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Black, Jasmine ORCID logoORCID: <https://orcid.org/0000-0001-9145-3889>, Morrison, Kerry, Urquhart, Julie ORCID logoORCID: <https://orcid.org/0000-0001-5000-4630>, Potter, Clive, Courtney, Paul ORCID logoORCID: <https://orcid.org/0000-0002-5683-8502> and Goodenough, Alice ORCID logoORCID: <https://orcid.org/0000-0003-0862-2894> (2023) Bringing the arts into socio-ecological research: An analysis of the barriers and opportunities to collaboration across the divide. People and Nature. doi:10.1002/pan3.10489

Official URL: <https://doi.org/10.1002/pan3.10489>
DOI: <http://dx.doi.org/10.1002/pan3.10489>
EPrint URI: <https://eprints.glos.ac.uk/id/eprint/12640>

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RESEARCH ARTICLE



Bringing the arts into socio-ecological research: An analysis of the barriers and opportunities to collaboration across the divide

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Funding information

UK Research and Innovation, Grant/

Award Number: AH/T012307/1

Handling Editor: Maraja Riechers

Abstract

1. Socio-ecological research collaborations between artists, natural and social scientists, and with the humanities more broadly, have increased significantly in recent years. This has been aided by increased investment by funding bodies such as UK Research and Innovation and others internationally in projects designed to encourage cross-disciplinary partnerships.
2. Within socio-ecological research and beyond it, despite some success stories, there is still a lack of awareness in 'the sciences' regarding how 'the arts' undertake their own forms of enquiry into the world. Further, different terminology and language used by different disciplines can cause confusion and misunderstanding, potentially leading to a reluctance to work collaboratively.
3. In this paper, we discuss diversity within the arts as a discipline and seek to clarify various terminologies being used in both the arts and sciences to characterise joint working in research projects.
4. Drawing on a series of semi-structured interviews and a workshop with artists and natural and social scientists with experience of collaboration in socio-ecological research, we compare understandings and expectations and reflect on the implications for funding bodies, institutions, artists and scientists which are widely applicable across different research contexts.

KEYWORDS

arts research, collaboration, funding, socially engaged arts, socio-ecological

1 | INTRODUCTION

Within a range of research fields, collaborations between the arts and (natural and social) sciences have become increasingly common in recent years (Nature, 2021b; Okamura, 2019; Stock & Burton, 2011).

Indeed, in early 2021 the journal *Nature* released the results of a poll on arts-science collaboration with the headline: "Scientists and artists are working together as never before" (Nature, 2021a). One explanation is the growing recognition across society that global challenges such as climate change and biodiversity loss require ever

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more robust cross-disciplinary approaches and solutions. In these terms, artists and arts-based researchers are seen to have important knowledge and experiential contributions to make alongside those of natural and social scientists and the humanities more broadly (Ledford, 2015). Nevertheless, artists are guided and inspired by epistemological traditions that are often very different to those guiding natural and social scientists (referred to from this point as 'scientists'), (Morrison, 2015; Saratsi et al., 2019). Whereas many scientists work with a hypothesis or set of research questions, gathering data of various kinds to interrogate and test these, the arts come from an aesthetic, often highly subjective perspective of enquiry, using a practice-based approach to produce original creative outcomes and artworks that celebrate the perspective of the artists themselves (Gabrys & Yusoff, 2012; Morrison, 2015; Saratsi et al., 2019). Despite this, social scientists do have common ground with artists to the extent that the latter may undertake work which explicitly values personal and individual experience, undertaking observations and in drawing out themes from qualitative interviews (Annett, 2010; Letherby et al., 2013).

In a socio-ecological research context, artists working in partnership with natural and social science colleagues can achieve a more holistic understanding of many socio-ecological issues. For example, an interdisciplinary approach can help improve understanding of the complex interplay between the environment, society, culture and economy. As such, this calls for greater recognition of the potential for such collaborations both in socio-ecological research and further afield. Indeed, funding for collaborative projects involving scientists and artists continues to increase, with major funding initiatives such as the United Kingdom Research and Innovation's (UKRI) 'Future of UK Treescapes' and 'Landscape Decisions' programmes each giving strong encouragement to applicants to develop proposals involving artists and arts-based researchers (UKRI, 2022a, 2022b; van Noorden, 2015). Internationally, organisations such as the Art Science Node (ASN) in Berlin, Germany, the US National Science Foundation, and the Simons Foundation in New York City provide opportunities and funding for interdisciplinary work.

