

## Networking the Flight of the Monarchs

Rob Mackay<sup>1</sup>, Soundcamp<sup>2</sup>, Jessica Rodríguez<sup>3</sup>, Rolando Rodríguez<sup>4</sup>, David Blink<sup>5</sup>, Pablo Jaramillo López<sup>6</sup>

<sup>1</sup>International Centre for Music Studies – Newcastle University, UK

<sup>2</sup>Independent Organisation – UK

<sup>3</sup>Communication Studies & Media Arts – McMaster University, Canada

<sup>4</sup>Independent Artist – Mexico

<sup>5</sup>College of the Siskiyous – California, UK

<sup>6</sup>IIES – National Autonomous University of Mexico, Mexico

[Rob.Mackay@newcastle.ac.uk](mailto:Rob.Mackay@newcastle.ac.uk); [Grant@Soundtent.org](mailto:Grant@Soundtent.org); [jac307@gmail.com](mailto:jac307@gmail.com);  
[rolasii@hotmail.com](mailto:rolasii@hotmail.com); [d.blink@siskiyous.edu](mailto:d.blink@siskiyous.edu); [pjaramillo@cieco.unam.mx](mailto:pjaramillo@cieco.unam.mx)

**Abstract.** *'Networking the Flight of the Monarchs' is an audiovisual telematic performance. Soundscapes from monarch butterfly reserves in Canada, Mexico and the USA are live-streamed from open microphones installed by Rob Mackay in 2018 and 2019, and blended with improvised performances networked in real-time from California (David Blink - handpan/trumpet); Mexico (Rolando Rodriguez - poetry); Canada (Jessica Rodriguez - video); and the United Kingdom (Rob Mackay - flutes and computer).*

*Inspired by Teresa Connors' creative practice, "ecological performativity" enacts a non-anthropocentric model, characterised as the dance of agency between living and non-living systems, human and non-human actors, and the complexity within which they are entangled [1]. This model stems from the premise that artistic practice enables different perspectives of the world and becomes an apparatus for change, promoting what Welsby considers "a long overdue ontological shift in the way we exist in the world" [2].*

*In this performance, multiple spatialities and temporalities are layered together, creating connections between past, present, and future, as well as multiple webs between human and non-human participants, weaving together in a dance of agency [3]. The intended effect is a kind of 'telephenomenology', building a sense of connectedness, embodied knowing, and empathy.*

## 1. Introduction

The performance is part of the project *Following the Flight of the Monarchs*<sup>1</sup> which is an interdisciplinary acoustic ecology project bringing together artists and scientists, connecting with ecosystems and communities along the migratory routes of monarch butterflies as they travel the 3,000 mile journey between Mexico and Canada each year.

Streamboxes are being installed along the monarch butterfly migratory routes between Canada and Mexico. These livestream the soundscapes of these different ecosystems 24/7 via the Locus Sonus Soundmap<sup>2</sup>. The first of the boxes was successfully installed in the Cerro Pelón UNESCO monarch butterfly reserve in Mexico in 2018, and a subsequent one installed at Point Pelee National Park in Canada in 2019. The streams are being used for ecosystem monitoring as well as integrating into artworks which are raising awareness of the issues the monarchs face, whose numbers have declined by nearly 90% over the past two decades.

*Following the Flight of the Monarchs* has produced creative works that enable people to connect with places and ecosystems across the monarchs' migratory routes, through immersive audiovisual technology and telematic audiovisual links, for a visceral experience. Installations include performances by Rob Mackay and collaborators in monarch habitats, interacting with nonhuman agents and hyperobjects [4] and revealing deeper and more entangled webs of interconnectedness. This approach has been extended through live telematic performances, inviting human (musicians, poets, video artists) and nonhuman (actors within the biophony across the monarchs' migratory routes) agencies to interact in a process described by Bennett as 'thing-power' – an inevitable process of entanglement with environment, as that which is seemingly outside of us comes in, to act upon and be acted upon by us, and then goes out again in ongoing "waves of encounters" [5]. Multi-species feminist theorist Haraway refers to our times as the Chthulucene rather than the Anthropocene, describing our epoch as one in which the human and nonhuman are inextricably linked [6]. Drawing on this conceptual approach, the project seeks to move away from dominant patriarchal and anthropocentric thinking over past millennia towards a more intertwined, non-anthropocentric perception of our relationship with environment.

