

***The Sixth*: a jeweller's participatory artistic
exploration of extinction and biodiversity loss in
New Zealand**

Michelle Wilkinson

A dissertation in partial fulfilment for the Master of Fine Arts degree at the Dunedin
School of Art, Otago Polytechnic, Dunedin, New Zealand 2019

Abstract

Contemporary jewellery can encourage people to learn more about our environment through the body, the jewellery object, and the conscious act of wearing and interacting with it. This calls for a move towards an approach based on social interaction.

The thesis examines how jewellery can act as a form of communication and an agent for change. It argues that the framework of contemporary jewellery has great potential to speak of issues within society and the environment.

Case studies demonstrate how a participatory approach may enable contemporary jewellery to disseminate, inform and question scientific research and discoveries.

In the exploration of these ideas, the thesis considers how jewellery can assist in communicating the latest scientific literature on the state of the environment in New Zealand. It places jewellery within the context of the history of art and science working together, in order to reveal the ability of contemporary jewellery to work as a teller of these stories.

Table of Contents

1.0	Introduction	5
1.1	The research, its aims and objectives.....	6
2.0	Art and Science as complementary disciplines	8
2.1	Environmental Art.....	16
2.2	BioArt	18
2.3	The synergistic fusion of art and science	19
2.4	Artists working with art and science	20
2.4.1	Brandon Ballengee	21
2.4.2	Vincent Fournier.....	27
2.4.3	Kate MacDowell	29
2.4.4	Suzanne Anker	30
2.4.5	Patricia Piccinini.....	31
2.5	Summary.....	32
3.0	Environmental research.....	33
3.1	Art, biodiversity loss and extinction.....	33
3.1.1	The sixth extinction	34
3.1.2	New Zealand as a case study for human-caused extinctions	34
4.0	Contemporary jewellery as a participatory form of communication.....	37
5.0	Case studies	40
5.1	Locating my research: the brooch as an environmental emissary.....	40
5.2	Research based projects.....	41
5.2.1	Revenant Bird Project	41
5.2.2	A Bat Forsaken	45
5.2.3	Grayling Draught Lamp	47
5.3	Collaborative projects	49
5.3.1	Art + Genetics: A Conglomeration of Stilts	49
5.3.2	Art + Oceans: What Lies Beneath	56
6.0	Exhibition	62
7.0	Research summary and evaluation.....	64
8.0	References	67

List of Figures

Figure 1	Ernst Haeckel-- <i>Kunstformen der Natur</i> , 1899, <i>Actiniae</i>	8
Figure 2	Heather Ackroyd and Dan Harvey, <i>Park Ave + Resident</i> , Void	11
Figure 3	Robert Zhao Renhui, <i>Memorial to the Last Cat on Christmas Island</i>	11
Figure 4	Vaughn Bell, <i>Village Green</i>	12
Figure 5	Jennifer Robertson, <i>Crystal Imperfections as Agents of Deformation</i>	12
Figure 6	Berndaut Smilde, <i>Nimbus D'Aspremont</i>	13
Figure 7	Lily Simonson, <i>Turtle Rock Antarctica</i>	13
Figure 8	Colin Fournier, Marysia Lewandowska and NEON, <i>Centipede Cinema</i>	14
Figure 9	Matt Shlian, <i>Unholy 85 (Go Down Moses/There's Fire in the Woods)</i>	14
Figure 10	<i>House Poem</i> , created by Huang Xiang for the City of Asylum project	15
Figure 11	Mathilde Roussel, <i>Lives of Grass</i>	16
Figure 12	Olga Ziemska, <i>Listen...</i>	17
Figure 13	Oron Catts & Ionat Zurr (2004) <i>The Victimless Leather</i> project	19
Figure 14	<i>DFB 42: Élékra Ozomène</i> . 2008.....	22
Figure 15	<i>DFA 147: Phaethon</i> . 2013	23
Figure 16	<i>Malamp Reliquies</i> , Museum Het Domein, Sittard	24
Figure 17	<i>RIP Charles Island Tortoise: After Ernst Haeckel</i>	25
Figure 18	<i>The Frameworks of Absence</i> . 2006-Ongoing	25
Figure 19	Ballengée cutting a burnt hand-colored stone lithograph	26
Figure 20	<i>The Frameworks of Absence</i> . 2006-Ongoing. Funerary urns	27
Figure 21	<i>Post Natural History</i> (2012-ongoing), Vincent Fournier	28
Figure 22	<i>First and Last Breath</i> (2010)	29
Figure 23	<i>Zoosemiotics</i> (1993- 1995)	30
Figure 24	<i>The Young Family</i> (2002-3)	31
Figure 25	<i>Seeding the Cloud</i> , Roseanne Bartley (2010 -ongoing)	38
Figure 26	<i>Host a Brooch</i> , Jacqui Chan, 2011	38
Figure 27	<i>Schmuck Quickies</i> , Yuka Oyama, 2002-ongoing	39
Figure 28	Two brooch examples	42
Figure 29	<i>MW2016-01-36 North Island Raven, MW2016-01-25 New Zealand Little Bittern</i>	43
Figure 30	<i>A Bat Forsaken</i>	46
Figure 31	<i>Grayling Design Workshop</i>	48
Figure 32	Kakī	51
Figure 33	<i>MW2017-01-01 Pure Poaka, MW2017-01-09 Pure Kaki</i>	52
Figure 34	Melting copper and fine silver together to make alloys	53
Figure 35	Display at the <i>Art & Genetics exhibition</i> , 2017	54
Figure 36	<i>MW2018-01-01, Nudibranch, MW2018-01-02, Spider crab</i>	58
Figure 37	<i>MW2018-01-03, Feather star, MW2018-01-04, Sea squirt</i>	58
Figure 38	<i>MW2018-01-06, Tube worms, MW2018-01-08, Large urchin</i>	59
Figure 39	<i>MW2018-01-11, Hexactinellid skeleton, MW2018-01-12, Brittle star</i>	59
Figure 40	<i>MW2018-01-13, Photochromic 1, MW2018-01-14, Photochromic 2</i>	60
Figure 41	Exhibition display, H.D. Skinner Annex, Otago Museum, August 2018	60

List of Tables

Table 1	Metal alloys	52
----------------	--------------------	-----------

1.0 Introduction

Contemporary jewellery can be used to address the complex questions facing society and the environment. This thesis shows, through a study of art/science approaches and case studies involving the use of jewellery, that it can do this by illustrating and augmenting scientific theories, discoveries and questions.

The subject matter brings together the concepts of extinction, biodiversity loss, hybridization, and the biological effects of the Anthropocene, and entwines natural history theories and discoveries with contemporary jewellery. I have investigated different ways to seek public engagement, curiosity and participation within an art inquiry that challenges the viewer to question beyond what they see and think more deeply around the natural history theories and anthropogenic effects that shape our world. In this way, art can open dialogues, initiate pathways and provide a forum for change.

The practices described traverse the boundaries of Environmental Art and BioArt. I take aspects of both and incorporate them in my thinking. I look at our connection with nature, I work with natural forms to augment the stories I tell. My work also has a critical function, in that it quietly questions our role as a keystone species and the effect we have on our environment. I draw on cultural practices (such as jewellery as a *memento mori*) and work with man-made materials and established processes, as well as coming up with my own. I reference the tools and techniques of art and science, both in the planning and execution of my work, and in my final exhibition and presentation.

The jewellery objects do this by looking at traces, what is left behind – shadows, ashes, and impressions, and combine this with the scientific practices of literature and field research, taxonomy, classification, and order, to present scientific information and observations in a new way.

1.1 The research, its aims and objectives

My aim is to create and present a series of work that is rooted in the theoretical framework of participatory art (Lignel, 2016) and open-ended action research (Mills, 2003). Public interaction with the pieces at various stages of their making and exhibiting life cycle is intrinsic to their role as triggers for curiosity and for information transference.

The writing and practical work form parallel explorations of the same issues. The resulting thesis and exhibition document an investigation of different art/science interactions and outcomes, as well as ideas concerning methods of public engagement and communicating scientific information.

This approach is informed by the growing range of platforms employed by art practitioners in order to engage a wider audience. The research demonstrates the value of a contemporary practice that moves away from the autonomy of the contemporary jewellery object and focuses instead on the relational processes and social interactions involved in the making, wearing, touching and viewing of that object

The project adopts the position that the work of art as a material object is the result of a process that serves to initiate further processes of thoughts and feelings in those that encounter it (Grant, 2017). For me, part of the original process is extensive research into the background information behind the piece of art.

Each art work is built upon empirically robust scientific research. This research involves popular press as well as scientific publications. Often a frustrating process, it can be difficult to source and establish which is the most up to date and verified information (such as with the extinct species' lists when they are continuously being investigated and re-evaluated at the genetic level). Frequently a wide net is thrown, with extensive background reading being necessary. I have found that during the process of making, new information has become available and have had to modify my output accordingly to ensure it is truly representative.

While the resulting pieces themselves are not exact facsimiles of the scientific data, they are made with the objective of communicating the story. Their purpose is to kindle appreciation, to foster an interest, and to communicate research findings and questions that may not currently be within the public's consciousness, to become conversation starters, to be triggers for further research or behavioural change.

As components of a larger, ongoing project, I undertook extensive research into three groups of animals that have been affected significantly by anthropogenic environmental effects: birds,

bats, and freshwater fish. Alongside this, I worked on two collaborative projects with scientists to produce work based on their current natural history research programmes.

2.0 Art and Science as complementary research disciplines

The arts and the sciences were considered to be separate discourses only relatively recently, as academic institutions distinguished between different classes of learning. However, this distinction has never held entirely and in the eighteenth century, with the rise of the Enlightenment and the aspiration that knowledge should be published, depicted, and available to all, the task of creating scientific atlases of visual information was first taken seriously. Artists were commissioned to reproduce the magnificence of nature, exactly, and in painstaking detail. These beautiful and balanced illustrations (Figure 1) now sit gathering dust deep in our libraries and museums, offering a precision, rigor and tangibility that, arguably, modern technologies including photography and digital analysis cannot achieve. This is because these depictions somehow manage to capture more than just what is observed, they also reveal the feelings, excitement, and the personal narrative of those doing the rendering. The artists' work adds an extra dimension to the scientific documentation.



Figure 1 Ernst Haeckel--*Kunstformen der Natur*, 1899, *Actiniae*

Despite this historic entanglement, art and science continue to be thought of as being disparate. This division of curiosity, inquiry and knowledge into specialised compartments can be seen a recipe for cultural stagnation. The questions about the nature of life transcend academic categories.

There is now a growing tendency in contemporary art to consider the natural world not only as a source of inspiration or subject to represent, but also as a realm to influence directly - a sphere of action to transform and improve through creative means.

In recent years, there has been a marked rise in the number of artists working at the heart of scientific and scholarly environments. In countries such as the United Kingdom, the Netherlands, Germany and the Scandinavian nations, and most recently Australia, academic institutions, government agencies, funding bodies and private corporations have all embraced the concept of the artist as researcher and recognise the importance of art practice as a valid and valuable form of research.

The *Synapse Residencies* are a joint initiative between the Australian Network for Art and Technology (ANAT) and the Australia Council for the Arts and have been awarded annually since 2004 (Australian Network for Art and Technology, 2019). *Synapse* involves Australian science organisations hosting artists in residence, leading to the artistic and professional development of the participants, as well as building a sustainable support base for interdisciplinary creative collaboration. Subjects explored up until now include the creation of simulations of chronic pain within a virtual reality environment; explorations of whether haptic and robotic technologies can make dance performance more accessible to audiences who are deaf-blind, blind or vision impaired; and investigations of pedagogical tools, processes and environments that have the potential to optimise the uptake and retention of anatomical learning.

Wellcome, a large international medical and pharmaceutical company, sponsors several Art/Science investigations annually, acknowledging the contribution that artists can make to the research environment (Wellcome, 2018). In 2016-17 *Wellcome* awarded grants worth GBP£72 million in public engagement and education. *Wellcome* also supports numerous art/science exhibitions.

Institutions such as *Science Gallery Dublin*, *Science Gallery London* (Science Gallery, 2019) and *FACT Liverpool* (Foundation for Art and Creative Technology, 2019) have championed work in the UK. Universities have played an important role too. In Scotland, the University of Dundee runs *LifeSpace* (Science Art Research Gallery, 2019), a science art research gallery, while Edinburgh College of Art recently launched a course called *Making Animal Studies* with artist Andrea Roe and veterinary scientist Andrew Gardiner (Undergraduate Course: Making Animal Studies, 2019). CERN have been running artist residencies in Switzerland since 2012 (Arts at CERN, 2019).

When it comes to collaboration, there is a danger that generalizing about scientists as rational, institutionalized, ends-oriented versus artists as emotional, free, process-driven can risk accentuating disciplinary stereotypes. Or, conversely, that trying too hard to find commonalities can lead to simplistic platitudes about 'creativity'. People are more than the discipline they represent. Collaborations allow those involved to stretch out beyond these boundaries.

Artists dealing with the environment today adopt a wide range of approaches and methods. Their practices are informed by the strategies of early conceptual art, performance, and institutional critique, with their roles ranging from that of a passive commentator or enquiring researcher to visionary innovator or active interventionist seeking social and political change.

Artists also often work in collaboration, undertaking complex projects with specialists from other disciplines, such as botanists: Heather Ackroyd and Dan Harvey manipulating photosynthesis with their large scale canvases of living grass (Figure 2); zoologists: Robert Zhao Renhui, a Singaporean visual artist who examines man's relationship with animals through photography, installations and fictional narratives (Figure 3); and ecologists: artist Vaughn Bell works with science institutions and local government to create participatory artworks focusing on the environment (Figure 4). Along with geologists: Jennifer Robertson, a woven textile specialist, interprets mineral flaws and incorporates them into her weaving aesthetic (Figure 5); meteorologists: Berndnaut Smilde creates nimbus clouds in a gallery setting (Figure 6); and oceanographers: Lily Simonson depicts the immersive experience of Antarctic Ocean exploration as she has experienced it during scientific expeditions as the artist in residence (Figure 7). Architects can also be involved: artist Marysia Lewandowska worked with architect Colin Fournier to create an interactive cinema experience in an historical town square in Portugal (Figure 8); as can engineers: a collaboration between artist Matt Shlian and engineers from the University of Michigan investigates paper folding as a foundation for three-dimensional nanotechnology (Figure 9); and urban planners: for example, the *City of Asylum* project, in Pennsylvania, USA, where in exchange for rent-free living and working space, medical benefits, a living stipend, help in securing publishers and long-term employment, *City of Asylum's* visiting artists can be found teaching creative writing to local school-age children, holding public readings in the adjacent Reading Garden, or joining local musicians during the Jazz Poetry Festival (Figure 10).