There are already some published examples of how such collaborations can work. For example, in the socio-ecological field, Collins et al. (2018) and Edwards et al. (2016) demonstrate how teams of artists and scientists worked together to deliver an arts-led practice of dialogue and open exchange with communities local to a project study site. Collins et al. and Edwards et al. both argue that through using arts-led aesthetic, (visual and sensual) engagements with the forest alongside investigating the social and cultural history of the forest, a more profound engagement with forest actors was achieved than if via natural and social science-based approaches alone. Additionally, the artists Collins and Goto's "relative freedom from institutional constraints" allowed them to pursue "originality, creativity and provocativeness", all of which was argued to be their unique contribution as artists (Edwards et al., 2016). Further, they argue that arts approaches, such as undertaking dialogue with the public, can lead to more inclusive forms of data gathering on socio-ecological issues, with the potential to engage with groups that may be harder

to reach than with traditional social science methodologies. Despite these successes, there is still a sense within the wider research community that bringing an arts perspective into applied research can be risky and challenging, not least because of the very different epistemologies and *modus operandi* that have been hinted at above. The *Nature* editorial quoted previously, for instance, acknowledges that, despite some instances of deeply integrated and equal partnerships between artists and scientists, arts-based contributions are still too often misunderstood as being simply a 'tool' for communicating the outputs of a research project to various audiences (Nature, 2021a). Scientists often do not have a full understanding of what constitutes 'the arts' or how an arts component can contribute to socio-ecological research more broadly (Little, 2017). At the same time, there is continuing confusion concerning how best to integrate arts perspectives and understandings within different types of research projects, with misconceptions on both sides about the best ways to design projects to respect and capitalise on the different working methods, and on the potential knowledge contributions of artists and arts-based researchers (J. Klein, 2010; Saratsi et al., 2019; Smith & Dean, 2009). Research collaborations can exist in a variety of forms, reflected in the different terms used to define ways of working together (multi-, inter-, trans-disciplinarity, etc). However, these terms are frequently misunderstood and therefore misused and need to be clarified and agreed within research teams in order to fully realise the potential of working across disciplines (Saratsi et al., 2019; Stock & Burton, 2011).

In this paper, we address some of the current challenges and opportunities for collaborative arts-science research in the socio-ecological field. We begin by reviewing the current literature, describing the evolution of artistic enquiry into the socio-ecological sphere. This is supported by findings from exploratory interviews conducted with artists (both freelance and those working within academia) and scientists in order to compare expectations and experiences of cross-disciplinary working and the challenges associated with this. Following the literature review, we detail the methods used for data collection, present and discuss the results from interviews and a validation workshop that we conducted with a cross-section of artists and scientists with experience of (or an interest in) collaborative working. We conclude the paper with some recommendations for better integrating arts and sciences together more broadly across a wide range of research fields, beyond the socio-ecological field.

2 | DIVERSITY WITHIN 'THE ARTS' AND THE CONCEPTS OF SOCIALLY ENGAGED AND EcoArt

In this section, we will take a more in-depth look at the history and relationship of art and socio-ecology to highlight how artists have worked in this context. We focus on two significant areas of art and socio-ecological convergence—socially engaged art and EcoArt. To unpick what we mean by 'the arts', it is important first to understand that there are many differently defined areas of arts practice and research. For example, the visual arts, which encompasses

much contemporary work and fine art, such as painting, sculpture and performance (see Figure 1), with its longer history of development. Contemporary art forms are complex and nuanced and contemporary art practice is ever evolving and constantly being redirected by artists. Through these re-directions, which can be described as 'movements', practice becomes ever more refined or, alternatively, broken down and re-asserted. Different forms of art can overlap and intersect, resulting in more hybrid expressions such as Concrete Poetry—an integration of text and visuals arranged in graphic patterns (Lopez, 2013). Furthermore, each art form has progressed through integrating different methods thereby creating new forms of interdisciplinary art (Bishop, 2012; Brady, 2016; Geffen et al., 2022; Pool, 2018; Weintraub, 2012). In summary, 'the arts' can be interpreted in many varied ways. Artists, like scientists, are not general practitioners, rather they are experts in specialised fields.

In terms of artists whose work has a specific environmental focus or mission, two strands of contemporary art practice stand out: social art (also referred to as socially engaged art (SEA)) and EcoArt (also known as ecological art or environmental art). We acknowledge here that within the arts, the term 'socio-ecological'—widely used in scientific research (in the context of social-ecological systems)—is not yet well recognised, despite the strong relation to the latter two forms of art. Social art and EcoArt each sit within their own canons. However, if we trace these back through time, it can be argued that they share a common root, emerging out of the work and ethos of the Black Mountain College (1950s); Fluxus (early 1960s); and Happenings (1960s) (Bishop, 2012; Helguera, 2011; Lacy, 1995; Morrison, 2015; Scholette et al., 2018; Weintraub, 2012). Each of these art 'movements' took art into the everyday, challenging the political and economic hierarchies of art and disrupting the status quo. Ultimately this created paradigm shifts that in turn paved the way for EcoArt and Social arts practice (Bishop, 2006, 2012; Helguera, 2011; Spaid, 2002). The origins of EcoArt can be traced back to the late 1960s. As a movement, it developed through the pioneering work of artists deeply concerned about the environment and people's connections to landscape and ecology; for example: The Harrisons, Joseph Beuys, Mierle Laderman Ukeles, Agnes Denes, Hamish Fulton and Richard Long. These artists introduced new approaches to art, including mapping, walking, conversations (dialogue), planting plants such as trees and others (Kwon, 2004; Matilsky, 1992; Morrison, 2015; Spaid, 2002). Figure 1 highlights the arts progression towards SEA and EcoArt, using a simplification of The Tate and Fanelli's timeline. It should be noted that these two new forms of art have not yet featured in the timeline, as it only runs

until 2000, whereas the term SEA was coined around 2011 (Froggett et al., 2011; Helguera, 2011). The preceding forms of art before SEA and EcoArt are shown on the timeline.