Artefacts produced so far include a touring installation (presented at the Eden Project, and various international conferences and festivals); a networked telematic performance; and a radio programme for BBC Radio 3<sup>3</sup>.

The installation was created in 2016 and consists of a hide-like structure containing 4 video screens and 4 loudspeakers. The creative intention is to immerse the installation participant as if they were in a hide in a mountain forest in Mexico observing the monarchs as they roost and swarm during the winter. The attempted affect is akin to teleporting the participant to that location (a kind of telephenomenology). The videos all present video material filmed by Rob Mackay in the El Rosario reserve in Michoacán. The sound for the installation consists of three layers: field recordings which include the rushing sound of millions of tiny monarch butterfly wings; a specially

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<sup>1</sup> <https://followingtheflightofthemonarchs.com/>

<sup>2</sup> <http://locusonus.org/soundmap/051/>.

<sup>3</sup> <https://www.bbc.co.uk/programmes/m000qyhz>

commissioned poem in Spanish by Rolando Rodriguez informed by the scientific knowledge we have of the monarchs' migration; and a musical layer which is an electronically manipulated arrangement produced from an improvisation between Rob Mackay (flute); David Blink (handpan) and John Sanders (accordion) recorded in the open air on the same day as the monarchs were filmed and recorded at the El Rosario reserve.



**Figure 1. Touring *Flight of the Monarchs* installation, presented at the Amy Johnson Festival, Hull, 2016**

The telematic performance has grown out of the material created for the installation, integrating more sounds and video recordings made at monarch reserves in Mexico, Canada, and USA (Virginia). The sounds were recorded by Rob Mackay, and the video material was recorded by Jessica Rodriguez and Rob Mackay. More details on the creative process and final results of this collaboration will be expanded upon in the rest of this paper.

The 30 minute radio programme for BBC Radio 's *Between the Ears* follows Mackay as he makes a sonic road trip following the monarchs' migration from Toronto, through Virginia, and finally to the State of Mexico. Mackay interviews monarch specialists on the way, and the programme combines these interviews with audio diaries, ambisonic field recordings, poetry, and music.

## **2. Live-streaming Technology and Installation**

### **2.1 Streamboxes**

The streamboxes have been designed and built by Grant Smith at Soundcamp<sup>4</sup>. They consist of a DriBox weather-proof container housing a Raspberry Pi microprocessor, a

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<sup>4</sup> <https://soundtent.org/>

soundcard (first iteration: Cirrus Logic, second iteration: Focusrite Scarlett 2i2), and two omnidirectional microphones (Primo capsules) at either end of the box with wind protection. The boxes can connect to a network in different ways depending on local resources. In the Cerro Pelón Biosphere reserve in Mexico, the Raspberry Pi connects via a wireless router with a data Sim connecting to a 3G network. Power is provided by two solar panels and two solar batteries connected to a charge controller. At Point Pelee National Park, the streambox is located close to the visitors' center. As a result, both power and network connection have been provided through a single 100 ft Cat 6 cable.



**Figure 2. Streambox and battery with wireless router in the Cerro Pelón UNESCO Biosphere Reserve in the State of Mexico.**