Figure 2 Heather Ackroyd and Dan Harvey, *Park Ave + Resident*, Void, Derry, Northern Ireland, 2011



Figure 3 Robert Zhao Renhui, *Memorial to the Last Cat on Christmas Island*, 2016 Wood, Resin, 90 x 80 x 50
cm



Figure 4 Vaughn Bell, *Village Green*, 2008/2013/2015



Figure 5 Jennifer Robertson, *Crystal Imperfections as Agents of Deformation*, 2016.



Figure 6 Berndaut Smilde, *Nimbus D'Aspremont*, 2012.



Figure 7 Lily Simonson, *Turtle Rock Antarctica*, Oil, acrylic, and ultraviolet pigment on canvas, 24"x36", 2016



Figure 8 Colin Fournier, Marysia Lewandowska and NEON, *Centipede Cinema* , 2012

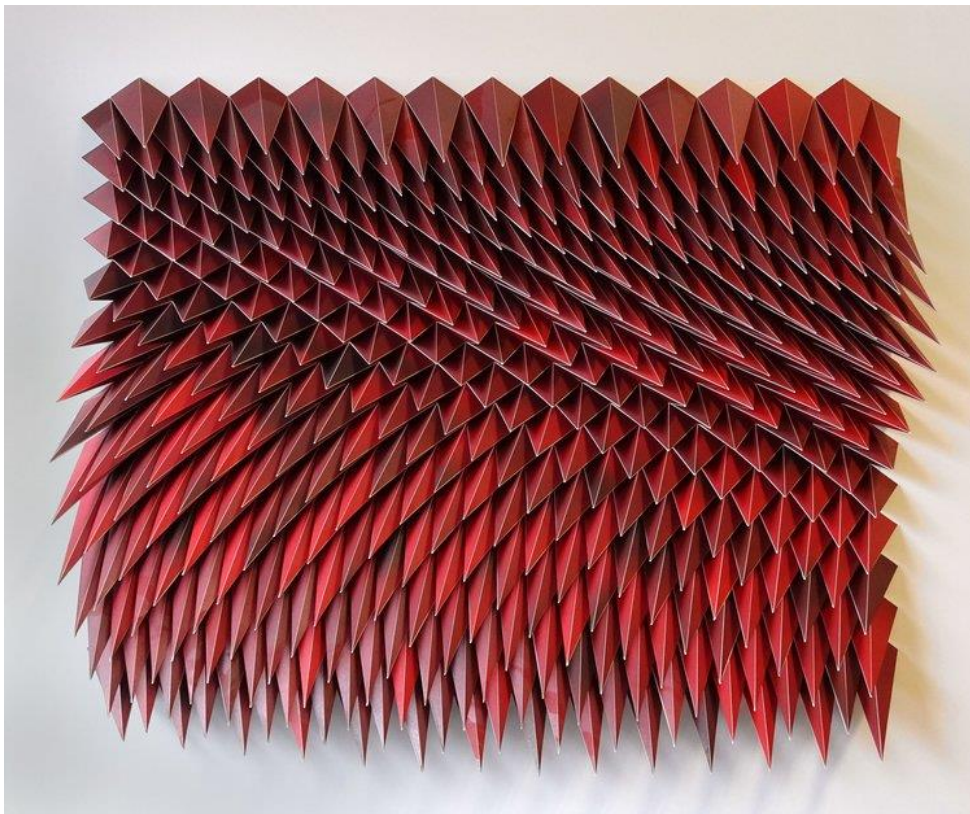


Figure 9 Matt Shlian, *Unholy 85 (Go Down Moses/There's Fire in the Woods)*, 48" x 40" x 5", 2018



Figure 10 *House Poem*, created by Huang Xiang for the City of Asylum project, 2002.

Usually, the artist's role is not to provide definitive answers; instead it is to see things in a different light. This new perspective often generates new questions. Unlike scientists, who must follow established scientific methods, the artist is free to question and redefine anything or everything at any stage, to be wide ranging and open to all possibilities (Brown, 2014). As a result, artistic practice projects can withstand a much higher level of risk than typical scientific experiments, which often come with expectations of tangible results. They can engage local communities and harvest broad support in ways that science alone can rarely do. They can offer tools for reflection, discussion, awareness and action that lead to new ways of thinking about and of being in the world.

The American artist and academic researcher Stephen Wilson, who has written widely about creative practice as research, set out in 1996 the important role that art should play in scientific advances:

Sceptics sometimes wonder what possible contribution artists can make to serious research and development. Artists can augment the research process in several ways. They can define new kinds of research questions, provide unorthodox interpretations of results, point out missed opportunities for development, explore and articulate wide-ranging implications of the research, represent potential user perspectives, and help communicate research findings in effective and provocative ways that can bring centuries of artistic experience to bear on the technological future (Brown, 2014, p109)

Two categories of art that embrace the art/science cross over are Environmental Art and BioArt.

2.1 Environmental Art

Environmental art is art that addresses social and political issues relating to the natural and urban environment (Tate,2018). Environmental art often takes the form of installation. The term came into use in the late 1960s and is often closely associated to land art. Its aim is to create art that helps improve our relationship with and understanding of the natural world.

In *Lives of Grass* by Mathilde Roussel (Figure 11), a work that features two grass covered figurative sculptures, Roussel explores the cyclic metamorphosis that transforms organic matter – whether vegetable, animal or human. Made of recycled metal and fabric structures filled with soil and wheat seeds, time sculpts the forms, changing its shape through growth and decay. These anthropomorphic and organic sculptures are intended to show that food, its origin and its transport, has an impact on us beyond taste. Observing nature and being aware of what and how we eat might make us more sensitive to food cycles in the world – of abundance, of famine – and allows us to be physically, intellectually and spiritually connected to a global reality. By working with scientific information and statistics Roussel has illustrated the interconnection between humans and their environment and the importance of understanding our place in the world in terms of the consumption of food resources in a new way.



Figure 11 Mathilde Roussel, *Lives of Grass*, soil, wheat seeds, recycled metal and fabric, Brooklyn, New York, 2010

Another environmental artist, Olga Ziemska, believes art is a tool for understanding life, and that it should help us to comprehend our place in the world. She sees art as a way to return to nature, making the human body part of the whole. Her work shows how easily the body can blend in, mesh and disappear into that which surrounds us – in an ever-changing reflection. In her piece *Listen* (2003) (Figure 12) she amalgamates tree logs with human hands, blurring the boundaries of both to make them one entity. Ziemska seeks to show how humanity should be grounded and connected to the natural world socially, philosophically, economically, and spiritually. She makes a statement as a reflexive communicator, allowing the viewer to discover and interpret the visual language she uses and apply their own reading.



Figure 12 Olga Ziemska, *Listen...*, plaster hand casts and locally reclaimed birch logs, Oronsco, Poland, 2003

According to Benjamin Truitt (2018), environmental artists identify the disconnect of humanity from the environment and attempt to rectify it through four different means:

- Exposing and critiquing the ways in which humanity is derelict in its duty to preserve and be connected to the earth
- Showing the limitedness and fragility of nature and the environment from disconnection
- Highlighting how disconnectedness from the earth causes social inequality and injustice
- Worshiping the beauty and greatness of nature and those connected to it (Truitt, 2018)

2.2 BioArt

Bioart, a term coined by Eduardo Kac, aims to provoke social discussion (Myers, 2015). The scope of BioArt is considered by some artists to be strictly limited to "living forms", while other artists would include art that uses the imagery of contemporary medicine and biological research or require that it address a controversy or blind spot posed by the very character of the life sciences.

In the pursuit of creating art, practitioners have generated tools and techniques that have aided researchers, while sometimes crossing into controversy, such as by releasing invasive species into the environment, blurring the lines between art and biology. In 2000, *Alba*, the genetically modified "glowing" rabbit, was created as an artistic work by contemporary artist Eduardo Kac, in collaboration with French geneticist Louis-Marie Houdebine. The insertion of a human antibody into the cells of a petunia plant also challenged scientific thinking and raised numerous scientific and ethical questions (Myers, 2015). Bioart encourages discussions about societal, philosophical, and environmental issues and can help enhance public understanding of advances in biotechnology and genetic engineering (Coskun, 2015).

Operating at the intersection of art and science, Oron Catts is the director of *SymbioticA*, a laboratory that explores the aesthetic and philosophical dimensions of tissue culture, based in the school of anatomy at the University of Western Australia. In 2003 he and long-time collaborator Ionat Zurr grew the world's first "semi-living steak" from frog cells. Another of his investigations was the *Victimless Leather* project (Figure 13), in which he and his colleagues grew an entire leather jacket made of cultured cells on a polymer substrate. The work was layered with ethical questions such as if it is cruel to kill an animal to make a garment from its hide, how do we feel about a garment that is itself quasi-alive?

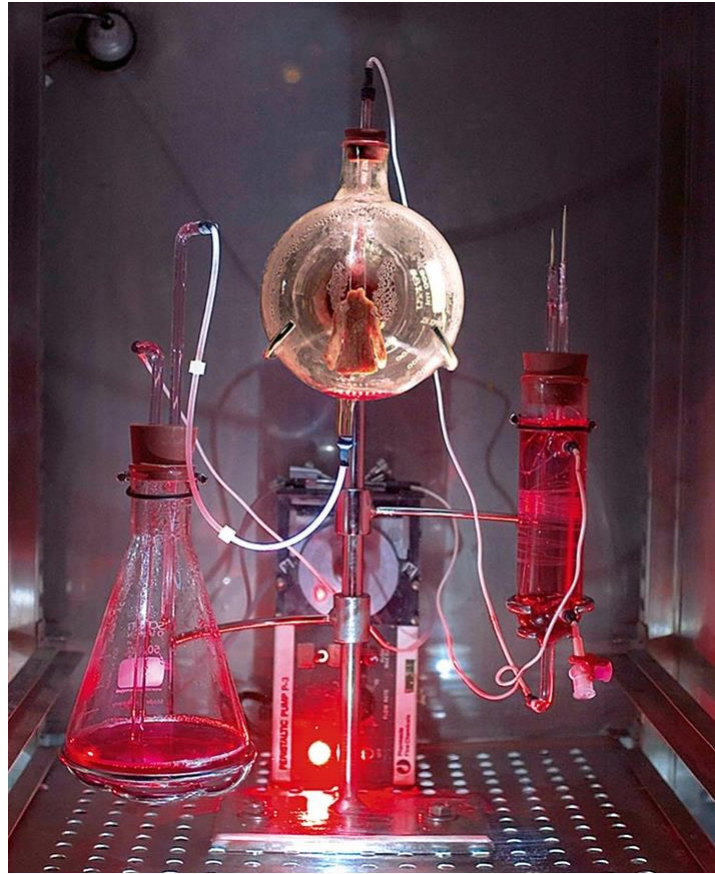


Figure 13 Oron Catts & Ionat Zurr (2004) The *Victimless Leather* project: a prototype of a stitchless jacket grown in a technoscientific 'body'. Biodegradable polymer connective and bone cells

Credit: The Tissue Culture & Art Project

BioArt reflects the way in which our relationship to the environment has changed. Our artistic response to this might be considered a form of Neo-romanticism, perhaps with a slight surrealist accent, echoing the art made during previous times of uncertainty about man's place in the world (Myers, 2015, p.6).

2.3 The synergistic fusion of Art and Science

Artists working in these fields open our eyes to the natural world, teaching us to experience it as more than a backdrop. Many have close working relationships with scientists, be it in a collaborative way, or as research scientists themselves. They combine science and art to engage and inform the public in a way that science alone cannot.

They forge new models of cooperation with scientists, government agencies, and activists, to query and solve problems of water, land, and air pollution. They serve as watchdogs,

questioning the side effects and outcomes of our practices and technologies. They also realise avant-garde, innovative visions for transformative, sustainable, and pleasurable ways of life.

These artists are often environmental activists, working with scientists, students and members of the public (or “citizen scientists”) to produce works that comment on the state of the environment. Collecting specimens, identifying, and observing them is frequently intrinsic in their practice, and often the presentation of the final work is only a small part of the larger story.

Through their art, they teach us to look at our surroundings in very different ways, giving us an appreciation not only of the complexity that underlies the natural world, but also transforming it into fascinating objects worthy of attention.

As artists, they have concerns for communities, both human and non-human, affected by climate change and other ecological impacts of the Anthropocene. Today’s environmental problems are global in scale and complex. To face these issues, the inventiveness of artists and scientists combined are fundamental in creatively addressing the challenges we and other species currently face.

The underlying goal is increased understanding of localized environmental problems with an overall awareness that each of us, as individuals, has an impact and can make a difference in our global environment. The work aims to initiate conversations and illuminate the vast gulf between accumulated science knowledge and public understanding.

By exhibiting in such venues as New York City’s Museum of Modern Art (MoMA) and London’s Tate Gallery, the artist can reach a wide audience in a deliberate attempt to help address what is often seen as an “information chasm”, a discontent between the public and scientists. Scientists often shy away from the spotlight and, as a result, the public has little means for accessing the information necessary to make positive, effective decisions about how to interact with the natural world.

2.4 Artists working with Art and Science

Examining the work of artists who sit at the art/science junction provides insights into the different methods that are effective in communicating science discoveries, theories and outcomes.

The way that art can insert emotional, relatable and analytical elements into the scientific information adds new dimensions and understanding to the knowledge that science research brings and provides a portal into the often-closed world of scientific knowledge generation.

