

Data-Phantoms: Impossible Nests (Memories Post Extinction)

Clarissa Ribeiro, PhD

Roy Ascott Technoetic Arts Studio at SIVA/DeTAO Shanghai, China
cr@clarissaribeiro.com

Abstract

Recent studies show that in 'anthropogenic landscapes' birds have been forgetting how to sing and build nests since their parents die earlier and their communities are forced to be fragmented. Dialoguing with the Sub-theme "Symbiotic Imaginaries: Inventing Worlds," the work "Data-Phantoms: Impossible Nests (Memories Post Extinction)" (2022) explores the phantasmagoric aspect of raw data coming from 'nature traces' of six (6) bird species declared extinct in nature along sequential morphogenetic transformations from numbers' lists (birdsongs used as primary data), to geometrically complex and irregular data sculptures. The paper presents a discussion around the poetics that refers to an ongoing endeavor in exploring and discussing metaphysical aspects of data visualization embedded in the tools and processes chosen for parametric modeling and digital fabrication. The work intends contributing to reinforce our "symbiotic imaginaries," 'inventing new worlds' in which humans together with all living beings coexist and collaborate in their surviving efforts. The six data-sculptures—imperfect or 'impossible nests'—are tentative explorations of the sublime in dystopian data-visualization aesthetics, manifesting in its irregular and messy geometry, the impossibility of birds, in broken ecologies, to perform their birdsong and successfully mate, to learn from their community how to build an 'optimum' nests and prosper.

Keywords

Data-Phantoms, data-visualization aesthetics, metaphysical aspects of data visualization, incarnation, inherited complex learned behaviors, parametric modeling, morphogenesis, birds' nests, anthropogenic landscapes, symbiotic encounters.

DOI

10.69564/ISEA2023-79-full-Ribeiro-Data-Phantoms

Introduction

“They approached with slow movements, in a blinding light, waving young *hoko si* palm leaves. With their arms decorated with scarlet macaw tail feathers and a profusion of bright, colorful bunches of paixi feathers, coated with vermilion annatto dye, they roared at the top of their voices, like a group of guests arriving at a reahu feast. There were so many of them, and they kept their eyes set on me. It was beautiful but terrifying because I had never seen xapiri spirits before.”¹

In “The Falling Sky: Words of a Yanomami Shaman,” Davi Kopenawa explains that, all our animal ancestors who got extinct, according to the Amazonian Yanomami’s “ecology as cosmology,” “[...] have not disappeared [...] they still have their animal names, but are now invisible beings. They have transformed themselves into xapiri, who are immortal.”¹

As a poetic reference to the extinction of species as a process of information disintegration and dispersion in natural environments, dialoguing with the understanding expressed by the Yanomami community from the Amazon—in a moment we sadly see young birds forgetting their songs as adults are dying faster²—this paper navigates the poetics of the work “Data-Phantoms: Impossible Nests (Memories Post Extinction)” (2022). The work consists of a series of data-sculptures generated using as raw data the birdsong of six species that got extinct in nature worldwide, inviting to meditate on how fragmented audio memories of birds recorded and immortalized by humans in short videos shared online on platforms such as Vimeo and YouTube, can haunt our imagination as phantoms of long-gone forests increasingly replaced by anthropogenic landscapes.

Birdsong is one of the most studied aspects of animal behavior and it is crucial in mate attraction and territorial protection. According to a study published in March 2021, due to the population decline, “[...] male songbirds are having trouble picking up on the songs to attract mates—just as humans lose their culture with future generations, these birds are losing theirs over time.”² The researchers observed that the impact of severe population decline on song culture, in a nomadic, nectarivorous songbird, had dramatic fitness consequences for the remaining individuals considering that the production of atypical songs carried reproductive costs—“males whose songs differed from the regional cultural norm were significantly less likely to be paired to a female.”²

Phantasmagoric landscapes

Anthropogenic landscapes are parts of Earth’s surface where humans’ populations have significantly and endlessly altered natural patterns and processes in order to meet their demands for food, fuel, housing, transportation, recreation, to mention a few. There is a general consensus among scientists who study threatened bird species that, if human impact on the environment continues as it has, one third of all species and an even larger proportion of bird populations will be gone by the end of this century. In Australia, as an example, in the 250 years since Europeans colonization, native birdlife has been dramatically impacted—22 of the native bird species have gone extinct.³ All over the planet, it is estimated that more than 180 bird species have likely gone extinct over the last 500 years. We are currently experiencing what many scientists perceive to be our planet’s sixth mass extinction with far-reaching ecological, cultural, and even economic implications.

