Worried Wings: eco-media-in-progress

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Abstract

Water is considered by indigenous peoples of Australia and Switzerland to be a sacred gift that is critical to their identity and existence, as well as being economically important (2). Worried Wings is a project-in-progress to create a working prototype for an Alpine freshwater biodiversity experiment. This experiment is an art and science collaboration based on Environmental DNA or eDNA workshops for citizen scientists in Switzerland and Australia and a Virtual Reality installation that also serves as a collection point for public engagement. Here the effects of climate change through eDNA display and transmedia stroytelling are exchanged (1). Waste and pond water quality testing is a long, manual process so the workshops will help scientists gather environmental DNA data (Fig 1). They are also asked to document their experiences. The aims is to raise awareness about biodiversity and how indigenous futures are at stake in each country.

Keywords

art, citizen science, eDNA, freashwater biodiversity, biomimicry, virtual reality. dragonflies and climate change

VR Protaganists as Metaphors

The collection point would be a tactile art and science VR installation, situated in Switzerland at Papiliorama, a museum, where the results and analysis of environmental eDNA will be sonified and visualized. We use the metaphor of dragonflies, because without the presence of them in freshwater environments, one can assume that the ponds in question might be contaminated, or the insects have become extinct or the biodiversity is jeopardized.

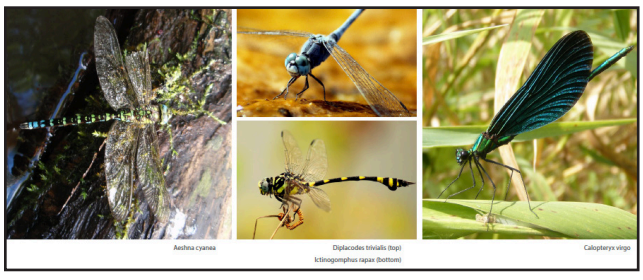

Figure 2. Four of the Dragonflies that are becoming extinct in freshwater ponds. © Jill Scott

Figure 1. The amount of information on biodiversity from one freshwater sample - Environmental DNA ETH, Zurich. © ETHZ

Dragonflies are one of the main players in a healthy food chain and clean water not only effects them, but it is essential to our health and our agriculture (Fig 2). By empathizing with them the audience can compare the biodiversity of different freshwater ponds in two Alpine sites: Switzerland and Australia (3). The collected drawings and samples from the workshop participants will feed into a Virtual Reality experience about the survival of fresh-water species based on various ponds where collection sites have taken place (4). This virtual experience will feature 3D models and sounds from locations. The citizen scientists will be asked to make drawings, interview locals, take photographs, and record sounds from the perspective of