Artists such as Mark Dion present their art in a very empirical way, much like displays seen in museums and scientific institutions. It is often representative, inspired by ecological field and laboratory research. This type of presentation gives sobriety and a seriousness to the work. By capitalising on the strengths of both art and science as expressive media, Dion appropriates aspects of scientific methodologies and presents them in more accessible formats and settings. Dion says:

My idea of art isn't necessarily something that provides answers or is decorative or affirmative. I enjoy...things toward the dark side that tend to have a more critical function. That's what I see as the job of contemporary artists - to function as critical foils to dominant culture...my job as an artist isn't to satisfy the public.... I don't necessarily make people happy. I think the job of the artist is to go against the grain of dominant culture, to challenge perception, prejudice, and convention. I think that it's really important that artists have an agitational function in culture. No one else seems to. (Sollins, 2007, p78.)

The reflective and “unfinished thinking” that comes with observing or participating in an art project are vital components in the journey to understanding the world around us. That is not to say that only through collaboration will progress be made, the individual disciplines are strong alone, but just that through working together different, often unintentional outcomes, can lead to new knowledge.

2.4.1 Brandon Ballengee

As an artist and scientist, Brandon Ballengee not only conducts his own research and presents exhibitions, he also engages the public in his work.

Embracing his passion for art and science Ballengee communicates and engages with the public about his scientific research. Ballengee says:

...when you are doing the science work you try to distance yourself as much as possible, in the field or in the lab, you are just collecting data, but that is not the way that human beings are, we are not objective, that's a part of us, but there is a whole other side. The side that needs to express something about what it is like to go to a wetland and find that 90% of the frogs have terminal deformities. It is overwhelmingly

sad, and so how do you explain that, not just through the analytical way of science, but can you tell that story through art? (Articulate, 2017)

Globally, climate change, species loss, and ecosystem collapse are now a part of the collective vernacular. Ballengee suggests that this growing awareness and concern for the environment is an emerging adaptation for our own species survival.

Ballengee's ongoing photographic series, "*Malamp Reliquaries*" (2001 – present) (Figure 14, 15, and 16), tells the story of the recent increases in amphibian deformities (Malamp is short for "malformed amphibian"). It is a series of enlarged stained images of terminally deformed field specimens.

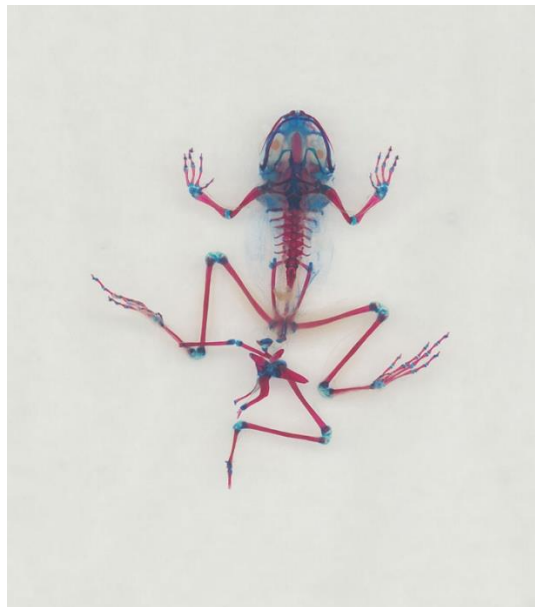


Figure 14 DFB 42: *Éléktra Ozomène*. 2008. Unique digital-C print on watercolor paper. Cleared and stained Pacific tree frog collected in Aptos, California in scientific collaboration with Stanley K. Sessions. Title by the poet KuyDelair. 46 x 34 in.



Figure 15 *DFA 147: Phaethon*. 2013. Unique Iris print on Arches watercolor paper. Cleared and stained Pacific tree frog collected in Aptos, California in scientific collaboration with Stanley K. Sessions. 46 x 34 in.

The aesthetic is strongly compelling. After being chemically treated, the specimens then undergo high-resolution scanner photography to create individual portraits. These portraits are printed as unique watercolour ink prints with each individual frog appearing to “float”, in what looks to be clouds or the night sky. This otherworldly quality is reinforced by the titles, named after ancient characters from Greco-Roman mythology. *Morpheus*, *Erebus*, and *Phaethon* float against celestial backgrounds, like ghosts or jewels lit from the inside.

Each finished artwork is unique and never editioned, to recall the individual animal and become a reliquary to a short-lived, non-human life.

The images are scaled in a way so that the amphibians are roughly the size of a human toddler. By scaling up to a size that we would normally be drawn to, Ballengee asks that we view the images with compassion.



Figure 16 Malamp Reliquies, Museum Het Domein, Sittard, The Netherlands. 2014.

Another of his scientifically sourced art projects., “*Frameworks of Absence*” is an ongoing exploration of extinction.

Ballengee states that:

...we have a really difficult time understanding and perceiving death, let alone this idea of an entire group of organisms that are completely gone. How do we wrap our head around extinction? I’m not sure that we are hard-wired to. From the artistic standpoint, I wanted to try to sort out how you could visually give form to something that is a negative, to something that is an absence. (Articulate, 2017)

Since 2006 Ballengee has been researching animals that have become extinct in the Americas over the past four centuries, selecting prints contemporaneous with the species’ demise and then painstakingly cutting the creature’s image from the page, leaving a hole. This removal of an image represents the extinction of a species. When exhibited, each image has a back plate of glass, so what the viewer sees is the absence, the shadows on the wall (Figure 17 and 18).



Figure 17 *RIP Charles Island Tortoise: After Ernst Haeckel. 1904/2014.* Artist cut and burnt chromolithograph, etched glass urn, and ashes. 18 x 14 inches. Species last observed 1840s. Photo by Casey Dorobek.



Figure 18 *The Frameworks of Absence.* 2006-Ongoing. Artist cut and burnt historical artifacts. Installed at The Armory Show, New York, NY, 2015. Photo by Casey Dorobek.

The use of original historic prints or artefacts is a fundamental concept to this body of work. Such “real” artefacts resonate history. As the depictions are removed, the *Frameworks of Absence* create a void in our own history, and we become attuned to the loss of the actual species.

By cutting up historic objects, Ballengee questions our sense of value. Such artefacts have worth, often in the monetary sense, but more importantly, in the sphere of human history and our changing attitudes along with behaviours towards the natural world. As Aldo Leopold famously said, “we stand guard over works of art, but species representing the work of aeons are stolen from under our noses”. (Leopold, 1987)



Figure 19 Ballengee cutting a burnt hand-colored stone lithograph, “*Pied Duck*” (*Labrador duck*) by John James Audubon from the limited Amsterdam edition of *Birds of America*, etched glass urn, and ashes. Photograph by Anthony Archibald J.

As an additional part of the project, Ballengee takes these cut-outs and burns them (Figure 19). He puts these burnt ashes into labelled funerary urns (Figure 20). When someone buys one of the *Frameworks of Absence* it comes with the urn and they are asked to scatter the ashes in the place where the species lived, to have their own ceremony.

By jarring the brain into acknowledging this absence, realising it as something completely gone from the landscape of our lives and environment, Ballengee’s work elicits a strong and almost visceral reaction, compelling the viewer to understand that what is gone cannot be replaced.



Figure 20 *The Frameworks of Absence*. 2006-Ongoing. Funerary urns, ashes. Photo by Michael Ahn.

Ballengee acknowledges that mourning is a critical element in this work, “Without mourning, there is no remembering. In the remembering we can choose to take steps to stop further loss of life through our everyday actions and long-term planning along with creative means of conservation.” (Higgins, 2015).

He uses the standard trope of the monument, using mourning to represent death, and perhaps to change our attitudes. The public goes to the gallery to feel things but frequently leave their feelings there – by engaging the public with the artwork (taking home the urn and scattering the ashes) the feeling is extended beyond the white cube through the act of participation, with the intention of making it last longer, leaving a deeper, indelible imprint in the mind and heart of the participant.

2.4.2 Vincent Fournier

Vincent Fournier, a French artist and photographer, blends his educational background in sociology, fine arts, and photography to create works that use the visual senses to articulate social behaviours and their potential consequences. His work is largely rooted in art history but aimed squarely at the future as anticipated by scientific and technological advances.

In his series *Post Natural History* (2012 - ongoing) he redesigns species to give them traits that better suit them for the Anthropocene, a world characterised by harsher climates and severely limited natural habitats. Such redesign, Fournier suggests, would go far beyond the familiar selective breeding of animals and plants, instead creating hybrids of the familiar and the exotic, with traits that would either help the species to survive or satisfy human desires.

The photorealistic images (Figure 21) portray species that are the imagined result of genetic modification. Synthetic biology, tissue engineering and the reprogramming of stem cells, are implied in the works. The images are presented as if they are of real creatures and hung like family portraits or museum exhibits. They lead us to question what we are doing to our environment to necessitate the existence of such individuals.



Figure 21 *Post Natural History* (2012-ongoing), Vincent Fournier

Fournier's work stands between cautionary tale and playful surrealism: the photorealistic quality of his contemporary bestiary makes it both alluring and grotesque, situated in an area where too much familiarity makes the fiction uncomfortable.

The artist takes his cues from Freud and Darwin, whose works redefined the ideas of what is sane/mad or animal/human, by depicting mental state and evolution as continuous (Myers, 2015). By extension *Post Natural History* redefines the border between natural and artificial as porous, on its way to complete disintegration, and accompanying a future characterised by hope and dread.

2.4.3 Kate MacDowell

Using porcelain sculpture, Kate MacDowell looks at the increasingly visible and consequential harm humans have on the environment and other species, and how this contradicts our romantic urge to feel united with the alluring details and mysteries of the natural world. She explores this notion using myth, humour, art history, and popular culture references, including recognisable symbols of genetic engineering. Using scientific information, MacDowell presents her work as a commentator, not trying to offer solutions to what she sees as catastrophic in the world. Instead they act as conversation starters.



Figure 22 *First and Last Breath* (2010)

In *First and Last Breath* (Figure 22) a white mother rabbit wears a gas mask while in a protective stance with one foot raised off the ground. Her ears are upright, and her head is cocked, signifying that she is frightened. Beneath the startled mother lies her young, new born and weak, with frail bodies and closed eyes. The piece creates a feeling of distress and sorrow, with the young vulnerable and defenceless, taking their first breath, which may or may not be toxic, as indicated by the mother's gas mask.

MacDowell's use of porcelain highlights both the impermanence and fragility of natural forms in a dying ecosystem, while paradoxically, being a material that can last for thousands of years and is historically associated with high status and value. Each of MacDowell's pieces are viewed as captured and preserved specimens, a record of endangered natural forms and a commentary on our own culpability.

The union between man and nature is shown to be one of friction and discomfort with the disturbing implication that we, too, are vulnerable to being victimized by our destructive practices.

2.4.4 Suzanne Anker

Looking to art history is also something that Suzanne Anker does in her work. Alongside that is her urge to critique the claim on universal validity that she says culture has granted science. Anker is a visual artist and theorist who has been working at the intersection of art and biology and contributing to its evolution for more than 20 years. She explores artefacts that have become icons of biology, such as chromosomes, MRI scans and petri dishes.

Anker's early work can be read as a meditation on visualisation in science: our need for it, its limits, and the long history of trusting imperfect technologies to generate what can become fixed cultural icons.

Around the same time as the Human Genome Project was initiated, Anker exhibited *Zoosemiotics* (1993). Taking its name from the study of animal communications, the exhibition showed bronze sculptures of chromosomes of different animal species. Anker exhibited the sculptures by positioning a glass flask in front of them, through which one could see different perspectives of the sculptures, amplified, deformed and wrapped (Figure 23).



Figure 23 *Zoosemiotics* (1993- 1995)

This contorting of what is commonly understood to be a template of who we are, acts as a warning and commentary of our continued manipulation of life at a genetic level. By using the

tools and accessories of science to tell her cautionary tales, Anker highlights our belief that what goes on behind the laboratory door is for the greater good.

2.4.5 Patricia Piccinini

Patricia Piccinini presents her work in the form of three dimensional life-like sculptures of hybrid creatures. She thrusts into our consciousness an uncomfortable combination of the plausible and grotesque: life forms we might one day breed, engineer or simply imagine.

In some ways her work can be seen as a three-dimensional expansion of Vincent Fournier's *Post Natural History* (2012-ongoing), which was discussed earlier. But Piccinini's work is a lot more alarming. The scale and the intricate attention to detail make the creatures so much more convincing and disturbing than a two-dimensional photograph. These works generate empathy; one can almost see the creatures breathe, and the pain and humanity in their faces makes the viewer fully accept that they could be real.



Figure 24 *The Young Family* (2002-3)

The Young Family (Figure 24) presents a transgenic creature. Piccinini's inspiration behind the work is the growing of human organs in other species, particularly pigs. She addresses the reality of these creatures in a compassionate way, without arguing for or against the technology. Genetically we share traits with the transgenic mother, and we also share the fundamental attribute of looking after our offspring. She raises the question of what the distinction is between human and animal characteristics, and the "animal-ness" of humans. Piccinini looks at the ethical issues that surround medical technologies. It is one thing to talk about an idea, another to be confronted by the emotional reality of a creature, and yet another to be in need of what that creature may provide.

2.5 Summary

Each of the artists and their works discussed above, deliver emotion, inquiry, and a deeper analysis of the implication of science knowledge and research as it effects our daily lives. By exposing the public to their works, be it in a gallery, private or public space, they address important science issues, seek to tell a story, and cultivate awareness.

The viewers and participants are exposed to information that they may not have previously been aware of or had considered, and ultimately are called on to question their own thoughts and behaviours as a result. They are not asked for, nor provided with, answers. The artists, instead, challenge what we think we know and quietly demand reflection and introspection.

The methods they choose to use vary, from public engagement through to the passive examination of belief systems and world views. Some use traditional museological and scientific formats while others create a more informal environment in which to have their conversations.

3.0 Environmental research

3.1 Art, biodiversity loss and extinction

Author Richard Louv (2005) has talked about a growing “nature-deficit disorder” among youth and adults resulting from an increasing disconnect with experiences in the natural world. The result is a widespread lack of understanding of ecosystems, other organisms, and even ourselves as part of a living community. Our connection to nature is becoming absent. In response, I try to engage audiences physically, emotionally and intellectually through art participation.

As we find ourselves in the middle of a human-caused mass extinction event, a re-evaluation of our collective value systems and ethics is vital. Each of our everyday actions has an impact on ecosystems and the greater community. Some positive and some negative, each action, in a sense, is a value judgement, reflecting what we choose to hold dear and protect.