By mapping and quantifying this loss, more and more scientists are joining efforts to help refining the scientific understanding about the “impact of habitat removal and other pervasive threats that are driving this observed extirpation.”⁴ The birds most at danger of going extinct today are typically those that depend on certain, unique environmental circumstances, portending a future with declining biodiversity that benefits invasive, generalist species in anthropogenic contexts.

Broken Memories

Back in the 1960s, Elsie and Nicholas Collias were running observations and experiments carried out on a colony of captive Village Weaverbirds (*Textor cucullatus*)—a bird that makes complex and highly organized nests—using a group of young birds hatched in a large outdoor aviary on the campus of the University of California Los Angeles (UCLA). Although many people view nest building as a prominent example of instinctual behavior in birds, this seminal research showed evidences that “[...] some social facilitation exists for nest building, since the birds tend to show interest in nest materials at about the same time, just as in the case of their other activities.”⁵



Figure 1. First nests built by young Village Weaverbirds males (right) are more crudely constructed than are nests built by adult, experienced males. ⁵ Image by Elsie C. Collias and Nicholas E. Collias ⁵.

In this seminal experiment, Elsie and Nicholas Collias ⁵ made crucial observation on how birds develop the ability to manipulate objects—a complex knowledge that is essential for building their nests. They observed that the two weeks age Village Weaverbirds, more than only gaping to receive food from parents, use of their bill to ‘preen disintegrating sheaths off the feathers’ involving ‘biting and nibbling at the feather sheaths’. The researcher considers that “The mouthing of the feather sheaths would seem to be the precursor of the ability to mandibulate strips of nest materials, and thus to adjust the position of a strip in the bill”⁵ since it introduces motor elements needed for nest building. This ability, according to the researchers’ observations, is very likely facilitated by parental example. In their comments on the birds gathering of nest material, the researchers observe that when a weaverbird obtains a strip from a leaf, after perching on the stalk or firm base of the leaf, it “[...] bites through one edge of the leaf, tearing off part of the strip, and then tears the rest of the strip loose by flying away with it in the general direction of the tip of the leaf.” ⁵ Elsie and Nicholas Collias comment that,

“In watching young weaverbirds, whether these birds were reared by hand or in the aviary, it seemed to us that they had to learn many things in carrying out the process of tearing a strip of reed grass properly. While experienced adult males generally fly off, finishing the tearing in one smooth action, the young often made such mistakes as perching in an unstable place, starting the tear too close to the tip of the leaf, or at the very base, or taking too broad or too narrow a bite, or tearing in the wrong direction, or tearing part way and repeatedly starting partly detached strips, or tearing strips that were too short to be woven.”⁵

Confirming the importance of socialization mechanisms in birds communities in helping refining learning abilities relate to nests building and even the role that collaboration between young and adult birds plays in teaching by “showing how to do,” Brosset ⁶ presents the results of a comparative study of social organization during breeding among the genus *Malimbus* of weaverbirds. Brosset observes that,

“In their morphology and behaviour, *Malimbus spp.* are close to the weaver birds of the genus *Ploceus*. *M. nitens* seems the least evolved species while *M. cassini* and *M. coronatus* are behaviourally the most evolved. In the last species, which has a very elaborate nest, the pair of breeding birds is helped by one to four other birds. These helpers are birds in full adult plumage, and are probably capable of breeding and may do so at another period in the long breeding season of at least six months.”⁶

Additionally, the research refers to similar comparable and systematic observations on species other than the weaverbirds, in regard to the handling of nest materials that had found that hybrid parrots, as an example, gradually improve their ability to cut and transport suitable nest materials in health environments and contexts where they can learn from previous generations’ examples. It seems reasonable to conclude that, teaching and collaboration are key in sustaining the planetary symbiosis of species and within species. Unfortunately, we see that population decline is dramatically eroding cultural memory in wild animals populations and that the birds are not alone in facing their dramatic destiny in this broken symbiosis with humans. The loss of culture is associated with individual fitness costs⁶ possibly contributing to ongoing populations decline for an endless number of species.