As defined by Beth Carruthers (Carruthers, 2006, p. 3) EcoArt is "a broad field of interdisciplinary arts practice, distinguished... by its specific focus on world sensitive ideologies and methodologies. EcoArt practice seeks to Restore, Protect and Preserve the world for its own sake, and to mediate human/world relations to this end." EcoArt is often complex including collaborative, durational (happening over a period of time, often connected to seasonal changes and non-human life cycles), social and interdisciplinary ways of working, (Brady, 2016; Curtis, 2020; Geffen et al., 2022; Haley, 2009; Kwon, 2004; Matilsky, 1992; Spaid, 2002; Strelow & David, 2004; Weintraub, 2012).

To clarify the interdisciplinary approaches undertaken by artists working between art and ecology, Weintraub (2012) devised a schematic matrix, which she has applied to several different artists. Each matrix shows the diversity of influences upon the artist—where they draw their inspiration from and how this informs their practice. This includes several EcoArt approaches, art strategies, art and ecological genres. For example, in Figure 2, The Harrisons matrix can be compared with other artists' matrices, to show how they differed to their contemporaries, that is the specific intersecting approaches, issues and genres taken.

Ecological arts practice continues to grow and evolve. An emerging tangent within EcoArt is eco-social art (Fitzgerald, 2018) and variations thereof, such as socio-ecological art and socio-environmental art, all of which articulate, as a practice, the coming together of the ecological and the social—however, these new terms have not yet been widely adopted. Since the 1970s, process-led art has given rise to performative social artworks, actions, environmental interventions and socio-political work broadly known as social art (Heim, 2005, p. 200). SEA, like social art, is rooted in the seminal work of Allan Kaprow and 'Happenings' (Helguera, 2011); however, SEA goes beyond arts commentary on social issues through to deep social engagement and co-creation with communities. SEA is used as a ground-up vehicle to give voice to those experiencing social inequalities with the aim to bring about social change (Fox et al., 2019).

3 | COLLABORATIVE WORKING ACROSS THE ARTS AND SCIENCE DIVIDE

The emergence of SEA arguably provides an ideal opportunity to foster collaborations with academic researchers from across the

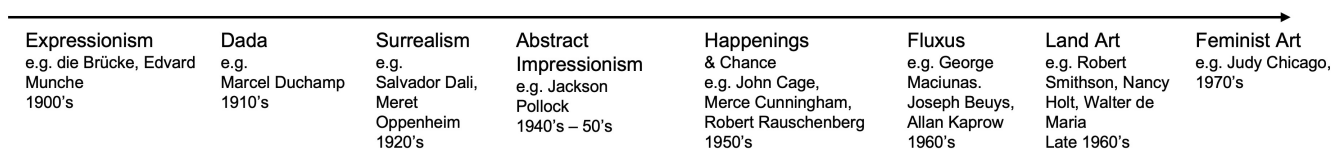


FIGURE 1 Artist timeline showing the line of progression through art genres and movements towards SEA and EcoArt, adapted from The Tate and Sara Fanelli's 'Artist Timeline' which can be viewed via Open Culture (2015), by searching for "Sara Fanelli" via <https://www.openculture.com/2015>.

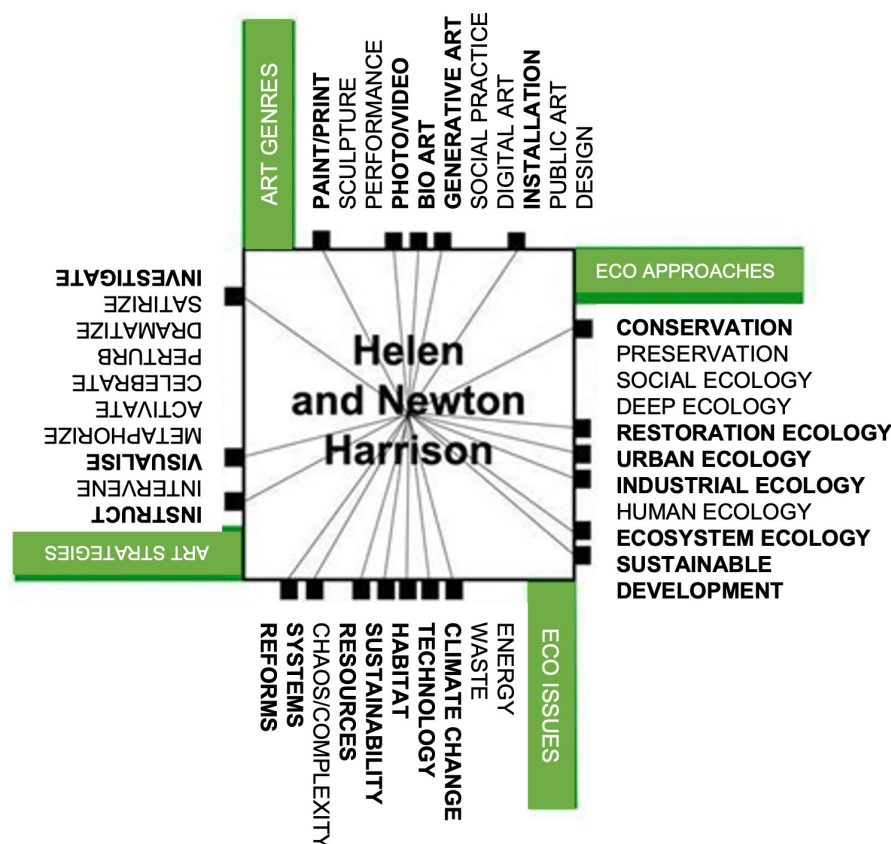


FIGURE 2 Adaptation of Helen and Newton Harrison, schematic matrix of practice (Weintraub, 2012, p. 74).