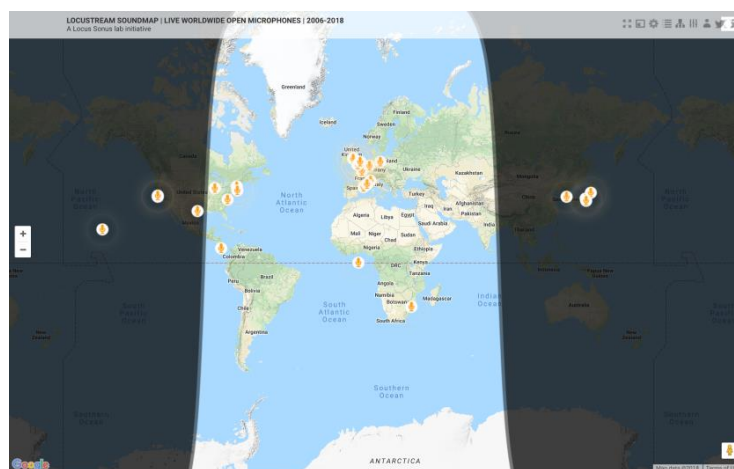


**Figure 3. Streambox, battery housing and solar panel in initial installation position in**

**the Cerro Pelón UENESCO Biosphere Reserve.**

## 2.2 Locus Sonus Soundmap

The streamboxes themselves livestream directly to the Locus Sonus Soundmap<sup>5</sup>, which is part of the Locus Sonus research project run by the Ecole Superior d'Art d'Aix en Provence. The soundmap has been running since 2006 and is an open-source project allowing anyone with access to add a high quality audio stream to the map. There are multiple ways to connect to the map with a variety of devices (Raspberry Pi, laptop, Mobile Phone app (LocusCast)).



**Figure 4. The Locus Sonus Soundmap run by the Ecole Superior d'Art d'Aix en Provence.**

## 2.3 Streambox installation and maintenance

The first streambox was installed in the Cerro Pelón UNESCO Biosphere reserve in the State of Mexico in January 2018 with a project team on site consisting of Rob Mackay; Dr Pablo Jaramillo López (who provided expert knowledge of monarch butterflies); forest ranger Patricio Moreno, networking expert Franco Ramirez, and David Blink. A survey of the area was conducted and a site was found suitably close to the monarchs' roosting grounds which also had a strong enough 3G data coverage and access to sunlight. This set-up is entirely solar powered due to the remote location. The installation is maintained by Patricio Moreno and Franco Ramirez in collaboration with Butterflies and Their People Arborists<sup>6</sup>, which is a non-profit conservation organization.

The second streambox was installed at Point Pelee National Park in Ontario in September 2019. It has been placed on the roof of the visitors' center and is connected to the network and power via a single Cat 6 cable. It is maintained by Andrew Laforet who is the Resource Conservation Project Coordinator for Parks Canada.

<sup>5</sup> <https://locusonus.org/soundmap/051/>

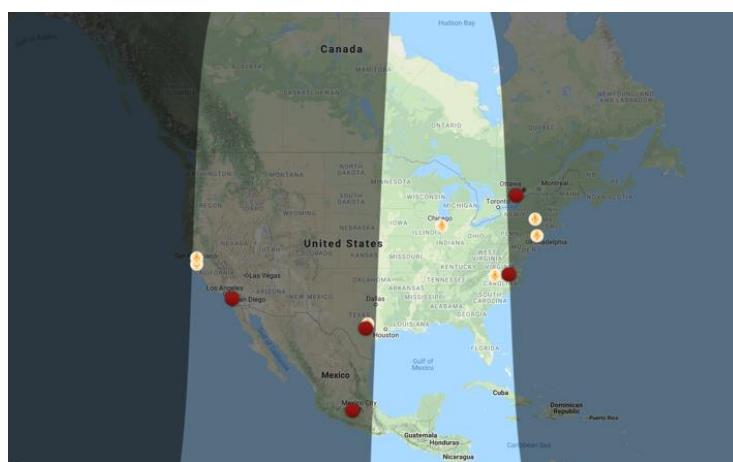
<sup>6</sup> <https://butterfliesandtheirpeople.org/>



A further streambox is currently undergoing installation in the Eastern Shores of Virginia, facilitated by sound artist Vaughn Garland in collaboration with the Coastal Virginia Wildlife Observatory.

We are also planning a streambox installation in Texas in collaboration with Dr Rebeca Quiñones of the National Wildlife Federation.

As well as following the main monarch migration along the Eastern Seaboard, we are liaising with Trevor Herbert at Stanford University's Jasper Ridge Biosphere Preserve near San José, California (where a streambox is already installed as part of their own research) to connect with the smaller western migratory population of monarchs.