Impossible nests

Exploring the impossibility of birds learning from previous and same-generation individuals how to build a proper and efficient nest in anthropogenic landscapes, the work “Data-Phantoms: Impossible Nests (Memories Post Extinction)” (2022)—explores phantasmagoric aspects of raw data as the birdsong used as the input for the generative design of the data-sculptures comes from birds declared extinct in nature. The work invites to meditate on how the building abilities of organisms, far from being straightforward gene expressions, are connected to complex inherited and learned behaviors that can be appreciated as part of the self-organizing adventures of species and their symbiotic abilities and

tendencies that drives cross-scale interactions and integrations in the most diverse environmental configurations and variable conditions.

Data-Phantoms, Data-Incarnations

The work is part of ongoing experiments and efforts in discussing and exploring the metaphysical aspect of data visualization in dialogue with Edgar Wind's notion of "incarnation."⁷ Wind broke with Neo-Kantian tradition by constructing an approach to symbolic forms that provides a true account of symbolic representation—the symbol has a real, visible meaning through embodiment (incarnation). The effort can be described as a meditation on how a creative process that includes the use of birdsong as raw data in a morphogenetic algorithmically driven process can conduct humans and birds through a collaboration-as-fantasy mediated by computers, evoking our symbiotic imaginaries. The work intends to evoke metaphysical aspects of data visualization embedded in the tools and processes chosen for parametric modeling and digital "materialization" (digital fabrication, 2D printing).

Edgar Wind⁸ elegantly dialogue with notions coming from discussions around the quantum measurement problem to discuss how in lab experiments, the laws which are to be discovered are already presupposed, being embodied in the instruments. Transplanting these considerations to discuss aspects of the work "Data-Phantoms: Impossible Nests (Memories Post Extinction)" (2022) related to its poetics, we can consider that in a collaboration between an artist (a human being), the "ghosts memories" or "ghost audio memories" of the six birds gone extinct in nature, a laptop running Rhinoceros 7 and Grasshopper and related customized algorithms, and the Printer used to print the posters (from a series of 3D renderings)—all recognized by the human as non-humans—the experiment tests its own presuppositions.

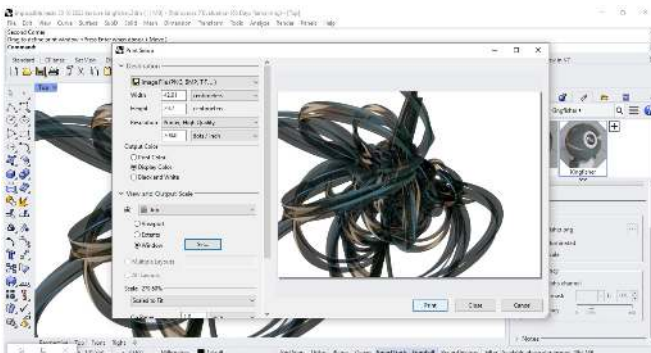


Figure 2. Generating one of the six 'impossible nests' in Rhinoceros 7/Grasshopper. Image by the author.

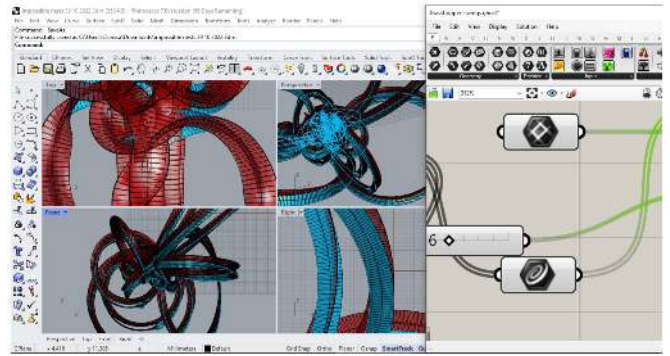


Figure 3. 3D rendering of one of the six 'impossible nests' in Rhinoceros 7/Grasshopper. Image by the author.