The roots of environmentalism in general, and contemporary perceptions of endangered and extinct species, lie in the decades around the turn of the nineteenth century, when Western societies’ perception of nature underwent a seismic shift.

For most of the preceding millennia, nature had been both the principal resource and a major threat to human well-being. Even as it provided humans with the basic raw materials and foodstuffs for survival, nature also put us constantly at risk.

In the face of the first wave of sustained industrialisation, around 1800, a perception that had only occasionally surfaced in earlier centuries began to make itself felt - the sense that humans were jeopardizing nature on a grand scale, rather than the other way around. This sense of nature at risk catalysed the emergence of movements and societies for the protection of nature at the end of the nineteenth century, and led to the rise of modern environmental movements between the 1960’s and the 1980’s. It shapes current fears about a range of ecological crises, including climate change, ocean acidification, and biodiversity loss.

According to Darwinian theory, extinction and adaptation are normal components of evolutionary processes that have taken place during all the 3.5 billion years of biological life on earth. However, the current rate of species extinction is believed to be 100 to 1000 times that of the background level (the exact numbers are in dispute among biologists) (De Vos, 2014). What is not in dispute, are the causes; habitat destruction, invasive species, pollution, human population growth and overharvesting (Pimm, 2014). Climate change is an additional factor driving extinctions in the future.

3.1.1 The sixth extinction

Over the last half billion years, there have been 5 mass extinction events on Earth (Kolbert, 2014). Scientists around the world are currently monitoring another one, considered the result of human impact, which is predicted to be the most devastating extinction since the asteroid impact wiped out the dinosaurs as well as 80% of the species then existing on Earth (Heise, 2016).

If we are currently undergoing a *Sixth Mass Extinction*, it may entail a large scale biological and ecological transformation whose consequences are difficult to predict. They include the possible collapse of some ecosystems, the destruction of some basic foundations of food and energy economies, the disappearance of medical and other resources for the future, and the loss of important cultural foundations and assets.

The anthropologist Richard Leakey has warned that "*Homo sapiens* might not only be the agent of the sixth extinction, but also risks being one of its victims" (Kolbert, 2014).

Whatever the concrete ecological crises at hand, modern environmentalists, like their nineteenth century forebears, have tended to rely on a similar story template: the idea that modern society has degraded a natural world that used to be beautiful, harmonious, and self-sustaining and that might disappear completely if modern humans do not change their way of life.

3.1.2 New Zealand as a case study for human-caused extinctions

When New Zealand drifted away from the supercontinent of Gondwanaland 85 million years ago, it took with it a large diversity of plants and animals. These species evolved in isolation into a unique ecosystem with an extraordinary range of birds and virtually no land mammals except for bats (Tennyson, 2006).

Without terrestrial predators or competition for food on the ground, the birds evolved quite differently than anywhere else. Many came to occupy ecological niches usually inhabited by mammals. Some, like the kiwi, became too bulky and heavy to fly. Others, such as Haast's eagle, the giant penguin and the moa (all now extinct) grew to enormous size. Parrots, usually tropical birds, adapted to life in temperate forests and cool alpine areas. (Tennyson, 2006)

The archipelago of New Zealand with its well documented human history and wealth of recent fossils has the dubious distinction of being one of the best places to research the causes of extinction and the effects of humans on the environment (Tennyson, 2006). Ecologist Jared Diamond considers that because New Zealand "started off with the most important and

interesting biota of any island, the extinctions have been the worst tragedy to befall the world's biomass" (Tennyson, 2006, p.1).

When discussing the reasons for the extinction of so many New Zealand bird species, paleoecologist Richard Holdaway states, "...our widespread and rapid bird extinctions were the inevitable result of successive waves of introduced predators reducing and eliminating the bird species that they could catch – neither disease nor climate change played a significant role" (Tennyson, 2006, p.2). However, that is just the birds. Other extinctions are far less easy to attribute.

Loss of biodiversity is one of the most alarming threats facing our world and our species. Edward O. Wilson predicts that the "quenching of life's exuberance will be more consequential to humanity than all of the present-day global-warming, ozone depletion, and pollution combined" (Tennyson, 2006, p.1). Humans have created a bottleneck of overpopulation and shrinking natural resources. The ecological pressure our species places on the world's plants and animals is intense. The outcome of such pressure is species extinction on a massive scale.

New Zealand's destiny is intimately tied to that of its celebrated environment. But our environment continues to be under extraordinary pressure from introduced pests and human activity, ranging from development and pollution to climate change and tourism.

In the past 800 years, humans and their accompanying pests had brought about the extinction of 32 per cent of indigenous land and freshwater birds, 18 per cent of endemic seabirds, three of seven frogs, at least 12 invertebrates, possibly 11 plants, a fish, a bat and perhaps three known reptiles (Morton, 2017).

Today, about 1000 animal, plant and fungi species are considered threatened, and it is likely that many unknown species are also threatened (Morton, 2017).

The IUCN [International Union for the Conservation of Nature] "red list" is a global inventory of the conservation status of species. New Zealand has more than 3000 native plants and animals listed as threatened or vulnerable, with about 800 of those listed as facing the risk of extinction. Some of our native biodiversity is "data deficient" – meaning that we simply don't know enough about these species to know how fast they are declining.

Like many places, New Zealand has a bounty of cryptic fungi, bacteria and other microorganisms that are likely to play a vital role in ecosystem function. We don't know how human activities such as land use intensification may affect the decline of these organisms.

Increasingly, our changing climate is looking set to add another element to biodiversity decline – either directly, through warmer temperatures making habitat unsuitable, which may already be occurring in some alpine and marine ecosystems, or indirectly, for example, through increased frequency of tree seeding events swelling the impact of rodents and stoats in our forest ecosystems. A changing climate, bringing wind-borne spores of plant pathogens such as myrtle rust, also brings increasing pressure on at-risk plants such as the iconic Bartlett's rata and kauri.

Together these global environmental stressors - invasive pests, climate change, and loss of habitat - mean that there is a requirement to pay much more attention to the decline of biodiversity. There is a need to raise awareness and public support for the concept of *kaitiakitanga*, or guardianship, of biodiversity, because when local and regional governments can see that their constituents value biodiversity, they are more likely to respond. Unless we can raise awareness of our biodiversity decline and provide people with opportunities to do something in their local area, our species will continue to slide towards extinction.

Protecting our biodiversity is fundamental, so building awareness amongst the community and turning it into action is paramount.

4.0 Contemporary jewellery as a participatory form of communication

From the origins of humanity, jewellery has played a role of connectivity through symbolic representation. Its logical connection to the body gives the medium potential to speak of important issues within society (den Basten, 2012). The body determines the shape, weight, and size of the piece, as well as performing as the ultimate showcase.

By its very nature, contemporary jewellery incorporates social participation. It can bring awareness to, or start a discussion of, themes or topics relevant within society (den Besten, 2012). Conversely, due to its scale and placement, jewellery can also be a quiet, almost private, statement. It orientates its face towards the social environment, while holding part of itself back, only interacting with the wearer.

But can it also be an effective agent for change?

Jack Cunningham's research into narrative jewellery identified a triangular relationship between maker, wearer and viewer (Cunningham, 2005). For Cunningham, a piece of jewellery is the conduit through which this relationship unfurls. By putting on the object, the wearer adds new meaning, which s/he can then communicate to the viewer.

American jeweller Bruce Metcalf however, believes that jewellers wanting to make political changes should be politicians instead and that artistic freedom would be threatened if artists were to strive towards common political changes (den Besten, 2012). In this he doesn't address the notion of individual choice, or the desire to make statements rather than large scale change.

In contrast, there are several jewellery artists and critics who believe in the capacity of contemporary jewellery to raise political questions

Jewellery will meddle in human affairs. It will bear witness to transfers of authority, seal alliances (marital or otherwise), stand proud over your scholastic achievements, or discretely signal that, no, not tonight, thank you. (Benjamin Lignel, 2016)

As a way of connecting people, jewellery can be a powerful means for mobilizing change (Skinner, 2013).

...in question is not whether objects have the power to modify the course of things, but whether objects can derail the symbolic order that lends them strength in the first place Benjamin Lignel, 2016.

Curator Cindi Strauss highlights the current preference toward ideas over function amongst contemporary jewellers and galleries (Lignel, 2016). An approach that has seen a growing

trend amongst jewellery practitioners to move away from the gallery space, opting to use alternative, interactive platforms to distribute their ideas.

Three contemporary jewellers who investigate public engagement with their works are Roseanne Bartley (*Seeding the Cloud*, 2010-ongoing, Figure 25), Jacqui Chan (*Host a Brooch*, 2011, Figure 26) and Yuka Oyama (*Schmuck Quickies*, 2002-ongoing, Figure 27). All take contemporary jewellery into the public space and involve the community, placing their practices somewhere between social project and performance. These participatory practices are embedded in a much larger cultural zeitgeist, with interactive art enjoying a resurgence and becoming an increasingly popular way to generate public engagement.



Figure 25 *Seeding the Cloud*, Roseanne Bartley (2010 -ongoing)

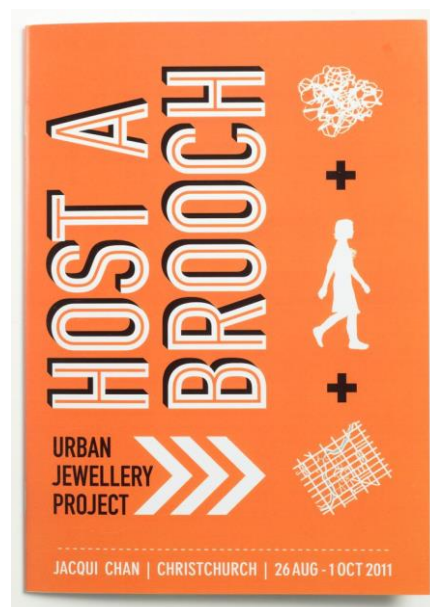


Figure 26 *Host a Brooch*, Jacqui Chan, 2011

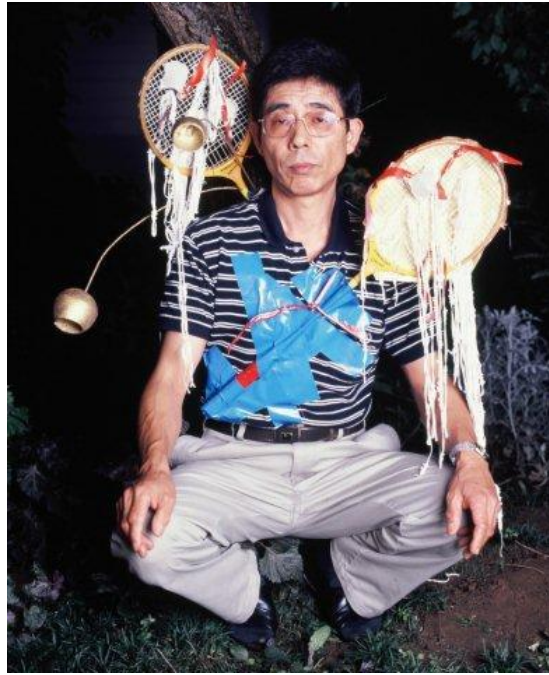


Figure 27 *Schmuck Quickies*, Yuka Oyama, 2002-ongoing

Benjamin Lignel describes this form of participatory art as “...a capitalistic dream of unpaid labour by anonymous workers, rolled up in a social project of community empowerment” (Lignel, 2016). It also breaks away from the ownership of the author, her work, and signature, in favour of process-based, knowledge- and production-sharing protocols that can be extremely rewarding to participants, in ways that over-the-gallery-counter contemplation is not (Lignel, 2016).

Some argue that craft and jewellery objects are participatory to begin with. Monica Gaspar says “Jewellery is a category of object that has always been relational in nature (Gaspar, 2015, p.4). By its very design, jewellery involves the active engagement of anonymous people; it generates a set of actions and emotions in them; it ferments interpersonal relationships; it cements genealogical relationships and builds community (Lignel, 2016). But it lacks the conventional markers that identify art social projects as defined by Claire Bishop, such as a rendezvous point, a started task, and its documentation (Bishop, 2012). This is where the three contemporary jewellers described above come in. They create jewellery projects that tick these boxes, making their projects participatory, by Claire Bishop’s definition. All are set up at a certain location(s), have a defined task (engagement), and involve documentation (photography), showing that contemporary jewellery can be an art social project medium.

5.0 Case studies

5.1 Locating my research: the brooch as an environmental emissary

Beginning with the Art Nouveau and Art Deco periods, when the brooch became an important accessory for the emancipated and in some cases, working woman, the brooch developed in three directions. As a fashion accessory, a wearable piece of artistic design, and as a medium for making political or social statements. “Nuclear power – no thanks”, and love and peace symbols were emblazoned on pins and buttons from the end of the 1960’s, displaying an attitude and membership to a movement (Wild, 2017).

Once attached to a human host, jewellery has great potential power. The conscious use of the brooch as a subtle means of communication was demonstrated by the former US foreign minister Madeleine Albright who used her brooches to show criticism of talks at the time (Albright, 2009).

Brooches and necklaces are often seen as the most confronting pieces of jewellery, because they are generally worn on the chest and directly address the outside world (den Besten, 2006). A necklace bears all kinds of recollections and references to symbols of power, not only in ethnological jewellery but also in Western European jewellery (chains of honour, mayoral chains etc.), whereas the brooch offers a more neutral form to work with. (den Besten, 2006)

A brooch can act as a tiny canvas where ideas may be expressed. As in all jewellery design, weight and wearability are important considerations. Occasionally, however, the concept takes over and wearability becomes, to paraphrase Mozart, the obedient handmaiden of the idea. (den Besten, 2006)

Apart from some flexible restrictions around wearability in terms of size and weight, there are no limitations with brooches, the pin on the rear side giving the wearer the possibility to fasten it wherever they want. The position of pinning is critical, and a wearer knows this. They recognise that they are a display of sorts and are willing to wear a statement on their body (den Besten, 2011).

Den Besten quotes Mieke Bal as identifying two moments when meaning is created with jewellery: “the first involves the author but is no more “original” or “primary” than the second, whose subject is the reader” (den Besten, 2011).

For my case studies, the wearer and reader are paramount, and are deeply considered in the designing and making of the pieces. Each of the brooches becomes a mobile narrator of a science story, seeking to hover somewhere between natural history and imagination.