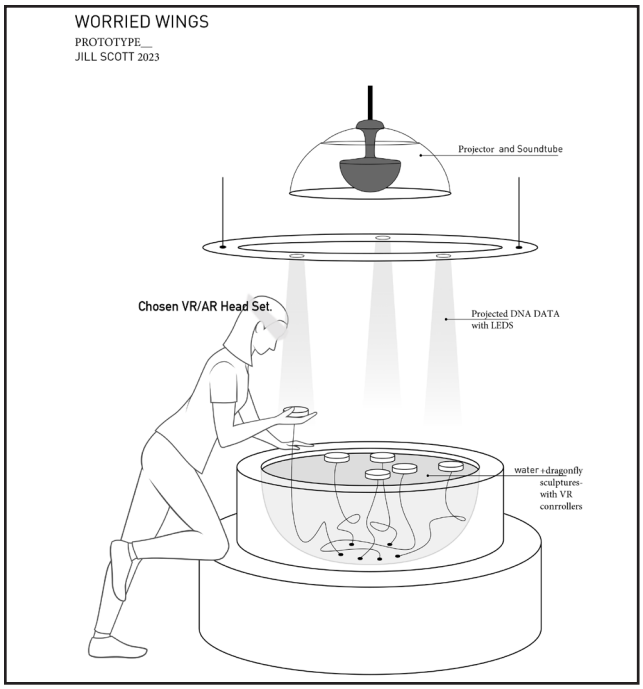

Figure 3. Sketch of the VR installation collection point.© Jill Scott

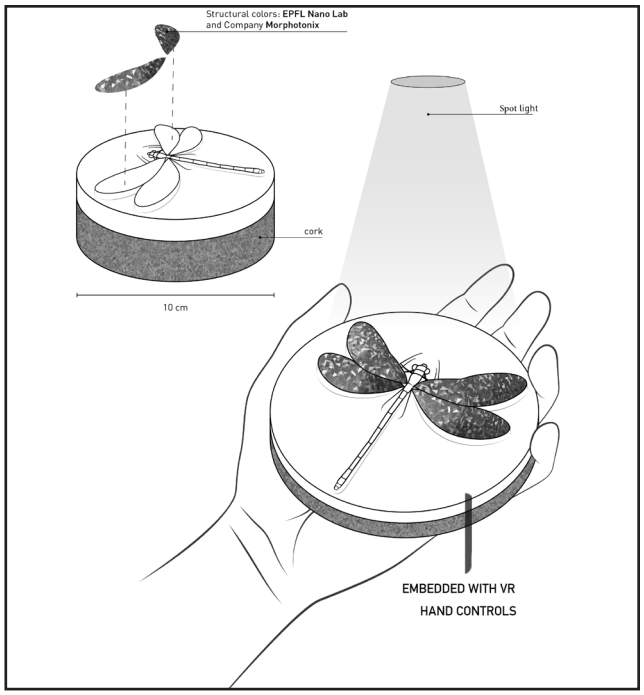

Figure 4. Controllers in sculptures for VR navigation. © Jill Scott

a dragonfly. These recordings are fed into the installation and also onto the VR platform where 3D printed models of either the dragonflies or their larva are used as navigators to understand the loss of biodiversity (Fig 4).

Process: Citizen Science

The citizens and indiginous representatives could be taken on hiking tours to collect water samples. These water samples will be analysed by a Standard Scientific eDNA Sequence Machine where optical technologies are commonly used to quantify nucleic acid, UV and fluorescence. Here, the loss of biodiversity can be measured in these samples, and the species present identified and their loss compared to the DNA found in healthy water (3). These workshop participants will also be taught water quality measurement through simple filtering systems. The monitoring of biodiversity also relies on the measurement of elements like total suspended solids (TSS) and total dissolved solids (TDS), which are the molecules and ions that remain in a water sample after filtration. The aim is to use the central collection point to display these results on the walls of the public space alongside the VR installation. In VR we plan to model four dragonflies that are becoming extinct and attach them to the VR controllers to fly through 3D landscapes related to the citizens findings. The virtual experience is to follow these dragonfly's life cycles from eggs-to larvae-to adults, a process which feeds different food chains and relies on the quality of water and its level of biodiversity to survive (FIG 9). In both, Switzerland and Australia these dragonflies are serious indicators of the health, food chains and ecosystems conditions of the water. Each dragonfly or larva can reveal its particular extinction stories. Freshwater species across the world have declined by a staggering 70% in the last 40 years. Raising awareness through interactive media art is one way to help us pay attention to this loss of life from our ponds.

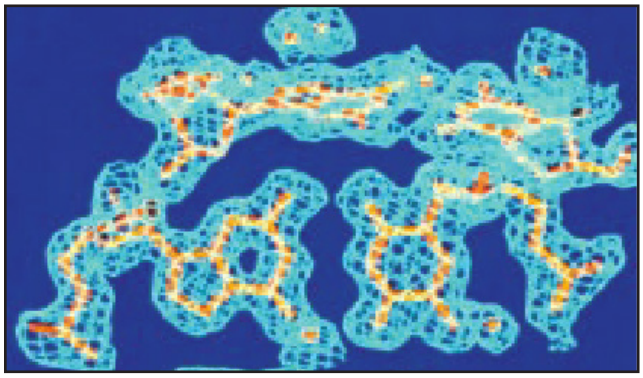

Figure 5. Molecules and ions that remain in the water after filtration displayed in the installation: Worried Wings. © Jill Scott