**Figure 5. Red dots indicate the planned network of listening stations across the monarch butterfly migration routes.**

### **3. Monarch Habitat Ecosystem Monitoring**

#### **3.1 Context**

The migration of monarch butterflies across the North American continent is a truly amazing phenomenon. There are four generations of butterflies each year. Generation 1 is born in Texas, and the migration moves northwards through generations 2 and 3 up to Canada. Generation 4 (often termed the super-generation) makes the full 3,000 mile journey to Mexico to overwinter in approximately 6 weeks, leaving Canada around the equinox in September, and starting to arrive in their roosting grounds in Southern Mexico around the beginning of November. Incredibly, they often return to the very same trees that their great-great-great-grandparents roosted in the year before.

Scientific monitoring techniques such as tagging; population counts; and temperature and humidity monitoring have proven that monarch butterfly numbers have dwindled by nearly 90% over the last two decades [7]. Evidence for this decline points towards three main factors [8]: industrial use of herbicides and pesticides (prevalent in the U.S. corn

belt); deforestation (particularly damaging to monarch numbers in Mexico where they overwinter densely at high altitudes); and climate change (with increased storm activity). The monarchs are therefore an indicator species of environmental changes. Using sound to monitor these changes helps ecologists understand the effects of logging, herbicides, climate change and other human activity on not only the monarchs but their whole ecosystem, including birds and other insects. This provides valuable information on implications for ecosystem health, including humans [9].

### 3.2 Acoustic Ecology

Acoustic ecology [10] as a field is relatively new, the term first coined by R. Murray Schaefer in the 1970s with his pioneering work establishing the World Soundscape Project [11]. In recent years this field has begun to develop several branches of enquiry, such as soundscape ecology [12] and ecoacoustics [13], which focus on the interrelationship of different species within a soundscape (biophony) and their specific sonic niches within this, alongside geophony (sounds naturally occurring in the environment not made by living organisms) and anthropophony (human-made sounds). These terms being defined by Bernie Krause [14].

Soundscape ecology is advancing the use of sound in ecosystem monitoring considerably [15], moving away from the previous model of collecting and identifying individual species established by Ludwig Koch [16] and towards a model of an interconnected ecology of sound which reveals details of ecosystem dynamics and health. Krause's case study of selective logging in the Sierra Nevada mountains [17] demonstrated the superior effectiveness of aural over visual observation in detecting environmental and ecosystem changes.

Most of the work in the area of sound monitoring has been done using recorded sound (a device is left in an area for a determined duration, ranging from hours to weeks, and is then later collected for analysis). Recent technological developments, however, have enabled the advancement of live-streaming high quality sound over 3G - 5G networks from remote locations. This allows for real-time remote sensing, making a continuous stream of audio data available to anyone with internet access around the world. Pioneering work in this area includes the Locus Sonus project; Leah Barclay's BIOM [18] collaboration with Soundcamp as part of her UNESCO Biosphere Soundscapes [19]; and Topher White's Rainforest Connection<sup>7</sup> which uses a network of solar powered mobile phone-based listening stations in the Amazon basin to detect the sound of logging activity and different species behaviour using machine listening [20].

### 3.3 Project Focus

*Following the Flight of the Monarchs* intends to build on this practice, making high quality audio streams available for ecosystem monitoring. Biodiversity and ecosystem dynamics can be monitored over time. As a proof of concept, a short recording of the livestream from the Cerro Pelón reserve was shared with ornithologists at UNAM (Universidad Nacional Autónoma de México). Jorge Schondube Friedwold, Adrián

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<sup>7</sup> <https://rfcx.org/home.html>

Ceja Madrigal and Elisa Maya Elizarrás identified the following bird species from the recording:

- Long-tailed Wood-partridge *Dendrortyx macroura*
- Gray-barred Wren *Campylorhynchus megalopterus*
- White-eared Hummingbird *Hylocharis leucotis*
- Mexican Violetear *Colibri thalassinus*
- Stellar's Jay *Cyanocitta stelleri*
- Olive Warbler *Peucedramus taeniatus*
- Mountain Trogon *Trogon mexicanus*
- American Robin *Turdus migratorius*

In addition, when overwintering in Mexico, the monarchs display a mass flight behaviour [21] in order to drink water and nectar from available sources once the ambient temperature has warmed enough for them to do this. The sound of millions of butterfly wings during this behaviour is clearly audible and several ambisonic recordings have been made as part of the project. With a streambox installed close to one of these areas, monarch behaviour could be monitored through sound.