There are five case studies presented here, three are the result of extensive personal research into natural history publications and scientific reports, and two are the result of collaborations with scientists on their research projects.

5.2 Research based projects

The following projects were based on comprehensive personal research into the topics. In many cases the information is in a continual state of flux, with species classifications changing as genetic techniques improve, and new discoveries are made. Taxonomic species revisions usually reflect progress in the understanding of our fauna and their relationships with other species worldwide. The better we understand these interactions, the greater the likelihood that we can preserve what is left of the world's biodiversity.

I have tried to keep abreast of the latest information, and, to the best of my knowledge, the species numbers and names are correct as of December 2018.

5.2.1. *Revenant Bird Project*

For this body of work, I developed a series of brooches depicting the 61 species of New Zealand native birds that have become extinct since human arrival (Robertson et al., 2017). The form of the brooches resembles that of a Victorian mourning silhouette brooch, worn in memory of someone who has died. Within each brooch is an image, a shadow, a trace of a bird now missing from New Zealand's biota (Figure 28).

The motivation behind this series is to illustrate the large number of species that are now missing from our unique, previously bird-dominated, environment. The reasons for their extinction are wide ranging; from hunting by humans for food, feathers and taxidermy, to predation and competition from introduced species such as cats, rats and mustelids, as well the loss of habitats and environmental modification.

These species were singular to New Zealand, and, with their demise, other plant and animal species have either been lost or are now on the brink. These brooches individually mark the passing and collectively form a memorial and tribute.

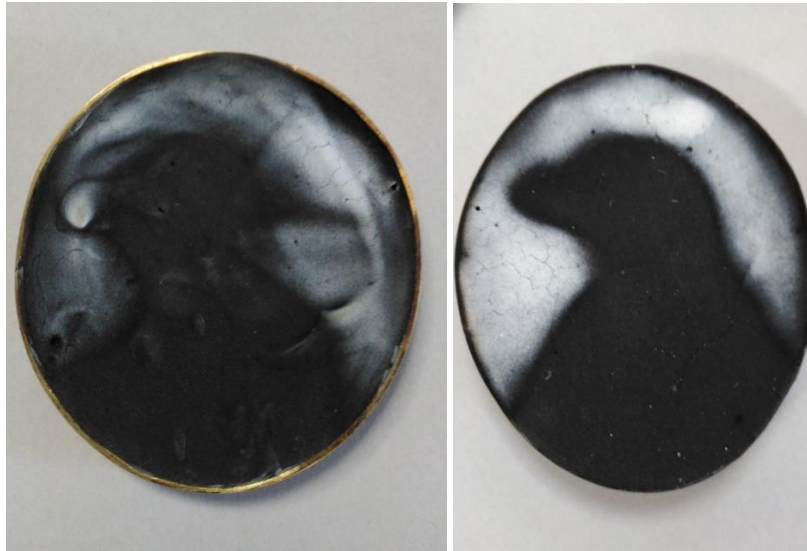


Figure 28 Two brooch examples, L to R: *MW2016-01-03 Chatham Island duck*, *MW2016-01-57 Waitaha Penguin*, Brass, gypsum plaster, pigment, resin, steel pin. Approx. 60 x 70 mm

Each brooch took a long time to make, with many steps and processes along the way. This slow making is integral to my practice. It allows time for contemplation and research about each bird as I go and allows for moments of mourning during the making process. This ambience of sadness is absorbed by the brooch and passed on to the subsequent wearer, interlocutor and viewer.

Some of the images captured within the brooches are more cryptic and ambiguous than others (Figure 28), reflecting the mercurial process involved with the image production. These esoteric forms invite inquiry and closer examination, reflecting the work of palaeontologists and taxonomists in uncovering historic biological evidence.

Image creation and metaphor are fused. The visual representation of nature, the embedding of memories, impressions, and stories are interwoven. Each bird shadow possesses its own individual back and white value, its particular essence, which plays a part in the developing form. The brooches emerge with an image steeped in atmosphere and weighted with loss.

How can a viewer who sees someone wearing such a brooch possibly understand what it means at a glance? Much of its narrative stays hidden. This ambiguity signifies the wide gap between the intended and attached meaning of a piece and its presumed decorative function. It also acts as a metaphor for science research communication. It invites a conversation, and engagement with the wearer, leading to the passing on of the story behind the piece.

As part of the larger participatory *Revenant Bird Project*, each brooch was sent out to a volunteer, along with a *Background Information Sheet* containing natural history information

about that bird, asked to escort it to the region where the bird once lived and take a photo wearing or holding it, or of it installed in the environment.

When these works are taken out into the world they carry and spread their stories in a different way than a display in a gallery or museum can. The intimate relationship and emotional engagement that comes with possession, touch, interaction and ownership seeks to leave a different kind of impression.

This public participation in the project is integral to the aim of information transference and the engagement of the participants (and their viewers) in the story of New Zealand's avifauna, and falls in to the category of a relational aesthetic project, with the brooches becoming facilitators of data exchange.

Another aspect of the concept behind the photos is to provide visual evidence of the brooches returning to where the individual birds used to call home, tying each brooch to place (Figure 29). Many of these areas are now highly modified, being farmland, suburban or urban areas. The brooches did not have to be taken to pristine environments, a photo representative of the actual modern environment was what was needed. This returning of the birds to their previous habitats is a form of mourning, a cathartic means of connection to other species, both living and gone.



Figure 29 L to R: *MW2016-01-36 North Island Raven, Auckland Northern Motorway, MW2016-01-25 New Zealand Little Bittern, Lake Wakatipu*

The brooches travelled around both the North and South Islands, to Stuart Island and out to the Chatham Islands. In each case they were united with their original habitats and allowed

to connect with and inform the public. In the case of the Chatham Island bird brooches, they became a part of the primary school syllabus, with a school field trip based on taking the brooches out into the world.

The collating of these photographs into a book provided an interesting insight into the New Zealand environment. Images of farms, living rooms and beaches combine to create a snapshot of how and where we live, and with a little imagination it is possible to reinsert these missing species into the pictures.

There have been some interesting responses to the brooches and the information sheets that travelled with them. Some people found the whole process incredibly sad, while others said that it provided a happy reconnection of the bird with the environment. Most commented on their excitement to be part of the project and noted a connection forming between themselves and their bird species, becoming champions for their extinct bird. Some said that they now have a renewed interest in the environment and have taken a greater interest in endangered species as a result. Overall, I believe that the project has fully achieved my initial goals and exceeded all of my hopes for engagement and participation.

5.2.3 A Bat Forsaken

The Greater Short Tailed Bat (*Mystacina robusta*), was once found all over New Zealand. It was a fascinating bat in that it frequently used its wings as legs and crawled around the forest floor, taking on a similar role to that of a rodent. It was capable of flight, but not at great heights or over great distances (Hill, 1986).

With the arrival of rats, the bat numbers seriously declined until it was only known to live on one off shore island, Big South Cape Island. When ship rats were accidentally introduced to the island in 1963 much of the bird life was decimated, leading to the extinction of two bird species.

At the time, the Greater Short Tailed Bat was not recognized as a separate species from its closely related cousin, the Lesser Short Tailed Bat, and not considered a priority for conservation effort. Consequently, when the wildlife service translocated bird species to save them, they left the bat behind. The last confirmed sighting of the bat was in 1965. No further confirmed sightings have been recorded despite numerous surveys (Hill, 1986).

Representing an absence

When discussing extinction and loss, Darren Higgins (2015) writes that,

...most of our monuments consist of objects added to the landscape: cenotaphs, statues, plaques. Loss symbolised by addition, the absence of something commemorated by the presence of something new. Perhaps we are afraid of looking into the void created by the lives, the people, the time, the whatever has gone missing. In this disconnected culture, stories wander placeless. Memories have no home. We seek replacement rather than understanding.

Keeping this in mind as well as the art works of the artists discussed earlier, I wanted to represent the extinct Greater Short Tailed Bat with something that talked of absence. Absence in a literal way.

This idea of representing something that is now removed from our living biota lead me to consider museum collections and the way they are stored, which eventually directed me to create pieces in the negative and reference the beaten-up archive boxes in which precious specimens are held.

When lined up together the image of the bat is apparent. However, when examined individually, the focus falls on the discrete parts of the bat, the feet, the clawed wings, and the large ears. The format of displaying the fragmented pieces as a collection is used to

encourage the viewer to make connections between each object, visually putting them back together, thus establishing a narrative that focuses on the objects' form.

Each brooch is assigned an accession number which has been crudely engraved on the back, as seen in museological collections. The pieces are scaled 1:1, representing the true size of the bat.

As well as being visual representations, the brooches ask to be touched. Naked fingers trace the impressions of a creature that is now absent, following the ridges and valleys that make up the imprint of its body. This physical involvement with the material surface of the brooches encourages a build-up of a surface patina at the same time as blurring the soft brooch face. The emphasis on permanence and preservation that surrounds the tradition of gallery and collection spaces is turned on its head with the invitation to actively interact with the pieces. As theoretical considerations of patina suggest, the materiality and imagery of the brooches will inevitably alter over time.

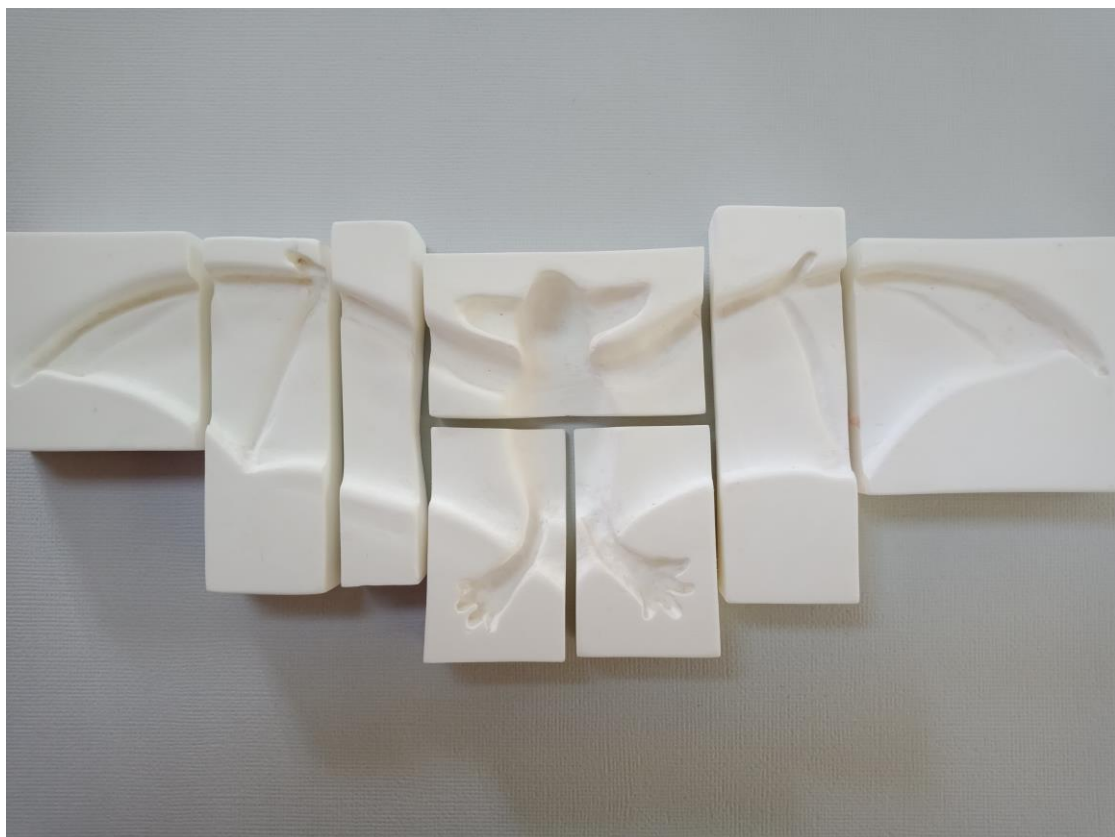


Figure 30 *A Bat Forsaken*, the Greater Short-Tailed Bat, Brooch series, MW2017-03-01 – MW2017-03-08, sterling silver, polyurethane resin, steel pin, sizes range from 55 x 54 x 20 mm to 95 x 35 x 20 mm.

5.2.3 *Grayling Draught Lamp*

In recent decades an estimated 20 per cent of the world's freshwater-fish species have become threatened, endangered or extinct (National Geographic, 2018). Extinction rates in fresh water are higher than in terrestrial and marine environments (National Geographic, 2018). But New Zealand's only extinct freshwater fish—the Grayling or Upokororo— was probably long gone before the current wave of species extinctions.

The Grayling's story

Once the most common freshwater fish in New Zealand, the Grayling appeared to disappear almost overnight. Perhaps, as with the passenger pigeon in North America, its abundance meant that when it vanished people had difficulty comprehending its loss. It is easy to understand when a rare species is lost forever, but the sudden disappearance of an abundant species is more difficult to fathom.

As early as the 1870's a decline was suspected (Allan, 1949). There were reports of the fish's disappearance from the Waikato River as early as 1874, and from the Buller district in 1884. Both areas had had previously very high populations (Allan, 1949).

Whatever happened to them seems to have happened rapidly. A specimen reportedly caught in the Hokitika in 1923 raised hopes that after a hiatus it was returning (Walrond, 2005). But it was not to be. A 1930 Marine Department report stated: "When it is as extinct as the moa—it is rapidly moving in that direction—those who were responsible for the control of New Zealand fisheries will certainly not escape a good deal of scornful criticism." (Walrond, 2005)

Ironically, by the time legislative protection was granted in 1952 the fish was probably extinct. New Zealand's foremost freshwater-fisheries scientist at the time wrote of Grayling as illustrative of "the indifference with which many natural resources of this country have been treated" (Walrond, 2005). His strong sentiments spilled over into the advice that anyone knowing the location of Grayling should keep it a profound secret.

In 1992 the World Conservation Monitoring Centre included Grayling on its list of extinct taxa but noted there was still a chance that the fish survived. By 1996 the *Red List of Threatened Species*, compiled by IUCN, categorised the grayling as extinct, the definition of which is that "there is no reasonable doubt that the last individual has died" (West, 2014).