disciplinary spectrum, including with natural scientists engaged in environmental research (Collins et al., 2018). Advocates argue that SEA methods and approaches can bring significant benefits to the design and execution of research projects, offering novel perspectives on the framing of research questions, and mobilising approaches which, by their very nature, are highly inclusive of human subjects, and increasingly, with the emergence of socio-ecological art, non-human (or 'more-than-human') actors (Fitzgerald, 2018; Saratsi et al., 2019). SEA approaches also have the potential to engage with a broader cross-section of publics and other actors than is possible via conventional survey methods or public engagement approaches. While particular strands of social science (ethnography or action research, for example) may support a more embedded or action-based approach, research emerging from a scientific context is frequently outcome-led and follows a relatively strict methodology (Bradbury-Huang, 2010; Saratsi et al., 2019). In contrast, while having clear intentions, SEA is, by its nature collaborative, dialogic and open-ended, allowing for an organic and experimental process to unfold into an outcome which is determined collectively through processes of engagement (Froggett et al., 2011; Helguera, 2011). It is therefore process-led, rather than outcome-led. A SEA approach encourages individuals to become involved through focusing on what is relevant to them and their community (Frieling et al., 2019). This level of engagement requires flexibility: listening to and acting upon the voices of those participating; voices expressing personal, mostly first-hand, experience (Fox et al., 2019; Frieling et al., 2019). More broadly across arts and sciences collaborative research, despite recognition of the potential

benefits of such collaborations, it can be challenging to realise this in practice, not least because both scientists and artists need to understand the multiplicities of the other (Nature, 2021a).

Within and beyond the socio-ecological context, it is important to note that there are important differences between collaboration in terms of whether the ambition is to achieve multidisciplinary, interdisciplinary and transdisciplinary outcomes. All these models offer valid ways to foster collaboration between artists and others, but they suggest varying degrees of integration of working methods and ways of working. Multidisciplinary teams consist of fellow academics who are from different disciplinary backgrounds and who work collectively on a project but do not change their disciplinary approach (J. T. Klein, 2010). The result is typically a body of research addressed from different research perspectives. Interdisciplinary teams also consist of fellow academics from different disciplines; however, they merge their epistemological approaches to create integrated method and solutions (J. T. Klein, 2010). Transdisciplinary teams consist of academics from different disciplines as well as non-academics, such as professionals, practitioners, policymakers and other stakeholders. These teams work together to combine different forms of knowledge and experiences from in and outside of academia (Bernstein, 2015; Klein, 2013).

At the same time, within these different cross disciplinary ways of working there are challenges to be overcome in terms of establishing shared understandings of the task in hand, knowing who and how to recruit artists and identifying appropriate sources of funding for collaborative projects. Further, the arts and the sciences produce

and disseminate outputs in very different ways, for example a peer reviewed journal paper in the sciences vs a (critiqued) artwork, process, or public event in the arts. For the SEA artist, the primary audience is the community within which, and with whom, the work was created (Fox et al., 2019; Frieling et al., 2019; Lacy, 1995; Scholette et al., 2018). Where these works are published also differs from the sciences, for example, in book and catalogue publications, and independent on-line arts journals, websites and blogs.¹ Therefore, they can be difficult for scientists to find unless they know what to look for. These are issues that are much talked about across a range of research contexts but rarely analysed in any systematic manner.

4 | METHODS

Exploratory semi-structured interviews and a validation workshop were conducted by the authors to gather data on the challenges and potential opportunities of working in collaborative arts-science socio-ecological research projects. The interviews provided an in-depth exploration of the issues and opportunities for collaborative working, while the subsequent workshop allowed us to reach a wider breadth of participants, validate the interviews and check for any further arising themes (Denzin, 1970). The interviews and workshop were used to create a triangulation method in order to validate the results (Lambert & Loiselle, 2008).

A snowballing method of recruiting interviewees was used, starting with existing contacts of the research team through their experience on arts-science collaborative projects in the UK and asking participants to suggest other potential participants (Flowerdew & Martin, 2013). Requirements for participants were that they had experience of arts-science collaboration for socio-ecological research or were actively pursuing such projects through networking across disciplines or applying for funding as a cross disciplinary team. Interview questions included asking participants about the benefits and challenges of their own experience of collaboration and sought to identify what is further needed in order for artists and scientists to work more effectively together on socio-ecological research projects in future. Full details of the interview questions and workshop agenda can be found in the [Supplementary Materials](#). The outcomes from the interviews were validated in a workshop with both artist and scientist participants recruited via the team's existing networks including the UKRI Landscape Decisions programme and the UKRI Future of UK Treescape programme. Workshops topics included sharing experiences of the challenges of art-science collaboration and what support is needed for improving collaborations. All participants involved in this research gave written informed consent prior to the data collection. Ethical approval for the research conducted for this paper was given by the School Research Ethics Panel of the School of Natural & Social Sciences, University of Gloucestershire, reference clearance code: NSS.1021.222.