**Figure 6. Mass flight behaviour of monarch butterflies in the Cerro Pelón UNESCO Biosphere Reserve in January 2018. Rob Mackay making a recording using a Soundfield ST350. Photo by David Blink.**

## **4. Performance Practice**

### **4.1 Phenomenology and playing place**



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Over recent decades, a body of artistic practice has developed which explores the phenomenology of place, and the relationship between our perception and phenomena external to ourselves: Place vs space, landscape vs environment. In order to engender a greater sense of connectedness with the world around us, many of these artworks seek to place humans firmly within, and as part of, the environmental systems we inhabit. Multi-species feminist theorist Donna J. Haraway refers to our times as the Chthulucene rather than the Anthropocene. Requiring sym-poiesis, or making-with, rather than auto-poiesis, or self-making. Describing our epoch as one in which the human and nonhuman are inextricably linked. In her words “Learning to stay with the trouble of living and dying together on a damaged earth will prove more conducive to the kind of thinking that would provide the means to building more livable futures” [6]. This approach moves away from dominant patriarchal/anthropocentric thinking over past millennia, towards a more intertwined, non-anthropocentric one.

Since 2015 a performance collective has emerged through various collaborations consisting of Rob Mackay (flute), David Blink (handpan and trumpet), Rolando Rodriguez (poetry), and Jessica Rodriguez (video media). The first collaboration formed the touring audiovisual installation<sup>8</sup>.

Mackay, Blink, Rodriguez and Rodriguez collaborated again when visiting the Cerro Pelón reserve in January and March 2018. A series of improvisations in the reserves were filmed and recorded in which human and non-human actors interact. In the capturing of these performances, framing was an important aspect. A single ambisonic microphone was used in most cases to produce a single-person perspective (so that listeners get the aural sense of standing in the space). The filming followed the same principle, usually being captured using one device with a fixed perspective. These techniques were augmented in January 2020 when Blink and Mackay visited the Cerro Pelón reserve again, and captured their open-air improvisations using a Sennheiser Ambeo mic and a Go Pro 360 camera in order to capture single point surround sound and video.

#### 4.2 Telepresence, telematics, telephenomenology

The performance explorations and creative process were further developed through 2019 – 2021 with the creation of the performance work *Networking the Flight of the Monarchs*<sup>9</sup>, which is an attempt to extend the dance of agency across time and space via a networked audiovisual performance.

The work is facilitated via the Locus Sonus Soundmap, whereby livestreams from the monarch butterfly reserves are combined with live improvisations by Mackay (UK) and Blink (USA), alongside poetry reading by Rodriguez, R. (Mexico), and live video mixing by Rodriguez, J. (Canada). The performers interact with each other and the live soundscapes in a structured improvisation piece. In addition to the livestreams, recorded soundscapes and performances are also blended into the mix.

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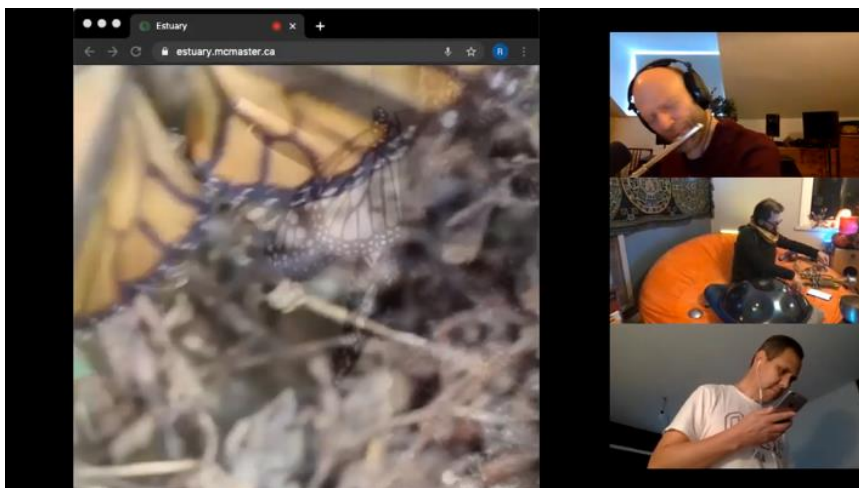
<sup>8</sup> Mackay, R. *Flight of the Monarchs*: <https://www.youtube.com/watch?v=Dhbv63REKtM>