Grayling Draught Lamp

This lamp was made with the purpose of casting shadows rather than light, to create a feeling of immersion. It is made up of individual Grayling brooches, or pins, attached to a frame that slowly turns and a light that dims and brightens, reflecting the reported habit of the species of disappearing and reappearing in a ghostly fashion, which was probably a reflection of its migration and spawning habits.

The individual fish pins have their own unique markings and patterns, just like the morphological variations seen within the species. Each is designed to be worn as an individual piece, as well as being a component of the larger artwork. The brooches were etched using the designs drawn by individual school-aged participants in a *Grayling Design Workshop*, held during school holidays (Figure 31). As part of the workshop, the participants learnt about the Grayling's story and about the importance of preserving our native species.



Figure 31 *Grayling Design Workshop* participant decorating the individual fish in preparation for etching

When set up in a darkened room, the *Grayling Draught Lamp* creates a feeling of being absorbed, becoming part of the shoal. As the shadows move around the room, they give off an impression of circling the drain, affirmed by the slow dimming of the light.

For this piece, participation is passively sought. Explanatory text about the work is available, but the emphasis is on discovery rather than statement. The work seeks to engage the viewer's attention through contemplation, without offering conclusions, as simply watching the shadows or examining the pins tactility is encouraged, leaving the viewer to add their own interpretation to the experience.

The pins can be removed from the lamp, taken away and worn by the gallery visitors, allowing the shoal to slowly decrease.

5.3 Collaborative projects

Collaborative art/science projects are increasingly popular and one obvious benefit is the greater visibility of the scientist's research through the artist's work. Science can be a powerful generator of visual ideas, woven with tensions, surprises and layers of interaction. It is a natural subject for critical art enquiry.

For the scientist, such a collaboration allows them to reach out beyond their usual audience, bringing interactions and affecting people whose lives, interests and outlooks are different to their own. This work can become the basis for popular talks (as mine did with *What Lies Beneath*), providing a different perspective and unexpected outcome of the research project. Collaborative projects can also reinvigorate the scientist's own curiosity about their subject matter and bring an outsider perspective to the bigger picture. They are reminded of the power of curiosity, something that can get lost in times of targeted research.

Creative collaborative partnerships open up a broader space in which individual artists and scientists can gain a new perspective on their own work and together can acquire new tools to reflect on some of the bigger issues that concern us all.

My two experiences of collaborations, both at a distance, were grounded in conversations, both real world and virtual. Access to the most up to date information and data along with photographs, video and first-person descriptions made for exciting discussions.

5.3.1 Art + Genetics: A Conglomeration of Stilts

Collaboration with Natalie Forsdick, Ph.D. candidate, University of Otago

Biological Hybridity

Natalie Forsdick is investigating the hybridisation between Kakī and Poaka, two New Zealand stilt species. Poaka have self-introduced from Australia, and their range has expanded across the country as the Kakī population has declined. Forsdick's research project is a collaboration with researchers at the University of Otago, the University of Canterbury, and the Kakī Recovery Team at the Department of Conservation. Forsdick is sequencing and assembling the genomes of Kakī and Poaka to investigate what effect this hybridisation has had on the threatened Kakī population, and whether any genetic information from Poaka has been incorporated into the Kakī genome.

Hybridity of native species, especially critically endangered ones, is of great concern to the natural history and wildlife management communities of New Zealand. (Allendorf, 2001). Hybridisation has contributed to the extinction of many species through direct and indirect means. However, recent studies have found that natural hybridisation has played an important role in the evolution of many plant and animal taxa (Allendorf, 2001). Determining whether

hybridisation is natural or anthropogenic is crucial for conservation but is often difficult to achieve.

Human impact on the environment has resulted in an increase in the interbreeding between species worldwide, which has given rise to an increase in hybridisation. This genetic mixing has the potential to threaten many species with extinction (Rhymer, 1996).

Hybridisation is greatly influenced by human impact on the environment, through effects such as habitat loss and fragmentation, and species introductions. Such impacts make it difficult to conserve the genetic diversity of populations (Rhymer, 1996).

Controversy has surrounded the setting of appropriate conservation policies to deal with hybridisation and introgression (genetic admixture resulting from backcrossing with one of the parent species) (Allendorf, 2001). Any policy that deals with hybrids must be flexible and must recognize that nearly every situation involving hybridisation is different enough that general rules are not likely to be effective.

The increased use of molecular techniques to determine the extent of interbreeding between species, focuses attention on the extent of this underappreciated problem, that is not always apparent from morphological observations alone. Some degree of gene flow is a normal, evolutionary process, however, hybridisation with or without introgression may threaten a rare species' existence.

Kakī and Poaka Genetic Research

When Kakī numbers have been historically low, interbreeding between the two species has occurred, resulting in fertile hybrids that display a range of plumage nodes intermediate to those of the pure black Kakī (Figure 32) and the mixed white and black Poaka, first described by R.J. Pierce in 1984. Plumage characteristics have been shown to be representative of the underlying genetic makeup of the three groups, with hybrids of intermediate plumage having a mixture of the genetic traits of both Kakī and Poaka.

A previous genetic study in 2010 used a very small number of genetic markers to confirm the genetic integrity of Kakī. However, the methods used, while the best available at the time, may not be representative of effects across the whole genome. Genetic sequencing techniques have rapidly advanced in recent years and allow for a re-examination of these results on a wider scale across the genomes of these birds.



Figure 32 Kakī. Photo by Liz Brown, DOC Kakī Recovery Group

Ms. Forsdick is also assessing regions of the genome associated with plumage colouration, to find out more about the genetics underlying the varying plumage nodes. As hybridisation may have negative effects on species survival and recovery, this information will be useful for Kakī conservation management, and inform other conservation programmes involving hybridisation.

Hybridity and Metallurgy

This project presented the opportunity to learn and investigate the different meanings and implications of the concept of hybridisation in its many different forms. It also presented the chance to raise awareness for Kakī and the complications it is facing to survive.

My response to Ms. Forsdick's research was to create a series of 9 brooches, *A Conglomeration of Stilts*. These brooches represent each of the individuals outlined in the original hybrid description by Pierce; a Kakī, a Poaka, and 7 intermediate hybrid birds.

Each brooch depicts the black and white plumage of the birds on the front, and the back, which represents the hidden, genetic profile of each, is made from a different metal alloy, pure silver for the Kakī, pure copper for the Poaka, and varying proportions of silver/copper alloy for the hybrid birds.

I began by designing a simple, anthropomorphic bird figure. Influenced by modernism, I wanted to create a form that captured the personality of the birds and could be recognised as a stilt. By being anthropomorphic, each talks of the influence that humans have had on their

continued existence. Long legs and beaks were imperative, and I designed a simple body form that would allow me to add plumage colours on the front and a metal alloy on the back.



Figure 33 *MW2017-01-01 Pure Poaka*, brooch, copper, 925 silver, aluminium, heat shrink tube, polymer clay, resin, steel pin, 150 x 50 x 10 mm. *MW2017-01-09 Pure Kaki*, brooch, fine silver, 925 silver, aluminium, heat shrink tube, copper wire, polymer clay, resin, steel pin, 150 x 50 x 10 mm

The silver/copper alloys were calculated to exact proportions, the individual metals weighed and combined before being melted together and poured into ingots (Table 1).

Brooch number	Bird descriptor	Silver/copper alloy
MW2017-01-01	Poaka	0 (copper)
MW2017-01-02	Hybrid D1	125
MW2017-01-03	Hybrid D2	250
MW2017-01-04	Hybrid E	375
MW2017-01-05	Hybrid F	500
MW2017-01-06	Hybrid G	625
MW2017-01-07	Hybrid H	750
MW2017-01-08	Hybrid I	875
MW2017-01-09	Kakī	1000 (Silver)

Table 1: Metal alloys



Figure 34 Melting copper and fine silver together to make alloys

As I created the metal alloys, metaphors presented themselves. The alloys had different properties to their parent metals (for instance, in terms of hardness, ductility, melting point, malleability, lustre, and degree of oxidisation), just as the hybrid birds differ from their precursors. The colour of the alloys changed from silver to gold to red, with unexpected results, dependent on the dominance of one metal over the other, used to convey the genetic variation or plumage morphology seen in the individual hybrid birds. The metals also mixed differently when alloyed, some more resistant to combining than others.

The heterogeneity displayed by the metals, reflects the diversity of physical and behavioural traits displayed by the intermediate hybrid stilts. It also delivers thought-provoking allegories and raises many complex and loaded moral and scientific questions around interspecies breeding.

For their display in the *Art & Genetics* exhibition they were hung like marionettes, in reference to the ways that their movements; positioning and destiny are controlled by someone else.



Figure 35 Display at the *Art & Genetics* exhibition, 2017

Conclusion

Through this project I have become aware of the grey areas that envelop the moral questions around species management, intervention and interference. I have come to understand the debates over the financial implications for managing a critically endangered species, and when to call time. If a species is threatened because of human impact, do we then owe it to them to do everything we can to ensure their existence, or are we messing with the greater picture of survival of the fittest? As we enter the Anthropocene these are all questions we need to consider.

As for Ms. Forsdick's experience of our collaboration, she learnt from me too. The explanations to my numerous questions lead her to consider the ethical implications of the species management policies currently in place. She was fascinated by the alloying of the metals and surprised at the metaphors that arose. She went on to wear her own brooch regularly, when not displayed on her lounge wall.

In terms of their effectiveness at information transference, these brooches were limited by their audience exposure. They were only displayed at the *Art + Genetics* exhibition and have had no other outing at this point. The hidden aspect of the metal alloy backs was probably the most interesting part of these pieces and by choosing to have this on the private, body facing surface, while demonstrative of the narrative I was seeking, meant that it mostly remained

hidden from the viewer and reduced its ability to tell the full genetic story. In subsequent outings, I intend to display the pieces in such a way that the backs become more visible by using moving stands so that they can be turned and viewed more effectively.

5.3.2 Art + Oceans: *What Lies Beneath - An investigation into seafloor biota changes in the Ross Sea, Antarctica.*

Collaboration with Dr Vonda Cummings, Principal Scientist – Marine Ecology, NIWA

Art and Ecology

The basic differences between art and ecology provide reasons why the cross-fertilisations between these disciplines are often so fruitful. As partners, they can invigorate both cultural and physical landscapes (Brown, 2014). Ecology's methods and its pronouncements are strictly impersonal. Art, however, is granted the licence to exploit the communicative components of personality. Ecology offers a framework to ask, "How did it get this way?" Art can extend the range of questions by contemplating, "What human values led to this?", "Why did it get this way?" and "How do we feel about it?" (Brown, 2014).

Many contemporary artists utilise the informative power of art to articulate the scientific principles of ecology, some of which I discussed earlier. They do not simply accomplish this task thematically. Ecological concerns are also embedded in artists' choice of medium and tools, their strategies for display and storage, and their management of studio waste (Weintraub, L., 2007).

Such considerations were incorporated into my artistic response to Dr Cummings' research. I used discarded, recycled and repurposed materials to create each piece, the rereading of which turned out to be an allegorical narrative around the fragility of the organism they were representing. Recently our society has adopted recycling as a mantra, using it as a symbolic expression of anxiety about overconsumption as a practical means to reduce our use of scarce resources and to minimise waste. Through regenerating objects and salvaging materials, I have sought to create a new kind of preciousness by giving a second life to what would otherwise be discarded as debris. As a result, my own studio waste has been minimised. For the exhibition I utilised existing structures for display, constrained by space and the availability of display furniture, I repurposed existing architecture and materials.

Antarctic Research

Resilience in Antarctic biota and ecosystems

Models and empirical data predict that climate change will affect continental Antarctica, potentially raising temperatures by several degrees (Lohrer et. al, 2013). Increasing temperatures will impact many organisms directly, but less predictable are indirect, ecosystem-level effects mediated through changes to the dynamics of land and sea ice. The ability of ecosystems to endure such change depends on their resilience, a property currently poorly understood. As part of a larger cross-disciplinary project, Dr Cummings is looking at

the sensitivity of Antarctic marine ecosystems to change, in order to underpin future management and monitoring decisions.

Examining changes in Antarctic seafloor communities that result from shifting climate baselines has provided interesting insights into the creatures living on the seafloor. These snapshots show how communities change as the sea ice breaks up in the warmer months which allows more light to penetrate the water column. More light leads to an increase in algae and therefore an increase and change in other biota too. It is hypothesised that this accelerated summer thinning and breaking up of the ice is due to a changing climate (Lohrer et. al, 2013).

Artistic Response

Dives below the sea ice at various sites in the Ross Sea, Antarctica, have identified some of the amazing creatures that live in this harsh environment. Often oversized and chimerical, they experience a phenomenon known as polar gigantism. This gigantism is thought to be the result of the high availability of oxygen, coupled with the fact that low temperatures slow animals' metabolism down and reduce their need for oxygen uptake (Moran, 1995).

Responding to the images taken of these animals, I have created three dimensional pieces using recycled and repurposed plastics and metals. The works are oversized, just like the animals themselves, and hover on the boundary of wearability. They seek to push the observer and wearer beyond their comfort zone (Figure 36, 37, 38, 39).