Interviewees included artists who have worked with in academia (allowing us to explore the differences between being a freelance

artist versus someone employed by a university—see further discussion of this important distinction below). As our aim was to better understand the barriers to artists involvement in socio-ecological research projects, we interviewed a larger number of artists than scientists. We interviewed 10 professionals: three scientists; four freelance, independent artists; two academic artists and one producer (with experience of both academia and art). See [Table 1](#) for an overview of the interviewees' disciplines. The workshop included 20 participants from a mix of arts, social and natural sciences. Therefore, we had a total sample size of 30 including the interviewees and the workshop participants.

Our interview and workshop approaches were iterative, cumulative and philosophically based in grounded theory (Glaser & Strauss, 2017). The approach is located within a pragmatist philosophy which understands that contextualised knowledge and experience is the basis on which action is initiated (Cornish & Gillespie, 2009). From an epistemological standpoint, this philosophy considers knowledge as a learned response to the environment rather than an accurate representation of reality (Rorty, 1999). Grounded theory allows an observed phenomenon to be studied through the collection of real-world data, from which new theories may arise (Glaser & Strauss, 2017). Generating theory in this way maintains the relevance of context and provides a potential means of establishing detailed evidence about the 'real-world' practicalities of individual and community behaviours (Cornish & Gillespie, 2009). In our judgement, such a pragmatic and contextualised set of methods is highly appropriate here, with the interviews and workshop allowing the contexts of the participants' experience to be maintained, while at the same time enabling new themes to emerge.

Themes arose from the answers given and consisted of understanding collaborative working in practice; differing expectations; finding partners for collaboration and funding. Two team members with different disciplinary backgrounds (one team member from environmental and social science and the other from environmental science and socio-ecological art practice) undertook the interviews together, allowing for a blended arts-social science approach to enquiry and to interpretation of the interview data. Following each interview, the two researchers discussed and reflected together on the transcripts and notes to identify the understandings, meanings and themes arising from each interview. This reflection created an iterative and cumulative process, through which we were able to assess new or similar emerging themes from one interview to the next and add in relevant questions to following interviews. Using this method, after 10 interviews, a saturation point was reached with no new themes emerging (Hennink & Kaiser, 2022). The workshop built on the findings from the interviews, creating a further step in the iterative process. While no new major themes emerged from the workshop, some nuances did arise which are included in the following sections.

The following sections present results from the interviews and workshop and combines this with a discussion of the challenges and opportunities arising from participants experiences and that in the literature. Each section is one of four key themes that arose during

TABLE 1 Overview of interviewees' disciplines.

Interviewee	Background discipline and experience						Experience working collaboratively across disciplines
	Interview type (arts or science)	Environmental science degree/experience	Social science degree/experience	Art degree/academic experience	Freelance artist	Producer in the arts	
1. Natural scientist	Science	✓					
2. Social scientist	Science	✓	✓				✓
3. Social scientist	Science	✓	✓				✓
4. Academic and freelance artist (fine art)	Arts			✓	✓		✓
5. Academic artist (fine art)	Arts			✓			✓
6. Freelance artist (fine art)	Arts			✓	✓		✓
7. Freelance artist (fine art)	Arts			✓	✓		✓
8. Freelance artist (fine art)	Arts			✓	✓		✓
9. Freelance artist (fine art)	Arts			✓	✓	✓	✓
10. Arts producer and academic	Arts			✓		✓	✓

the data collection, including understanding collaborative working in practice, finding partners for collaboration, differing expectations and funding. While interviewees and participants spoke of their experience from socio-ecological projects, it is worth noting that the themes which arose could be seen as being more generally applicable to cross-disciplinary collaborative working.

5 | UNDERSTANDING COLLABORATIVE WORKING IN PRACTICE

Our interviewees were able to draw on a rich and varied set of collaborative experiences in relation to projects investigating topics such as woodland management, water quality and soil and peatland conservation. Several interviewees, both from science and art disciplines, felt that 'the arts' in general are often not used to best effect within research projects due to misunderstandings about their potential role.

The artists we interviewed reflected the literature in pointing to the differences in understanding that can arise during the earliest stages of project planning when project leaders may have unintentionally poorly formed ideas about collaborating with an artist (Candy & Edmonds, 2018; Greenwood, 2019; McNiff, 2013). A common experience amongst the interviewees was that scientists' knowledge of art practices and methodologies can be limited to traditional visual arts such as painting and sculpture. These interviewees indicated that scientists are not always aware of how art can create lines of enquiry and research *as science does*, albeit in ontologically and epistemologically different ways (Nature, 2021b). This reflects the documented views of many artists and arts-based researchers that art is too often only used as a tool for dissemination and communication of scientific results in research projects rather than as an analytic lens itself (Nature, 2021b). While this can be a powerful way of translating science into easily understandable information and real-world contexts, arts approaches have much wider potential as research tools. Workshop participants noted that when undertaking art as a research tool, the process of doing the art itself, not the outcome, is the most important factor for success. Despite this, some workshop participants had the view that more recently scientists understand art as a broad and multi-faceted discipline.