<sup>9</sup> <https://www.youtube.com/watch?v=Jpbb9dnOHPY&feature=youtu.be>

The audio streams are separated from each other by having several different iterations of the soundmap running on different browsers. These are then routed through Loopback into Ableton Live. Here the livestreamed soundscapes and performances are combined with recorded soundscapes and performances to create a montage of different times and places.

The live video component uses recorded footage from the monarch reserves in Canada, USA and Mexico, transmitted using the browser-based platform Estuary/, developed at McMaster University. The live video mixing is done by Jessica Rodriguez (Canada), without any direct input from the audio information apart from listening. The visuals present a contemplative composition highlighting monarch butterfly habitats. The sections of video material set the narrative arc of the performance, opening with shots of the mountain habitats in Mexico, moving the close-up and medium shots of other organisms which inhabit these reserves, and then finally revealing the monarchs at the end of the composition.

Several performances of the work have been presented via zoom at various festivals and conferences (*Music Studies on a Damaged Planet, Seeing Sound, Vibrant Practices, BEAST FEaST, and Bestly Landscapes*).



**Figure 7. Performance of *Networking the Flight of the Monarchs*, Queens University Belfast, 12/11/2020.**

### 4.3 Performance ecosystem

Each iteration of the performance has been different, being a fluid and dynamic dance of agency between the livestreamed soundscapes, human performers, live-electronic processing, and recorded soundscapes, performances, and video footage. The assemblages of sound are collaged in a roughly pre-determined structure along with the video assemblages.

The group have performed to audiences in both hybrid (where some performers and present with the audience in a physical performance space) and entirely online formats. The online performances have been facilitated by Zoom and YouTube livestreaming.

The latest iteration of the technical chain uses OBS software for both the visual presentation and the livestreaming of the combined audio and visual elements.

The performances are coordinated via a text score produced by Mackay in collaboration with the other performers. This score is then communicated section by section via a Facebook Messenger group chat. The musical textures vary between flowing, asynchronous passages, and other sections which require rhythmic synchronization of the performers. The group work with the ecology of the technical set-up and work around the inevitable delay caused by latency of data transmission. In order to maintain audio quality, the Locus stream can have very long delay (up to 30 seconds at times). This is circumnavigated by David Blink muting his monitoring for these sections, and playing rhythmic ostinatos on the handpan. The other performers wait for Blink's audio feed to come through, and simply play in time with that.

All of the audio streams are mixed in Ableton Live on Mackay's computer. The live instruments and voice are further manipulated by live audio effects in Ableton Live including reverb, delay, beat-repeat, and looping (including pitch transposition).

#### **4.4 Ritual and entrainment**

Seeing the mass migration of monarchs and their roosting area can be a transformative ritual experience (like seeing the Grand Canyon for the first time). Durkheim [22], [23], and Turner [24] developed the theory of ritual process. Turner refers to the three stages of the ritual process as separation, liminality, and reaggregation. Liminality, which can be thought of as being in a state controlled by one's inner psyche rather than controlled by ego [25] is preceded by separation, the detachment of the individual from the existing social structure, cultural conditions, or both. Liminality is followed by reaggregation, the return of the individual to everyday life, possibly with changes based on transformations attained during liminality [26]. The project team prepares for annual and delegation *Flight of the Monarch* visits through education, travel, and hard physical activity, which is the first of the tri-part ritual process of Victor Turner. Liminality (the second part) is the real-time experience that can be thought of as a limbo (or transitional) space. This space is perfect to rethink our individual place in this world. Liminality can also open the individual to a stronger form of community (or *communitas*) as a result of personally witnessing the awe of seeing the butterflies in mass migration. The third phase of the ritual process is reaggregation, in which we apply the lessons learned in liminality to our new (transformational) persona.