Worried Wings aims to be an alternative art and science project to raise awareness about water quality. The project educates "citizen scientists" to collect these samples in the field and learn how analysis about the loss of biodiversity through DNA sequencing is conducted and which species of dragonflies are endangered. But these citizens will also learn transmedia art: how their own drawings, photos and sounds can be feed into a central project and combine to make virtual experience for others to appreciate. For science, this analysis adds to the mammoth work of contributing to the mapping of our biodiversity and the related organisms that exist in the environment. However by integrating these results into VR, they contribute to the arts. This new form of hybrid communication can help the audience who are visiting the exhibit to empathise with these creatures and their habitats as well as relate ecology to a sense of place (FIG 6).

Figure 6. Ponds where collection takes place and resultant drawings from Alpine regions - Australia/ Switzerland©Jill Scott

Dragonfly and Larva Details

In these ponds, and hungry bats and birds eat dragonflies who also prey on other insects, and they are supremely adapted for this. With extraordinary vision and superlative flight powers, they are the insect kings of Alpine ponds (FIG 7). *Aeshna cyanea* is a species of hawker dragonfly and it is often the first species to investigate new water. It has a clear preference for small and at least partly shaded habitats. In many places they have either become extinct or on the verge of extinction. *Calopteryx virgo* is a damselfly. It is often found along fast-flowing waters usually in the immediate vicinity of forests. It is very sensitive to oxygen deficiency and dies quickly in polluted sludgy water. *Diplacodes trivialis* breeds in ponds, wet rice fields, shallow lakes, drainage ditches and similar habitats. They are becoming more and more affected by the settlements of pesticides on the water surface. *Ictinogomphus* occur in sluggish water areas like river ponds, riverine lagoons, and isolated ponds. Their existence is severely affected by pollution from industry and human waste. In order to explore these water pollutants, the users can become the nymph and enter into the fresh water. Here, the predator prey relationship to fish and other underwater animals can be explored (FIG 8).

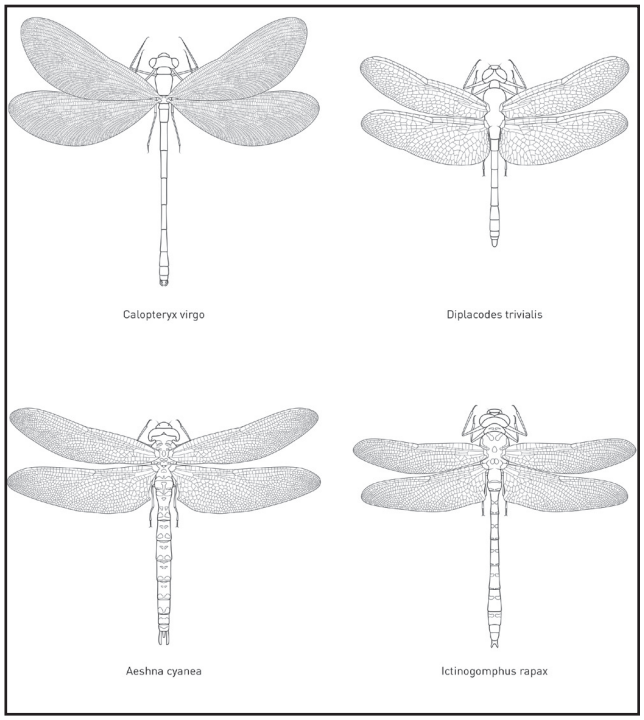

Figure 7. Structual wings of the dragonflys. ©Jill Scott

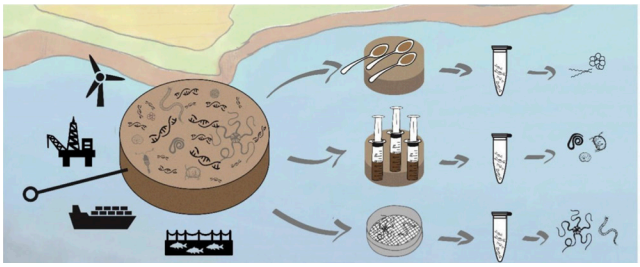

Figure 8. Environmental DNA analysis via the dragon fly eggs or larvae. ©Jill Scott