Workshop participants further related the ability of the arts to enable and value emotion in research processes. While there is a degree of subjectivity in social and even natural sciences, emotion is not valued as a factor in their enquiries or methods (Gabrys & Yussoff, 2012; Saratsi et al., 2019).

Some of our interviewees indicated a need for both scientists and artists to move beyond their own preconceptions and ways of thinking in order to maximise the benefits of arts-science collaboration. As one interviewee explained: "[These preconceptions] potentially restrain my thinking... [whereas] if I go out without my science hat on, I can be freer in my way of seeing.... As a scientist you have your... methods... so there isn't much room left to think about things in new ways" (Interviewee 1). Despite not having yet been successful

with gaining funding for collaborative projects, this scientist recognised that working with artists offered new ways of looking at a particular issue that could complement scientific understanding. This recognition came from the scientist's own interest in undertaking art and trying to perceive a research project from an artistic viewpoint. This way of working is exemplified in projects such as the Black Wood of Rannoch in which artists and arts-based researchers and social scientists worked with local communities and actors to engage them in the forest's management (Collins et al., 2018; Collins & Goto, 2016). Equally, many of the artists we interviewed spoke of how they bring science into their work, "science plays a fundamental role" (interviewee 5). Another commented that "there's a poetry in science", suggesting that there is a form of art *within* science but also that "there is a middle ground between the two [art and science]; they can be mixed and that can create impact." Further, Interviewee 5 recognised that scientists did not always join different parts of their data together or take into consideration the wider landscape of the socio-ecological project that they were collaborating on. This interviewee believes that an artist can take on the role of creating connections between data and the wider picture since: "being an artist in the mix allows a joining up of the data and landscape". This interviewee further explained that the scientist collaborators on projects they have been involved with usually appreciated this skill. One scientist interviewee we spoke with (Interviewee 2) had begun to read into art theory as well as philosophy after working collaboratively with artists. This has helped them to gain a better and broader understanding of the arts, although this behaviour was viewed as rare amongst the artists we spoke to.

Differences in working practices and timelines to completion also emerged from the interviews. Interviewee 7 described their experience of academic institutions taking time to produce outputs due to the need for rigour and to fulfil certain obligations for funders and requirements, such as completing reports to deadlines and publishing peer reviewed papers. Interviewee 7 described artists as "*nimble*" and as "weavers, who bring together different threads [of thoughts, disciplines, issues, etc.]" The interviewee expanded to say that artists can act and create rapidly in response to events or issues happening within society and the environment. We argue that this flexibility can enrich scientific research, if recognised, understood, and facilitated.

Regarding our artist interviewees perspectives on the flexibility that art can bring, there is a novel distinction to be highlighted between an *academic* and a *freelance* artist. Interviewees 7 and 8 expressed their understanding that freelance artists are not bound by the same expectations and outcomes as employed academic artists are (e.g. journal papers, research excellence and impact). Therefore, they allow progress to be organic, can take risks and transgress convention. However, this artistic flow can be constricted within academic research projects where outputs are defined at the application stages of a project. Interviewee 8 related that a freer style of working can also create conflict in planning and undertaking collaborations due to the risk involved.

As an academic artist, interviewee 5 explained that networks for collaboration are readily available within academia and a stable

income is provided from which to develop projects. For freelance artists, however, networks—to other disciplines in particular—can be more challenging to form and income needs to be secured through securing commissions or other (sometimes non-arts related) work. Academic partners may also find freelance artists harder to connect to, as their work lies outside of academic publishing. One freelance artist said "we [artists] are an island" between scientists and institutions—there is a feeling of being isolated when not belonging to an institute, or without peers on a collaborative project. Further, another freelance artist interviewee commented that "you are alone" as a freelancer, compared to academics (whether scientists or artists) within institutions.

Further, it is important to highlight the difference between artist academics who actively practice art and those who do not. Some of our artist academic interviewees practiced art not in pursuit of new funding opportunities but rather out of a passion and need to innovate (we recognise that scientists can also work in this way). Our artist academic interviewees noted that when considering the contribution of art to a collaborative project, it is worth considering the different merits of those who are not actively practising and innovating as artists.

6 | DIFFERING EXPECTATIONS

Expectations and understanding are closely linked, and we found that gaps in understanding can lead to differences in expectations between scientists and artists when working together. As a foundation for working collaboratively, Interviewee 10 explained that both scientists and artists "need to be prepared to explain to each other what they do and why" and to respect each other's ways of working. An implication being that each party needs to learn to speak the other's language or at least agree some sort of shared lexicon given that the same words can mean different things to artists and scientists. Our interviewees agreed that it is crucial that all researchers within a project feel valued and that there is ontological and epistemological equity in which all ways of knowing and researching are recognised and respected. Others emphasised the need for researchers within a team to have common goals when undertaking a project together, and Interviewee 7 commented that it is "essential to build relationships"; a sentiment that was shared by most other interviewees.