Collective effervescence, termed by Collins [27] is a useful lens to gain insight into the performances. Collective effervescence extends the individual experience of liminality to a group. According to Collins, collective effervescence can result from a mutual focus of attention and a shared mood, with feedback intensification through rhythmic entrainment building the group's mood. *Entrainment* is a synchronization of musical rhythms or a group's activities [28], [29]. Witnessing the complex multi-generational migration of the monarchs with others creates a shared mood and the sound of the huge population of butterflies creates rhythmic entrainment for the group of people, creating awe and collective effervescence. In turn, the group experience can lead individuals to reflect on their own lives and how we are also part of a complex system of nature.

During Blink's years working with the *Flight of the Monarchs* project, he witnessed a version of the phenomenon of collective effervescence. The phenomenon of collective effervescence starts with a tipping point or boiling over of emotional energy. Viewed through the related lens of an *interaction ritual chain* [27], transformation can be linked to a sequence (chain) of small ritual interactions that, when added up, lead to an emotional tipping point in which our bodies have a physical reaction, e.g., goose bumps on the arms. These breakthrough moments may occur at different points in the interaction ritual chain for each individual, but entrainment pulls the transformations together for the group. A 2018 College of the Siskiyous delegation visit with the *Flight of the Monarchs* team took faculty members and administrators on a trek to Cerro Pelón. When we got close to the roost, our group reclined on the ground and watched the monarchs flying above. Within minutes, the group began to weep. This is what Collins describes as *collective effervescence* which is a result of interaction ritual chains. To understand *interaction ritual chains* deeper, we return to the *ritual theory* developed by Durkheim and Turner.

Durkheim showed that ritual outcomes varied with social membership patterns and the emotions linked to those patterns. Collins realized that the symbols of social membership through ritual create a mutual focus in which a group of people collectively focusing can become emotionally entrained. These emotions are what Collins called emotional energy (EE), which can strengthen the symbols of group membership and create a feeling of solidarity. Each time an interaction ritual takes place between individuals or a group, their EE can be recharged and again feed into feelings of solidarity and powering the symbols that represent membership. "Durkheim noted that a successful social ritual makes the individual participant feel strong, confident, full of impulses to take the initiative" [27]. In this feedback loop, successful social rituals fill your wellbeing, create EE through entrainment, and give you the motivation to seek more social interaction rituals to continue the flow of EE. *Entrainment*, the synchronization of musical rhythms or a group's activities [28] [29], can increase participation within a group.

In Collin's *Interactional Ritual Chains*, the sequence of small activities feed into a feeling of awe. As *Flight of the Monarchs* musicians who have all experienced this phenomenon, we use these telematic performances to recall and intensify our past experiences with the butterflies, re-engaging our individual liminality and re-experiencing collective effervescence. The telematic performances also entrain a new group of people (the audience) engaged in the lecture and performance, leading to collective effervescence of the larger (musicians and audience) group. By using our past collective improvisations, we get back into a state of flow of EE with the larger group.

Clayton, et al. [29] suggested that "through exploring the phenomena of entrainment, ethnomusicologists may be able to better understand how musical sound serves as an interface that connects selves - viscerally and cognitively- to society" (p. 22). In this new way of improvising and engaging in our past improvised performances, we are in a sense creating a new collective effervescence - recharging our past transformative experience. When we perform, Blink plays the handpan in the first track (without hearing the other performers). Although isolated from the other members of the

ensemble at the time of the telematic performance, he recalls the past experiences and sounds created through our past collective effervescence performances in the butterfly roost. By connecting to past experiences (through visuals and memories), he is able to feel a sense of connection and flow with the other members of the ensemble (from past recordings and experiences and from the delayed visual feedback of the other musicians). He feels the mood and intensity of what is being mixed in the final product, but can only imagine the interactions. Not until the performance is complete, can he connect fully with the other musicians and listen to the completed performance recording. When reflecting on the performance as a whole, he cannot distinguish what is the live version and his past recorded self on handpan and trumpet. In essence, the performance is not only re-energizing his own liminality and transformation and the group's collective effervescence, but it is also reconnecting with the original phenomenon of performing together in the actual butterfly roost.