The work poetics is woven in a way it can help us transcend our technoscientific fetishes for precision and certainty and perhaps develop a model for knowledge production based on a spirited cosmology and intimacy over cruelty and domination. To generate the data-sculptures the choice for the raw data was the audio extracted from short videos shared on YouTube from the following birds' birdsongs: Alagoas curassow (*Mitu mitu*), Guam kingfisher (*Todiramphus cinnamominus*), Guam rail (*Hypotaenidia owstoni*), Hawaiian crow or 'alalā (*Corvus hawaiiensis*), Socorro Dove (*Zenaida graysoni*), Spix's macaw (*Cyanopsitta spixii*). Dialoguing with the Sub-theme "Symbiotic maginaries: inventing worlds", the work highlights dystopian aspect of the use of data coming from 'nature traces' of 6 (six) bird species declared extinct in nature', bringing the opportunity to meditate on how multispecies collaborations in media arts can help rising consciousness in our community on critical ecological issues.



Figure 4. 3D rendering of 'Data-Phantom 02: Guam kingfisher (*Todiramphus cinnamominus*) Impossible Nest' in Rhinoceros 7/Grasshopper. Image by the author.

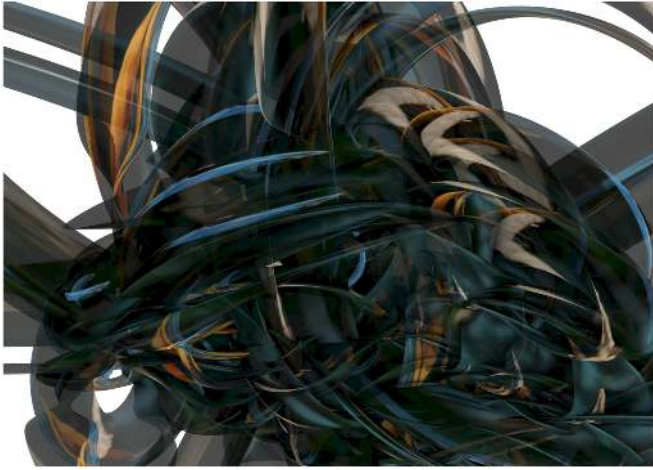


Figure 5. 3D rendering of 'Data-Phantom 02: Guam kingfisher (Todiramphus cinnamominus) Impossible Nest in Rhinoceros 7/ Grasshopper. Image by the author.



Figure 6. The Antwerp magpie nest constructed with anti-bird spikes, seen on the fork of a branch in a sugar maple tree on 25 October 2021. Image by Hiemstra et al ¹¹.

The understanding of a nest as an artifact – that it is part of the information embedded in the organism that created it—was explored by Richard Dawkins in the early 1980s in "The Extended Phenotype". Dawkins argued that ⁹ comparatively, since there are genes involved in the animal body's morphogenesis (such as the 'homeobox gene'), there must be genes whose phenotypic expression is the bird's nest architecture—or the spider's web, for example. Mike Hansell and Raith Overhill, in *Bird Nests and Construction Behavior*, considers that ¹⁰ gene expression in sort of "extended phenotypes" may be more complex than pondered by Dawkins, observing what an organism builds and how can be taken as an expression of the genetic information embedded in the organism.

It is relevant to notice that nests building strategies as complex learned behavior in birds, as it has been observed and documented by scientists in different contexts, includes lifelong learning to meet challenges in hostile environments and can sometimes lead to dystopian innovations.

In a paper published on July 11, 2023, Auke-Florian Hiemstra, PhD candidate in Evolutionary Ecology at the Naturalis Biodiversity Center, The Netherlands, together with his team, discusses the use of "anthropogenic mass" instead of "living biomass" as alternative nesting "materials" by urban birds when building their nest, having birds being observed using "[...] bird deterring materials like anti-bird spikes as nesting material [...]."¹¹

Although bird spikes are designed to keep birds away from nesting and perching, there have been documented examples of sharp, industrialized products being used by birds as nesting material. According to the authors,¹¹ published reports of wire nests date back to 1933, and the Kansas Barbed Wire Museum proudly exhibits a corvid nest made of barbed wire. The team of researchers guess that, from the evidences, members of some bird families are able to remove spikes from buildings and learn how to handle them and might have discovered a new potential for this human-made product.

It is important to observe that, this recent publication ¹¹ focuses exclusively on corvid behavior, describing all currently known nests of carrion crows and European magpies made out of anti-bird spikes, discussing the possible implications of the usage of this bird repelling product as an alternative 'material' for nest construction.

According to the researchers, ¹ the evidences may further support the notion that the use of these sharp anthropogenic 'materials' can be used to enhance nest defense since, as observed, nest building by magpies is sometimes disrupted by carrion crows attempting to prevent dome construction, "as a dome will hide the content of the nest from attacks from above."