'Trust' was also cited as vital for collaborations to work and that time and space—beyond the work environment—need to be prioritised in order to develop this. The importance of having space in which to be together as a team was highlighted throughout the interviews. Research teams need places and regular times to discuss the research, progress and form ideas collectively. This was strongly emphasised by our artist interviewees, but also appreciated by the scientists we spoke with. Time and space are needed to establish shared understandings and clarify expectations and processes. Generally, interviewees recognised the "power of chat"—being able to sit down and hang out together in an informal situation to and talk through ideas, and potential research, general interests,

thoughts and opinions. The literature corroborates this, emphasising the need for time and space in multi, inter and transdisciplinary teams, to explore different dimensions of a project and develop understanding of different disciplines (Bruce et al., 2004). The literature also underlines the extent to which time is required early in the life of projects to build trust within teams; without this foundation building, there is a risk that information sharing may be hindered due to persisting language and terminology barriers (Buller, 2009; Stock & Burton, 2011).

In most instances, the scientists we spoke to had given their artist collaborators an open brief within the project, describing the process as being guided by the artists. One scientist interviewee had also been invited onto projects by artists and therefore has experience being led by the artists. Where scientists had experience of working with artists with both open and closed briefs, they felt that the outcomes of the project were stronger when the artist had an open brief. A closed brief states what the art outcome will be, for example, an exhibition, an interpretation panel, an App; in other words, the non-artist pre-determines what they think they want or what they expect. An open brief would set the parameters of the research question but crucially leave the art methodologies and methods open, so the artist can develop authentic artwork in response to the research question.

Differing expectations of project outputs appear to be a further significant barrier to effective collaboration. Both artist and scientist interviewees recognised that there is usually a degree of uncertainty when working with artists, and indeed the outcomes of science are not always known. Our scientist interviewees explained that this may be hard to reconcile with the expectations of funding bodies and an insistence on measurable outputs and impacts. Whilst there is merit in this metrics-based approach for academic artists, our artist interviewees noted that such outputs are not likely to be the driver for the freelance artist who will be developing their work in response to the environment and the communities living there—both human and non-human. An artist rarely begins with a hypothesis. Artist Interviewees 4 and 7 explained their process of taking inspiration from the surroundings and digesting this information in conjunction with scientific research. These ruminations led to ideas and the ideas to artwork. For the SEA artist, the motivation is likely to be the local community and the development of new artwork with them and for them (Heart of Glass & Battersea Art Centre, 2021).

Participants in the workshop built upon these themes of expectations, relating differences in technicalities such as ethics processes. They discussed that there needs to be an understanding of the personal ethics process of the artist, as well as the institutional ethics processes put in place to protect research participants.

7 | FINDING PARTNERS FOR COLLABORATION

Some of the scientists we interviewed commented that it was often difficult to know where to go—or who to ask—to recruit artists to multi, inter or transdisciplinary teams. Although this barrier to collaboration

is increasingly well recognised by funders (e.g. through collaborator finders such as in the UKRI Future of UK Treescapes programme²) there is still some room for improvement to allow for connections outside the usual funding institutions to be made in order to reach artist organisations and freelancers. Initially, project leads need to understand what type of art and artist a good match for their project is. After learning about and identifying the appropriate art approach(es), scientists need to be able to network with artists in order to build collaborations which then can lead to undertaking projects together (see Figure 3). Some interviewees suggested the need for a 'dating site' or forums between artists and scientists in order to find suitable collaborators, as often there are no networks in place to begin finding a relevant collaborator with which to discuss working together. Indeed, Interviewee 7 suggested that this "needs a whole project in itself" to set up and administer. Scoping out collaborators, and an open-minded approach for all collaborators, is also a significant part of the relationship and trust building process, which was stressed as vital by interviewees, and mentioned in Section 4. If this cannot be undertaken properly, poor matches may be made with negative consequences for the ensuing collaborative project. However, the often short application window of funding calls can hinder finding suitable partners and establishing workable and productive relationships.

One potential option to help support collaboration building might be grant funding that aims to support new collaborations to work on small pilot projects as a way to test and build relationships, prior to applications to larger funding streams. This would be an opportunity to test out new ideas and new ways of working, learning, and reflecting on the experience of the pilot. As related in Section 6, it is important to understand the expectations of all actors on a project team. Therefore, clear and transparent memorandums of understanding or terms of agreement (i.e. contracts) at the start of projects could also help to provide agreement on intellectual property rights, copyright and other such specifics, to avoid misunderstandings. Artist interviewees suggested that a further strategy might be the inclusion of a professional facilitator or animateur to aid the progression of creative projects by holding space and allowing for reflexive approaches.

Clearly, the type, and personality, of each collaborator is important for the partnership to work, as Interviewee 5 said "we bring who we are" to a project. For example, both parties need to be open to collaborating with the other and have an enthusiasm to learn different ways to explore a subject or issue.