Biomimicry and Ecology of Place

The coloured wings of each different species of these dragon flies`larva emerge a week after they hatch. The wings are made from structure and not from pigment! Each segment captures light in a different way. Here we wish to mimic the thin layers of a naturally occurring polymer called chitin ("kite-in"), that can be seen as clear or iridescent colour depending on the reflection of light. Here, we will use a unique and patented method of Morphotonix. A nanostructured master pattern for each wing will be designed and produced with the support of EPFL (5). The concept is to use this biomimicry of the wonderful colours to create an interesting metaphorical scenario for the audience to contribute to, reflect upon and empathize with the ecological diversity and the condition of water quality and the collected stories about biodiversity. Therefore, the research for the Worried Wings prototype will gather collaborators from citizen science, environmental science, nanoscience, physics, and game design to create unique interactive macro and micro virtual and real ecologies.

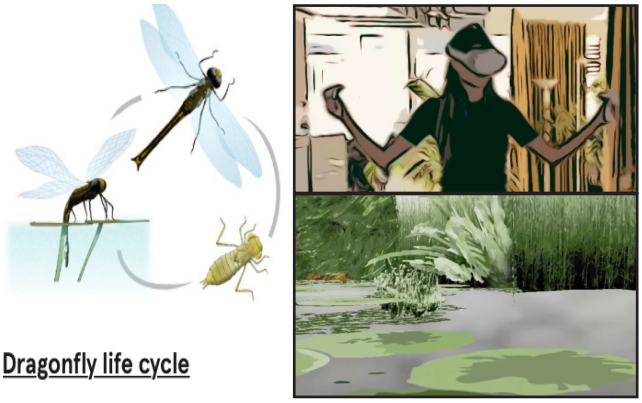

Figure 9. Become a dragonfly to discover biodiversity in freshwater and the effects of climate change in VR. ©Jill Scott

.....Research Team:

Project coordinators and producers:
Jill Scott and Toni Fröhlich
Artistic director: Jill Scott
VR Software and model-based controllers:
Raffaele Grosjean (www.somebodyelse.ch)
Citizen science and eDNA analysis, workshop and production: Prof. Dr. Kristy Diener (ETH Zurich) and Professor Dr. Dianne Gleeson (University of Canberra).
Structural colours of dragonfly wings:
Dr Veronica Savu (www.morphotonix.com), with Prof. Jürgen Brugger (EPF Lausanne) and Dr. Toni Fröhlich

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Biographies

Prof. Dr Jill Scott is a media artist, a writer and art and science researcher. She is professor emerita at the Zurich University of the Arts (ZhdK) in Switzerland and founded their Artists-in-Labs Program in 2000. Her own artwork spans 44 years of production about the human body and body politics. In the last 20 years, she has focused human health based on research into molecular biology, neuroscience, and ecology. She has had many international exhibitions in both art and science venues. *www.jillscott.org*

Dr. Toni Fröhlich has a doctorate in experimental physics. He graduated from the University of Basel in the field of nanoscience, molecular electronics and plasmonics. He is an expert in fabrication methods for nanostructures and carbon nanotubes. He will design the structural colours for various wing designs and collaborate with **Dr. Veronica Savu** (Morphononix) www.morphotonix.com and **Prof. Jürgen Brugger** (EPF Lausanne) https://people.epl.ch/juergen.brugger.

Prof. Dr. Kristy Diener Professor for Environmental Systems Science, ETH Zurich. *https://environmental-dna.ethz.ch/people/prof--dr--kristy-deiner.html.* Her company www.simplexdna.com. In collaboration with **Professor Dr. Dianne Gleeson,** National eDNA Reference Centre, Faculty of Science and Technology, University of Canberra, ACT 2617, www.ecoDNA.org.au

Raffaele Grosjean is a Swiss industrial designer and software programmer for Virtual Reality, Unity. He is co-director of the company **Somebodyelse**. They specialize in making VR accessible projects for science museums and exhibitions. See "Batvision" (2022), *https://somebodyelse.ch*