Emptiness Ecologies

The series of data-sculptures "Data-Phantoms: Impossible Nests (Memories Post Extinction)" (2022) were commissioned by Mat Keel and Liz Lessner for the collective exhibition "Emptiness Ecologies," at "Yes We

Cannibal"—an institution for experimental art and social practice they co-founded and direct in Baton Rouge, Louisiana., U.S..

Opening on Saturday, December 17, 2022 and displaying until the closing reception on February 4, 2023, YWC directors considered this to be their most ambitious gallery show yet.^{12, 13} According to the curators¹³, "Emptiness Ecologies" was crafted to serve as a creative audit of Ecology as an effusively privileged nexus that ostensibly offers new ways to speak about social and environmental relationships and events. Over the course of six weeks, the idea was to build collectively "[...] a critical space within which to explore those questions and current moment, taking stock of the conceptual uses of ecology and the nature of reality, itself."¹³

Exploring "emptiness" as a core topic, "Data-Phantoms" dialogues with the curators' intention of¹³ making sense of "cognitive dissonance in a moment of stunted political life and ecological cataclysm, including living through the sixth great extinction."

This multimedia show at YWC featured new works of art and writing, including installations by multimedia artist Dawn Dedeaux, collages by artist and Houma nation storyteller Monique Verdin, and works by U.S. based artists and international figures, including a video piece by Duke and Battersby of Syracuse, New York, paintings by Tokyo native Chihiro Ito of Brooklyn, New York, an experimental film by Anna Scime of Buffalo, New York and prints of 3D renders from the series of data-sculptures "Data-Phantoms: Impossible Nests (Memories Post Extinction)."



Figure 7. Emptiness Ecologies show curated by Mat Keel and Liz Lessner at YWC Yes We Cannibal Government Street gallery, Baton Rouge, Louisiana, US, from December 17, 2022 to February 4, 2023. Image courtesy Yes We Cannibal.

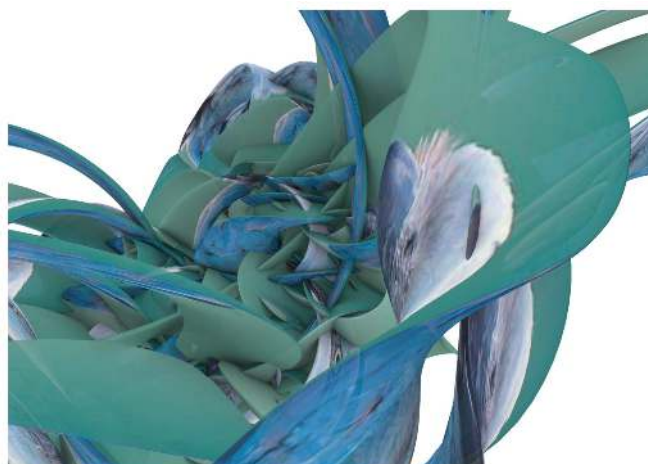


Figure 8. 3D rendering of 'Data-Phantom 06: Spix's macaw (Cyanopsitta spixii) Impossible Nest in Rhinoceros 7/ Grasshopper. Image by the author.

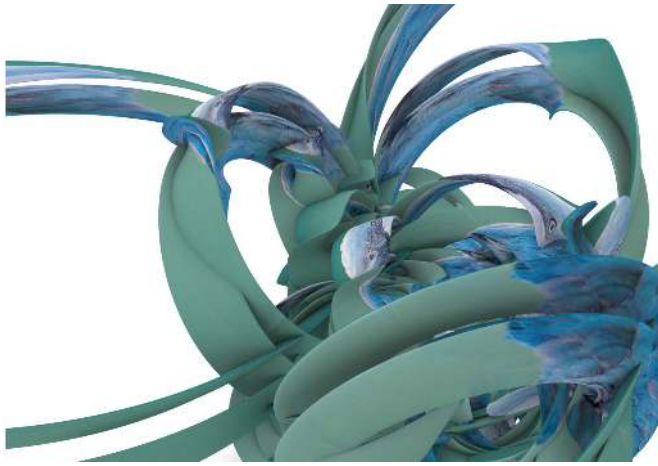


Figure 9. 3D rendering of 'Data-Phantom 06: Spix's macaw (Cyanopsitta spixii) Impossible Nest in Rhinoceros 7/ Grasshopper. Image by the author.