## 5. Future Developments

The ensemble are continuing to develop our practice. In addition to the networked performance, during our last visit to the Cerro Pelón reserve, we made 360 video and audio recording of outdoor performances in the reserves for use in immersive VR installations. We are also currently experimenting with browser-based tools to improve our telematic performance capabilities.

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## Networking the Flight of the Monarchs (performance)

Rob Mackay<sup>1</sup>, Soundcamp<sup>2</sup>, Jessica Rodríguez<sup>3</sup>, Rolando Rodríguez<sup>4</sup>, David Blink<sup>5</sup>,  
Pablo Jaramillo López<sup>6</sup>

<sup>1</sup>International Centre for Music Studies – Newcastle University, UK

<sup>2</sup>Independent Organisation – UK

<sup>3</sup>Communication Studies & Media Arts – McMaster University, Canada

<sup>4</sup>Independent Artist – Mexico

<sup>5</sup>College of the Siskiyous – California, UK

<sup>6</sup>IIES – National Autonomous University of Mexico, Mexico

[Rob.Mackay@newcastle.ac.uk](mailto:Rob.Mackay@newcastle.ac.uk); [Grant@Soundtent.org](mailto:Grant@Soundtent.org); [jac307@gmail.com](mailto:jac307@gmail.com);  
[rolasii@hotmail.com](mailto:rolasii@hotmail.com); [d.blink@siskiyous.edu](mailto:d.blink@siskiyous.edu); [pjaramillo@cieco.unam.mx](mailto:pjaramillo@cieco.unam.mx)

Example Performance:

<https://www.youtube.com/watch?v=Jpbb9dnOHPY&feature=youtu.be>

'Networking the Flight of the Monarchs' (audiovisual telematic performance) - Soundscapes from monarch butterfly reserves in Canada, Mexico and the USA will be live-streamed from open microphones installed by Rob Mackay in 2018 and 2019, and blended with improvised performances networked in real-time from California (David Blink - handpan/trumpet); Mexico (Rolando Rodriguez - poetry); Canada (Jessica Rodriguez - video); and Leeds (Rob Mackay - flutes and computer).

Inspired by Teresa Connors' creative practice, "ecological performativity" enacts a non-anthropocentric model, characterised as the dance of agency between living and non-living systems, human and non-human actors, and the complexity within which they are entangled<sup>1</sup>. This model stems from the premise that artistic practice enables different perspectives of the world and becomes an apparatus for change, promoting what we consider "a long overdue ontological shift in the way we exist in the world"<sup>2</sup>.

In this performance, multiple spatialities and temporalities are layered together, creating connections between past, present, and future, as well as multiple webs between human and non-human participants, weaving together in a dance of agency. The intended effect is a kind of 'telephenomenology', building a sense of connectedness, embodied knowing, and empathy.

'Following the Flight of the Monarchs', is an interdisciplinary acoustic ecology project bringing together artists and scientists, connecting with ecosystems and communities along the migration routes of monarch butterflies as they travel the 3,000 mile journey between Mexico and Canada each year.

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<sup>1</sup> Connors TM. 2015. Audiovisual installation as ecological performativity. In: Proceedings of the 21st International Symposium on Electronic Art (ISEA2015). Vancouver: ISEA. [Also published as a PhD at The University of Waikato.]

<sup>2</sup> Welsby C. 2011. Technology, Nature, Software and Networks: Materializing the Post-Romantic Landscape, *Leonardo*, 44:2.

Streamboxes are being installed along the monarch butterfly migration routes between Canada and Mexico. These livestream the soundscapes of these different ecosystems 24/7 via the Locus Sonus Soundmap (<http://locusonus.org/soundmap/051/>). The first of the boxes was successfully installed in the Cerro Pelón UNESCO monarch butterfly reserve in Mexico in 2018. The streams are being used for ecosystem monitoring as well as integrating into artworks which are raising awareness of the issues the monarchs face, whose numbers have declined by nearly 90% over the past two decades.