Figure 36 L to R: MW2018-01-01, *Nudibranch*, brooch, wire, plastic milk bottle (HDPE), felt, thread, steel, wire
 MW2018-01-02, *Spider crab*, brooch, reclaimed brass wire, sterling silver scraps, paint

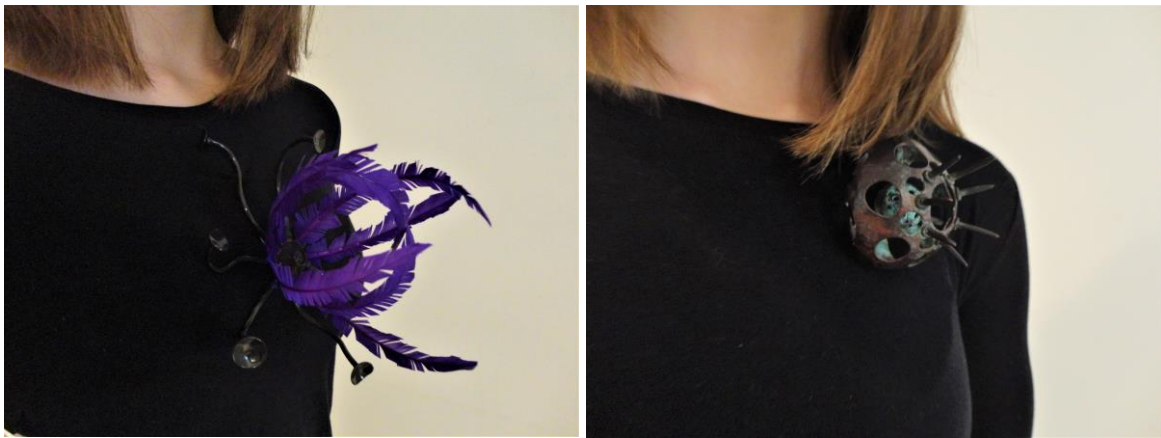


Figure 37 L to R: MW2018-01-03, *Feather star*, brooch, copper, brass, sterling silver, feathers, zinc plating, steel wire
 MW2018-01-04, *Sea squirt*, brooch, copper, patina, steel wire



Figure 38 L to R: *MW2018-01-06, Tube worms*, brooches, basketball rubber, plastic shopping bags (HDPE), copper
MW2018-01-08, Large urchin, brooch/object, aluminium, steel piano wire, polystyrene, magnets, paint



Figure 39 L to R: *MW2018-01-11, Hexactinellid skeleton*, brooch, fused milk bottle (HDPE), fused scrap sterling silver, steel wire
MW2018-01-12, Brittle star, brooch, brass, copper, patina, paint

These pieces support two, more traditionally-sized brooches which represent the scientific use of quadrats in ecological studies (Figure 40).

Working from photographs of seabed quadrats and breaking them down to coloured pixels, I abstracted the biota to the point of them becoming small blocks of pigmented resin. Each block representing an individual component of the seafloor community under standard light conditions. The increase in biota seen when the sea ice has broken up was illustrated by the additional use of resin blocks containing photochromic pigments. These pigments respond to the presence of UV light (sunlight) by changing from an opaque white to a bright colour, in this case pink and purple.



Figure 40 L to R: *MW2018-01-13, Photochromic 1*, brooch, epoxy resin, pigment, oxidised sterling silver, steel wire
MW2018-01-14, Photochromic 2, brooch, epoxy resin, pigment, oxidised sterling silver, steel wire

Both sets of brooches make statements and invite enquiry. When worn on the body the oversized creature brooches appear to take over the human host. Their size is unexpected, and true to life. They illustrate the surprising diversity and multifarious forms of these, usually concealed, creatures. The photochromic brooches contain the element of surprise. By responding to the light, they demonstrate the addition of added seafloor colour in a literal way.



Figure 41 Exhibition display, H.D. Skinner Annex, Otago Museum, August 2018

Conclusion

In this collaboration we found the boundaries between art and science, to a large extent, dissolved. Dr Cummings and I had worked together in the past, and while I was a bit rusty on some of the terminology, we found that we were able to discuss the work with minimal translation. We both found this shared background and knowledge helped enormously in our conversations and discussions.

The success of this collaboration depended upon several factors. These included: a common set of research interests; a working method that relied on constant dialogue; a shared sense of curiosity, and the ability to persist in the face of challenges.

Restricted by our differing geographic locations, our communications were mostly based on emailed images, scientific papers, emailed responses to questions, and phone conversations. We tried to coordinate a face to face catch-up, but conflicting schedules got in the way.

Dr Cummings responded very positively to the process and outcome of our collaboration. She went on to purchase some pieces and used images of others in a subsequent national public lecture series.

This project has pushed me to experiment with previously untried materials such as repurposed plastics, metal scraps, unconventional materials, and oversized forms. Extensive online research into photochromic materials and pigments lead to the discovery of a supplier in the US. I pushed myself past my usual literal interpretations into a more abstract work which was challenging and surprisingly freeing.

I received positive responses from exhibition attendees. People remarked on how they would wear the pieces, despite their oversized and vaguely disturbing nature. The materials prompted surprise when explained. People wanted to touch and play with the pieces. The spider crab was recognised by a fellow exhibitor as a creature they had encountered on a trip to the Southern Ocean and elicited a shiver and a great story.

The audience response achieved my original goal; a fascination with creatures not seen before by most people, surprise and horror that they were life sized, and an interest in how and what they were made from. I believe they were strong pieces, and successful in fulfilling my initial intention of information transference and the igniting of curiosity.

6.0 Exhibition

The three collections of work to be displayed in this final exhibition will be the *Revenant Bird* brooches, the *Bat Forsaken* brooches and the *Grayling Draught Lamp*.

Amanda Game (1998) talks of jewellery as interactive, made to be worn or caressed –a notion important to both historic and contemporary work. A piece of jewellery can become an experience, whether in material or metaphorical terms.

The inherent quality of jewellery as wearable becomes secondary once in an exhibition space, losing the role of the wearer, reshaping the maker/wearer/viewer discourse. If the work is appraised off the body, then the relationship between maker/wearer/viewer and the jewellery object becomes fragmented and abstracted through the absence of the wearer's tactile engagement with the work, but also through the absence of the role of jewellery as the conduit between the wearer and viewer. Therefore, the object can usually only be deciphered visually.

Galleries and museums most commonly serve as places for the display of contemporary jewellery. This alienates it from the everyday, as it is natural only for a small group of people to move within the gallery scene. Liesbeth den Besten states that these venues of display generate a separation between contemporary jewellery, the body, the viewer and the wearer (den Besten, 2011).

While the initial intention for all of my pieces is that they be worn and experienced, for the purpose of a final exhibition they will be displayed in a museological way, referencing the traditional display mechanisms and furniture of collection repositories. By doing so, the uniformity of the display case permits the viewer time and space to contemplate each object in succession, as well as collectively, allowing for engagement with the material content and aesthetic detail of each object while observing their differences and removing the awkwardness of staring at someone's chest for an extended period of time.

By placing the pieces in these traditionally styled vitrines they become autonomous objects, with the act of being worn removed from them. However, for the purposes of this exhibition, the conventional glass protection and velvet ropes are absent.

The *Bat Forsaken* brooches are to be picked up and touched, *without* the white gloves. The patina that comes with touch is, in this case, desirable. As jewellery belongs to a class of objects where understanding is contingent on touch preventing this direct access to the object denies complete knowledge of it, which goes against what these brooches are designed for, the physical acknowledgement of absence.

The turning of the *Grayling Draught Lamp* can be interrupted, and the brooch components removed and pinned on the viewer before it is restarted. This removal of the objects on display emulates the removal of the individuals from the greater gene pool, eventually leaving nothing behind but the lamp structure itself. The purposeful removal of objects challenging traditional gallery etiquette.

The *Revenant Bird* brooches, sorted by geographical location, are displayed in simplified, oversized museum drawers, referencing classification, collecting and preservation, as well as alluding to jewellery storage drawers, both public and private. A drawer can be a way to hide from view or a way to present objects to an audience (den Besten, 2012). As a space, the drawer offers an intermediate form of exhibition but can also indicate potential: objects-in-waiting in a drawer. The presence of the book, *Revenant Birds: Book of the Dead*, suggests the possibility of the brooches as objects once worn. It contains an image of each brooch returning to the place where the bird it represents lived. The brooch in the drawer is dislocated from its origins as a worn object but can be reunited with its provenance through the associated photograph.

7.0 Research summary and evaluation

This thesis, the contemporary jewellery objects themselves, and the accompanying exhibition have illustrated a range of methods of art/science investigations, including research based and collaborative projects. There are advantages and disadvantages to each method, but together they demonstrate the ability of the art object to transcend empirical science research and knowledge barriers and deliver accessible, narrative works.

In answer to my original research question, which sought to consider if contemporary jewellery, as an art practice, can disseminate, inform and question scientific research and discoveries, I have shown that indeed it can. But it can do much more than that, it also has the ability to connect people, to become a mobile storyteller, to raise questions, be intimate or public in its outlook, to talk of the past, present and future, and to rise above the limitations of culture and language.

Maker and writer David Watkins (2002) claims that the emotive qualities embedded in the handmade, and the social importance of the jewellery object, allows it to become: 'a testing ground for questions, provocations, emotions and allegory'. Dormer and Turner (1985) describe jewellery as "a shrewd monitor, reflecting the ups and downs not only of money and fashion, but also of political, social and cultural change". These interpretations identify a structural shift from the ornamental interests of the traditional jeweller to the exploratory concerns of the contemporary maker, and a desire to challenge and extend preconceptions of the notion of what jewellery can be.

This relatively new socially-led approach to contemporary jewellery talks of how the wearing of, or engagement with an object can influence how the body behaves and functions. It is also illustrative of the choices that can be made by an individual and the personal, bodily experience of wearing or using an object. The body becomes a platform for artistic contemplation that aims to question, challenge and provoke.

The size and weight limitations imposed upon each piece, in terms of wearability, mean that they beg closer inspection which leads to conversations. Material choices, image reproduction and mechanisms also demand viewer investigation which also leads to further discourse.

While this communication is widely acknowledged and encouraged within the contemporary jewellery and arts communities, the communities themselves are relatively small. The realm of influence in terms of a wider audience is limited. By taking these jewellery objects outside of the usual arts arena, such as galleries and museums, and letting them loose in the countryside (*Revenant Birds* project), encouraging touch (*Bat Forsaken* project) and participation (*Grayling Draught* project), and introducing them to the science world (though

public lectures (*What Lies Beneath*) and simply being worn at science conferences (*Conglomeration of Stilts*), I sought to engage a wider audience and expand the boundaries of influence.

The science research material investigated and embodied in the artworks was often multi-layered and complicated. The art objects broke it down into a more accessible, digestible format, allowing the viewer and participant to translate this information and make emotional connections with it. This interpretation of the specialised scientific data allowed for ownership of the information to be passed on, releasing the research so it could be understood through the jewellery objects themselves, with little or no background knowledge being necessary.

The interaction and social participation aspects of these works and research project, help to reinforce the stories they tell. It is a well-recognised phenomenon that as soon as something comes into your hands, by touching it, interacting with it, absorbing it, the recall and understanding of that object or subject increases, and it sparks a deeper interest. Such interactions expand the level of engagement with a subject. If someone tells you something, your recall is far more limited than if visuals are also included. This recall increases exponentially once someone comes into physical contact with it. If you get to interact with the object and its story, whether it be at the beginning (its inception and creation (the making of the individual Graylings)), becoming part of the story itself (bird volunteers and inclusion in the book), or at the final display (the handling of the bat brooches and the removal of the fish from the *Grayling Draught Lamp*) the understanding and impact of the objects and their story becomes etched so much deeper into the mind of the participant.

Hands-on experiences also allow for passive learning. By engaging with the public, they end up with an experience and anecdote that is more likely to be retained and retold. This information transference, from the maker, the wearer and the observer, is fundamental to this project, to spread the story of New Zealand's anthropogenic biodiversity loss and to inspire ownership and governance of the future.

The exhibition has been designed to allow for as much hands-on interaction as possible, while still referencing the museological displays it is based on. The bird brooches are displayed like specimens in a museum, grouped and ordered based on geographical location, with cards representing the spaces reserved for new objects. The accompany book illustrates the brooches' adventures in the real world. The fragmented bat brooches are set up like a specimen box, vacant, awaiting its object. The public is allowed and encouraged to pick up the brooches, to touch, to disassemble and reassemble the pieces like a jigsaw puzzle. Being true to size and based on a bat specimen held deep within the Auckland Museum collections (the only complete specimen of this species in existence), the observer can visualise an extinct

species that we will never get to see in the wild. The immersive *Grayling Draught Lamp*, with its ever-decreasing school of fish, can be stopped and the brooches removed to be taken away. This removal of objects on display goes against usual gallery and museum protocol but allows for mementoes to be taken home. Removing the brooches being analogous to the removal of the fish from our rivers and streams.

By combining art and science and producing artworks that demystify and inform, it is possible to take the message further than scientific circles and allow the narrative to become part of the public vernacular.

8.0 References

Books

- Adamson, G. (2007). *Thinking through craft*. Oxford, United Kingdom: Berg Publishers.
- Albright, M. (2009). *Read my Pins: Stories from a Diplomats Jewel Box*. USA: HarperCollins
- Attenborough, D. (2007). *Amazing rare things: the art of natural history in the age of discovery*. London, United Kingdom: Royal Collection Enterprises.
- Art Jewelry Forum, (2016). *On and Off; Jewelry, territory, identity, domination, sex, and death.*, Mill Valley, U.S.A.: Art Jewelry Forum.
- Baker, S. (2000). *The postmodern animal*. London, United Kingdom: Reaction Books.
- Barrett, E. & Bolt, B. (2007), *Practice as Research: Approaches to Creative Arts Enquiry*. London, United Kingdom: I.B.Tauris.
- Barrow, J.D. (2005). *The artful universe expanded*. New York, U.S.A.: Oxford University Press.
- Bergdorff, H. (2012), *The conflict of the faculties: Perspectives on artistic research and academia*. Leiden, The Netherlands: Leiden University Press.
- Bishop, C. (2012). *Artificial Hells: Participatory Art and the Politics of Spectatorship*. London and New York: Verso
- Brown, A. (2014). *Art and ecology now*. London, United Kingdom: Thames & Hudson.
- Brugger, M. (2016). *Brosche, or the jewelry without object of Manfred Nisslmüller*. Mill Valley, U.S.A.: Art Jewelry Forum.
- Cohn, S. (2013). *Unexpected pleasures: the art and design of contemporary jewellery*. London, United Kingdom: The Design Museum.
- Conrad, P. (1998) *Modern times, modern places: Life and art in the 20th century*. London, United Kingdom: Thames and Hudson.
- Corin, L.G. Kwon, M., & Bryson, N. (1997). *Mark Dion*. London, United Kingdom: Phaidon Press.
- Cunningham, J. 2005, *Maker, wearer, viewer: Contemporary narrative European jewellery*. Glasgow, Scotland: Scottish Arts Council.
- Daston, L. & Galison, P. (2007). *Objectivity*. New York, U.S.A.: Zone Books.

Daston, L. & Park, K. (1998). *Wonders and the order of nature*. New York, U.S.A.: Zone Books.

den Besten, L. (2012) *ON Jewellery: A compendium of international contemporary art jewellery*. Stuttgart, Germany: Arnoldsche Art Publishers.