Nest-Works

The explorations that converge in the series of data-sculptures comes from the conversations orchestrated by Amy-Claire Huestis for the 'poetic wilding of all-too-human spaces' she called "nest-works." As Huestis explains, "*Nest-works* began with an experimental panel for the 2021 College Art Association Conference, called "Co-Making this World." The experimental session was modeled after the nest of a bird, a Black-Capped Chickadee. As this cavity-nester builds a home of disparate materials, the panel of artist-researchers built a session of disparate theories and practices, as we considered relationships with world-systems that are in the process of *making* (such as the nest of the chickadee)." ¹⁴

The material produced during the collaboration was curated and organized for *Technoetic Arts* academic journal as *nest-work* of research material, considering new models for knowledge and creative production as "[...] an entanglement of short essays made by artists working with a common pattern, framing eco-poetics on collaborative and participatory processes with the non-human/more-than-human."¹⁴ The article "Data incarnations: Nesting complex inherited and learned behaviours"¹⁵ documents the stimulated dialogues and outcomes starting from Huestis initial invitation.

Final Considerations

In this collaboration-as-fantasy that expands initial experiments in dialogue with a group of artists to discuss aspects of interspecies and human-non-human

collaboration, diving into dystopian aspects of ecological events, the creative effort invited the ISEA 2023 community to navigate our symbiotic imaginaries from a structural perspective. If in nature nests can be incarnations of birds' complex inherited and learned behavior in dialogue with other species and the environment, the experiments having as an outcome the collection of 6 (six) data-sculptures—the 'impossible nests—can embody a tiny sample of this complexity when an artist invites birds that gone extinct in nature, thought the digital audio memories—"ghosts" of their actual, live performed bird songs—into a process-oriented by the intention of algorithmically generate data-sculptures from these birdsong transduced into sequential numerical variation.

Recalling Edgar Wind's notion of incarnation, the intention highlights the "analog-digital" continuum as inherent to nature's complex morphogenetic strategies and not as detached from it.¹⁵ The resultant data-sculptures explores sublime aspects of data-visualization aesthetics in a dystopian endeavor manifested in the irregular and intricate geometry of the resultant objects referring to the impossibility of birds in wrecked ecologies, deprived of proper symbiotic encounters, to socialize, collaborate, teach and learn how to build successful nests and survive.

al Considerations

In this collaboration-as-fantasy that expands initial experiments in dialogue with a group of artists to discuss aspects of interspecies and human-non-human collaboration, diving into dystopian aspects of ecological events, the creative effort invited the ISEA 2023 community to navigate our symbiotic imaginaries from a structural perspective. If in nature nests can be incarnations of birds' complex inherited and learned behavior in dialogue with other species and the environment, the experiments having as an outcome the collection of 6 (six) data-sculptures—the impossible nests—can embody a tiny sample of this complexity when an artist invites birds that gone extinct in nature, thought the digital audio memories—"ghosts" of their actual, live performed bird songs—into a process-oriented by the intention of algorithmically generate data-sculptures from these birdsong transduced into sequential numerical variation.

Recalling Edgar Wind's notion of incarnation, the intention highlights the "analog-digital" continuum as inherent to nature's complex morphogenetic strategies and not as detached from it.¹⁵ The resultant data-sculptures explores sublime aspects of data-visualization aesthetics in a dystopian endeavor manifested in the irregular and intricate geometry of the resultant objects referring to the impossibility of birds in wrecked ecologies, deprived of proper symbiotic encounters, to socialize, collaborate, teach and learn how to build successful nests and survive.

References

1 Davi Kopenawa, Bruce Albert, *The falling sky: words of a Yanomami shaman*, translated by Nicholas Elliott and Alison Dundy, Cambridge, Massachusetts London, England, the Belknap Press of Harvard University Press, 2013, 61

2 Crates, Ross, Naomi Langmore, Louis Ranjard, Dejan Stojanovic, Laura Rayner, Dean Ingwersen, and Robert Heinsohn, "Loss of Vocal Culture and Fitness Costs in a Critically Endangered Songbird", *Proceedings of the Royal Society B: Biological Sciences*, *The Royal Society*, 2021.

