened due to strong winds and the spectral sensor could not be used. It was replaced with a powerful integrated aerial zoom camera, DJI Zenmuse Z30, which allowed us to scan the south facing slope of the forest, a natural habitat for cycads. It gave a closer view of the trees, and these footages were analysed to search for cycads.

On the day when the weather improved, a DJI Matrice 210 drone was deployed and equipped with a Micasense Red-Edge-MX multispectral sensor and programmed to fly in a grid



Drone Mission Search for *Encephalartos woodii*, Map over Ngoye Forest, KwaZulu-Natal, South Africa with search boundaries. Image: Google Earth / Airdata.

over two selected areas, each around 40 acres collecting a total of 4000 images.

Flying 80 metres above the takeoff point allowed us to capture imagery with a ground resolution of 8.44 cm. However, uneven terrain such as hilltops and valleys created some challenges as multispectral imagery is ideally photographed over

flat terrains. In addition, the weather was partly cloudy causing changes in the light conditions which can be seen in the final stitched image mosaic.

The multispectral camera takes five photos, one for each wavelength band - red, blue, green - visible to the human eye and additionally Red-edge and Near Infrared which can only be seen using false colours to the final image. A natural colour composite closely resembles the colours as we normally see them. When applying false colours using the red-edge band, photosynthesising vegetation can be seen and also provides information about dying vegetation (seen as blue in the above image). The near infrared band provides powerful ways to classify healthy vegetation, and discriminate between dead trees, roads and geology types. Moreover it can be used to discriminate between different plant materials and distinguish tree species. In addition to using colours, we were also searching for different structures and viewed from above the cycad would have a palm-like structure to its canopy.

Together the drone missions and aerial flights provided a wealth of photos that were each combined by stitching them together to form a mosaic that could be analysed. This is the first time these methods have been used to search for *Encephalartos woodii*.

And while the search continues, the story of the enigmatic *Encephalartos woodii* and the elusive female, its discovery and subsequent disappearance from nature, reminds us just how easy it is to lose a species and lose biodiversity.

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