Donald, D., Munro, J. (2009). *Endless Forms: Charles Darwin, natural science and the visual arts*. New Haven, U.S.A.: Yale University Press.

Game, A., & Goring, E., (1998). *Jewellery Moves: Ornament for the 21st century*. Edinburgh, Scotland: NMS Publications.

Galison, P.L., Holton, G., Schweber, S.S. (Eds.). (2008). *Einstein for the 21st century: His legacy in science, art and modern culture*. New Jersey, U.S.A.: Princeton University Press.

Gaspar, M., & Skinner, D., (2015). *After Wearing: A History of Gestures, Actions and Jewelry*. New York: Pratt.

Grant, K., (2017). *All about process*. Pennsylvania, U.S.A.: Pennsylvania State University Press.

Grinnell, F. (2009). *Everyday practice of science: Where intuition and passion meet objectivity and logic*. New York, U.S.A. : Oxford University Press.

Hamilton, C., (2017). *Defiant Earth: the fate of humans in the Anthropocene*. Cambridge, U.K.: Polity Press.

Heise, U.K., (2016). *Imagining extinction*. Chicago, USA.: The University of Chicago Press.

Jung, C.G. (2009), *The Red Book* (ed. S. Shamdasani). New York, U.S.A.: W. W. Norton & Company.

Kemp, M. (2006). *Leonardo da Vinci: Experience, experiment and design*. New Jersey, USA.: Princeton University Press.

Kolbert, E., (2014). *The Sixth Extinction: An unnatural history*. London, U.K.: Bloomsbury Publishing.

Leakey, R. & Lewin, R., (1995). *The Sixth Extinction: Patterns of life and the future of humankind*. New York, USA.: Doubleday Publishers.

- Leopold, A. (1987). *Game Management*. Madison, USA: University of Wisconsin Press.
- Lindemann, W. & Trier, F.H., (2011). *Thinking Jewellery; On the way towards a theory of jewellery*. Stuttgart, Germany: Arnoldsche Art Publishers.
- Louv, R. (2005). *Last child in the woods: Saving our children from nature deficit disorder*. New York, USA: Workman Publishing Company.
- McNiff, S. (ed), (2013), *Art as research*. Bristol, United Kingdom: Intellect.
- Meine, C.D., Knight, R.L. (Eds.) (1999) *The essential Aldo Leopold: Quotations and commentaries*. Wisconsin, U.S.A.: University of Wisconsin Press.
- Meyer-Westfield, N., (2014). *Land of Birds: An illustrated tribute to the birds of New Zealand*. Nelson, New Zealand: Craig Potton Publishing.
- Mills, G. (2003). *Action Research: A guide for the teacher researcher*. New Jersey, U.S.A. : Merrill/Prentice Hall.
- Moyer, T., Harper, G. (Eds.), (2011). *The New Earthwork: art action agency*. New Jersey, U.S.A.: ISC Press.
- Myers, W. (2015). *Bio Art: Altered realities*. London, United Kingdom: Thames & Hudson.
- Norman, G. (2013). *Buller's birds of New Zealand: The complete work of J.G. Keulemans*. Wellington, New Zealand: Te Papa Press.
- Rothenberg, D. (2011). *Survival of the beautiful; Art, science and evolution*. New York, USA.: Bloomsbury Press.
- Skinner, D. (2013) *Contemporary jewelry in perspective*. New York, U.S.A.: Lark Books.
- Skinner, D., & Murray, K. (2014). *Place and adornment: A history of contemporary jewellery in Australia and New Zealand*. Auckland, New Zealand: Bateman Publishing.
- Sollins, M. (ed). (2007). *Art21: Art in the Twenty-First Century 4*. U.S.A.: Harry N. Abrams Publishers.
- Strasberg,E. (2015). *Art and science* (2nd Ed.). New York, USA.: Abbeville Press Publishers.

Suisted, R., & Dench, A., (2011). *Birds of New Zealand*. Auckland:, New Zealand: New Holland Publishers.

Sullivan, G. (2010). *Art practice as research: Inquiry in visual arts*. California, U.S.A.: Sage Publications.

Tennyson, A., & Martinson, P. (2006). *Extinct birds of New Zealand*. Wellington, New Zealand: Te Papa Press.

Wilson, S. (2010). *Art + Science*. London, UK.: Thames and Hudson.

Zilioli, E.M. (Ed.), (2016), *Open space – mind maps: Positions in contemporary jewellery*. Stuttgart, Germany: Arnoldsche Art Publishers.

Articles

Morton, J., (2017). *Could 'bio-banking' halt NZ's species loss?* New Zealand Herald. 5 November, 2017.

Walrond, C., (2005). *Out of the Frying Pan: Into Oblivion*. New Zealand Geographic. Issue 075

Scientific Journals

Allen, K.R., (1949). *The New Zealand Grayling—A Vanishing Species*. TUATARA: Volume 2, Issue 1, March 1949

Allendorf, Fred W.; Leary R.F.; Spruell P.; Wenburg J.K. (2001). *The Problems with Hybrids: Setting Conservation Guidelines*. TRENDS in Ecology & Evolution. **16**:613–622.

Busch, K. (2009), *Artistic research and the poetics of knowledge*. Art & Research, Volume 2, No. 2., Spring 2009.

De Vos, J.M., Joppa, L.N., Gittleman, J.L., Stephens, P.R., Pimm, S.L. (2014). *Estimating the normal background rate of species extinction*. Conservation Biology **29**: 452-462.

Hill JE, Daniel MJ, (1986). *An historic record of the New Zealand greater short-tailed bat, *Mystacina robusta* (Microchiroptera: Mystacinidae) from the South Island, New Zealand*. Journal of the Australian Mammal Society, Vol 10, No 1, June 1986.

- Lohrer, A.M., Cummings, V.J., Thrush, S.F., (2013). *Altered Sea Ice Thickness and Permanence Affects Benthic Ecosystem Functioning in Coastal Antarctica*. *Ecosystems* **16**: 224-236.
- Moran, A.L., & Woods, A.H., (1995). *Why might they be giants? Towards an understanding of polar gigantism*. *The Journal of Experimental Biology* **215**, 1995-2002.
- Pierce, R. J. (1984). *Plumage, Morphology and Hybridisation of New Zealand Stilts Himantopus spp.* *Notornis* **31**:106-130.
- Pimm, S.L., Jenkins, C.N., Abell, R., Brooks, T.M., Gittleman, J.L., Joppa, L.N., Raven, P.H., Roberts, C.M., Sexton, J.O. (2014). *The biodiversity of species and their rates of extinction, distribution, and protection*. *Science* **344**
- Robertson, H.A., Baird, K., Dowding, J.E., Elliott, G.P., Hitchmough, R.A., Miskelly, C.M., McArthur, N., O'Donnell, C.F.J., Sagar, P.M., Scofield, R.P., and Taylor, G.A. (2017). *Conservation status of New Zealand birds, 2016*. New Zealand Threat Classification Series 19. Department of Conservation, Wellington.
- Rhymer, J. M.; Simberloff, D. (1996). *Extinction by Hybridization and Introgression*. *Annual Review of Ecology and Systematics*. **27**:83–109.
- Steeves T.E.; Maloney R.F.; Hale M.L.; Tylianakis J.M.; Gemmell N.J. (2010). *Genetic analyses reveal hybridization but no hybrid swarm in one of the world's rarest birds*. *Molecular Ecology* **19**:5090-5100.
- West, D, David, B. & Ling, N. 2014. *Prototroctes oxyrhynchus*. *The IUCN Red List of Threatened Species* 2014: e.T18384A20887241.
- Yetisen, A.K., Davis, J., Coskun, A.F., Church, G. M., Yun, S.H.,. (2015). *Bioart*. *Trends in Biotechnology*, DOI: 10.1016/j.tibtech.2015.09.011

Online

Ackroyd and Harvey (2017). Retrieved 7 February 2017, from <http://www.ackroydandharvey.com/downloads/StrandedNHMpublication-AckroydAndHarvey.pdf>

Alfrey, N., Daniels, S., and Sleeman, J., '*To the Ends of the Earth: Art and Environment: Art & Environment*', in *Tate Papers*, no.17, Spring 2012. Retrieved 8 December 2018 from <https://www.tate.org.uk/research/publications/tate-papers/17/to-the-ends-of-the-earth-art-and-environment>.

Allen, K.R, *The New Zealand Grayling- A vanishing species* (1949). Retrieved 11 February 2018 from <http://nzetc.victoria.ac.nz/tm/scholarly/tei-Bio02Tuat01-t1-body-d5.html>

Articulate. *The Nature of Art* (2017). Retrieved 5 February 2017 from <https://www.articulateshow.org/articulate/brandon-ballengee>

Arts at CERN (2019). Retrieved 10 January 2019 from <https://www.arts.cern/>

Australian Network for Art and Technology (2019). Retrieved 2 January 2019 from <http://www.anat.org.au/>

Brandon Ballengee, (2017). Retrieved 10 May 2017, from <http://www.brandonballengee.com/collapse/>

Cell Press. (2015, November 23). Bioart: An introduction. *ScienceDaily*. Retrieved 10 December 2018 from <http://www.sciencedaily.com/releases/2015/11/151123203619.htm>

Centre for Post Natural History (2009) Retrieved 13 December 2016 from <http://www.postnatural.org/>

Dana Hakim (2010), *I Care A Lot | Middle East Portable Discussion*. Retrieved 19 February 2017 from <http://www.designbreakonline.com/2010/09/05/i-care-a-lot-middle-east-portable-discussion/>

Foundation for Art and Creative Technology (2019). Retrieved 10 January 2019 from <https://www.fact.co.uk/>

Higgins, D., (2015). *Without Mourning there is no Remembering: Interview with Brandon Ballengee*. NC Magazine, Vol. VI, No. 9, September 2015. Retrieved 26 January 2017 from <http://www.numerocinqmagazine.com/2015/09/09/without-mourning-there-is-no-remembering-interview-with-brandon-ballengue-darren-higgins/>

Kate MacDowell, (2018) Retrieved 14 January 2018 from <http://www.katemacdowell.com/>

Lehrer, J. (2008). *The Future of Science...Is Art? Forth Culture*. Retrieved 29 August 2012, from http://www.seedmagazine.com/content/article/the_future_of_science_is_art/P1/

Lignel, B. (2016). *Made Together: thrills and pangs of participatory jewelry*. Retrieved 15 August 2018 from <https://www.artjewelryforum.org/made-together>

Love, T. (1995). *Science and the Arts*. Retrieved 29 August 2012, from http://www.physlink.com/education/essay_love.cfm

Freshwater Threats. Retrieved 6 March 2018 from <https://www.nationalgeographic.com/environment/habitats/freshwater-threats/>

Maarten vanden Eynde (2013) Retrieved 14 February 2017 from <http://www.maartenvandeneynde.com/>

Neukom Vivarium, (2017). Retrieved 14 February 2017, from https://www.en.m.wikipedia.org/wiki/Neukom_Vivarium

Nikki Romanello (2017), Retrieved 15 February 2017 from <http://www.nikkiromanello.com/NikkiRomanello/BIO.html>

Patricia Piccinini (2017). Retrieved 15 February 2017 from <http://www.patriciapiccinini.net/printessay.php?id=45>

Ross, S. (2011). *Bid to honour our 'forgotten' Nobel laureate CTR Wilson*. Retrieved 19 September 2012, from <http://www.martinfrost.ws/htmlfiles/scotnews11/110508-crtwilson.html>

Science Gallery (2019). Retrieved 14 January 2019, from <https://www.dublin.sciencegallery.com/>

Science Art Research Gallery (2019). Retrieved 14 January 2019 from <https://www.lifespace.dundee.ac.uk/>

Seattle Art Museum (2017). Retrieved 15 February 2017, from <http://www.seattleartmuseum.org/eMuseum/code/emuseum.asp?style=browse¤trecord=1&page=search&profile=objects&searchdesc=Number%20is%202007.1&searchstring=Number/,/is/,/2007.1/,/0/,/0&newvalues=1&newstyle=single&newcurrentrecord=1>

Shindler, K., *Spotlight on Ecology: Mark Dion* (2007). Retrieved 5 February 2017 from <https://www.magazine.art21.org/2007/11/08/spotlight-on-ecology-mark-dion/#.W8PrCfZuLIU>

Smithsonian (2013). *What is the Anthropocene and are we in it?* Retrieved 14 December 2017 from <https://www.smithsonianmag.com/science-nature/what-is-the-anthropocene-and-are-we-in-it-164801414/#RhYXMtQe1bvBPCYK>.

Stephens, C., and O'Connor, G., *When artists get involved in research, science benefits* (2017). Retrieved 5 September 2018 from <https://theconversation.com/when-artists-get-involved-in-research-science-benefits-82147>
<https://www.theconversation.com/when-artists-get-involved-in-research-science-benefits-82147>

Suzanne Anker (2017). Retrieved 26 February 2017 from <http://www.suzanneanker.com/>

Tate Gallery. Retrieved 8 December 2018 from <https://www.tate.org.uk/art/art-terms/e/environmental-art>

This is Alive (2014). Retrieved 5 February 2017 from <http://www.thisisalive.com/post-natural-history/>

Benjamin Truitt *What Is Environmental Art? - Definition, History & Movement*. Retrieved 25 February 2017 from <https://www.study.com/academy/lesson/what-is-environmental-art-definition-history-movement.html>

Undergraduate course: Making Animal Studies (2019). Retrieved 15 January 2019 from <http://www.drps.ed.ac.uk/16-17/dpt/cxartx08069.htm>

Urban 75, (2008). *MoMA Contemporary Art Center, New York*. Retrieved 19 September 2012, from <http://www.urban75.org/photos/newyork/ps1-art-long-island-city.html>

Vincent Fournier, (2016). Retrieved 16 February 2017 from <http://www.vincentfournier.co.uk/site/index.php?r=slideshow/view&id=8>

Public Engagement Fund (2018). Retrieved January 3 2019 from <https://www.wellcome.ac.uk/funding/public-engagement-fund>

Wild, J. (2017). *The Pin, a Special Connection*. Retrieved 5 November 2018, from <https://www.klimt02.net/forum/articles/pin-special-connection-essay-julia-wild>