3 Rebecca Heisman, "Six Extinct Birds Whose Fame Lives On: The Dodo, Passenger Pigeon, and More", *Bird Calls Blog of the American Bird Conservancy*, September 06, 2022, accessed November 10, 2022, <https://abcbirds.org/blog/extinct-birds/>

4 Michelle Ward et al, "Creating past habitat maps to quantify local extirpation of Australian threatened birds", *Environ. Res. Lett.* 17 024032, 2022, accessed November 10, 2022, <https://iopscience.iop.org/article/10.1088/1748-9326/ac4f8b>

5 Elsie C. Collias, Nicholas E. Collias, "The Development of Nest-Building Behavior in a Weaverbird", *The Auk*, Published by: University of California Press on behalf of the American Ornithologists' Union, Vol. 81, No. 1 (Jan., 1964), 42-52, accessed November 10, 2022, <http://www.jstor.org/stable/4082609>

6 A. Brosse, "Social organization and nest-building in the forest weaver birds of the genus *malzmbus* (ploceinae)", *IBIS International Journal of Avian Science*, Willey Online Library, Volume 120, Issue1, January 197, p.27-37, accessed November 10, 2022, <https://onlinelibrary.wiley.com/doi/10.1111/j.1474-919X.1978.tb04996.x>

7 Edgar Wind, *Experiment and Metaphysics: Towards a Resolution of the Cosmological Antinomies*, trans. E. Cyril, Abingdon, Routledge, 2001.

8 Edgar Wind, "Some points of contact between history and the natural sciences", in R. Klibansky and H. J. Paton (eds), *Philosophy and History: Essays Presented to Ernst Cassirer*, Oxford: Clarendon Press, 1936, 255-64.

9 Richard Dawkins, *The Extended Phenotype: The Long Reach of the Gene*, Oxford, Oxford University Press, 1999.

10 Mike Hansell, Raith Overhill, *Bird Nests and Construction Behaviour*, Cambridge: Cambridge University Press, 2000.

11 Auke Florian Hiemstra, Cornelis W.Moeliker, Barbara Gravendeel, Menno Schilthuisen, "Bird nests made from anti-bird spikes", *Deinsea*, Issue 21, 11 July 2023, 17-25.

12 Zane Piontek, "Yes We Cannibal's New Ecology Themed Exhibit its' most ambitious yet", *225 Baton Rouge*, December 20, 2022, <https://www.225batonrouge.com/things-to-do/yes-we-cannibals-new-ecology-themed-exhibit-its-most-ambitious-yet>

13 The Advocate, "Yes We Cannibal opens multimedia exhibit featuring work by regional and international artists", *The Advocate*, December 15, 2022, <https://rb.gy/yrgnh>

14 Amy-Claire Huestis, "Nest-works", *Technoetic Arts: A Journal of Speculative Research*, 19:3, Nov 2021, p.227-241, https://doi.org/10.1386/tear_00065_1

15 Clarissa Ribeiro, "Data Incarnations: Nesting Complex Inherited and Learned Behaviours." *Technoetic Arts: A Journal of Speculative Research*, 19:3, Nov 2021, 253-26, https://doi.org/10.1386/tear_00067_1

Acknowledgements

I'd like to thank Amy-Clair Huestis for starting the conversation around 'nest-works' and Mat Keel and Liz Lessner for the invitation to contribute to YWC Yes We Cannibal "Emptiness Ecologies."

Author Biography

Clarissa Ribeiro, Ph.D., is a multimedia artist and researcher with an interest in cross-scale information and communication dynamics that impact and shape macro-scale emergent phenomena. In her more recent projects, she explores the metaphysics of information-visualization in subversive morphogenetic strategies that welcome the animistic to navigate ecologies as cosmologies. Chair of the first Leonardo/ISAST LASER talks to be hosted in Brazil/Latin America since 2017, she is an active member of the UCLA Art|Sci Collective and was recently awarded the Roy Ascott Studio's Pete Townshend Endowed Senior Lectureship in Performative Technoetics. She is an Associate Professor of Technoetic Arts at SIVA Shanghai Institute of Visual Arts, DeTao Masters Academy, Roy Ascott Studio in Shanghai and represents the University of Fortaleza in China. She has widely published in journals and conference proceedings and her work has been exhibited worldwide. She has been serving as a reviewer for Leonardo Journal and the Technoetic Arts Journal, the Leonardo Abstracts Service (LABS), contributing as a member of international conferences and symposium committees.