Many of the interviewees noted that recommendations for working with someone from another discipline often came via word of mouth—from colleagues in existing networks, particularly for those working in academic institutions. Freelance artists, however, felt less well networked, particularly with potential scientist collaborators. Interviewee 5 noted about their experience with an organisation which had set up a 'lab' for collaboration—a physical space in which artists and scientists can gather to learn about each other's practice, build relationships and a body of work. This again, in theory, aids collaboration but it can also have limitations. For instance,

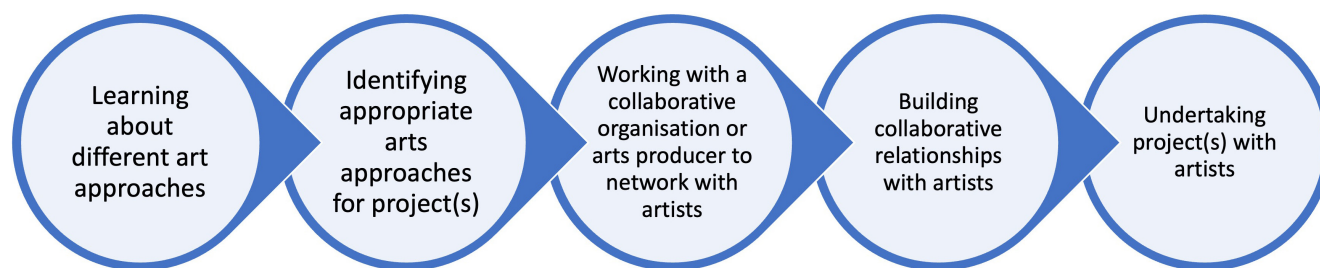


FIGURE 3 Steps for creating collaborative relationships with artists, based on needs arising from the interviews and workshop, as well as the authors' reflections.

'labs' suggests a science focus and starting point, which can potentially bias the collaboration towards science.

A scientist interviewee highlighted the importance of the role of arts commissioning experts, such as art producers and curators, in bringing artists and scientists together and supporting project leads in engaging and recruiting artists. This can be particularly useful in instances where project leads have little or no experience of writing artists' brief or commissioning artists.

FUNDING

Disciplinary silos are often reinforced by the ways in which new research is funded. For instance, in the UK, research councils are often discipline-focused, with specific research councils, and therefore funding streams, being directed at specific academic disciplines or fields of study (e.g. Arts & Humanities Research Council, Natural Environment Research Council, Innovate UK). While research councils often provide joint funding for interdisciplinary research programmes, they are usually led by one research council. It was widely agreed by our interviewees that cross-council collaboration is essential to ensure that funding calls (e.g. language used in the call) and the review process (e.g. to include reviewers from across the remits of the funding research councils) are designed in ways that are equitable across the disciplines. Without this, such programmes can result in unequal partnerships between the disciplines from the outset or a misunderstanding of the full research potential. Indeed, previous literature reflects the interviewee's concerns of power dynamics created by one discipline dominating the approach of a project and the negative effect on trust that this can have for the team (Stock & Burton, 2011).

Further bias can come into play regarding funding competition and the perceived or real need to bring in an artist with reputation. Under this approach, freelance artists may not be recognised as 'legitimate' to partner with or have an equal standing to academics and are therefore not considered. Bringing freelance artists into a funded project can have income-related issues for the commissioned artists or the institutions commissioning them. As UK research councils generally fund up to 80% of the full economic cost of a project, this can create economic difficulties for the research institute in being able to afford to commission a freelance collaborator at 100% of their daily rate (as set by the Scottish Artists Union and Artists' Union England). Interviewee 1 described how some funding calls for partnering scientists with artists can be restrictive due to a cost-sharing rule which

makes it difficult to fully cover the costs of artist fees. Moreover, Interviewee 1 explained that working with artists can be perceived as a financial 'risk' for smaller research institutes who may not fully understand the positive contribution artists can bring to a project and have a lower financial capacity than large research institutes.

Another issue that interviewees described in relation to funding is the "rigid time frames" and a feeling of being forced to deliver project outcomes without having the necessary time and space to meet, discuss, get to know and understand each other's backgrounds and approaches. High importance was attached by many of the artists interviewed to having spaces available in which to create shared understandings. Further, having the time to implement an iterative process in a project, where ideas and data are discussed, adapted, and evolved, rather than focusing on set outcomes, is often integral to artists' way of working. Previous literature has suggested a long-term, 10-year process to build strong relationships and trust within multi, inter and transdisciplinary teams (Jerneck et al., 2011). One academic artist we spoke with recognised the ability to submit practical work such as exhibitions to the Research Excellence Framework (REF—a system in the UK for assessing the quality of research in higher education institutions), which can provide funding for the institution in the longer-term. However, if working in localised contexts, it can be difficult for this to be submitted to the REF due to the need for international impact, even if it is having a significant impact upon the locality and its socio-ecological system.

A conflict of interest was further raised by one of the academic artist interviewees around academic institutions not recognising (or knowing of) artist academics within their own institutions as practising artists. They explained that this oversight can lead to an 'in house' artist being overlooked and therefore not included in funding bids (where otherwise a freelance artist would be contracted). As we have previously noted, an opposing bias can occur, where artists who are also academics are written into funding bids in place of freelance artists, due to their academic credentials rather than their innovative artistic practice.

9 | CONCLUSIONS AND RECOMMENDATIONS

This paper demonstrates that there are both opportunities and challenges for integrating the arts more effectively into inter, multi

or transdisciplinary research projects, both in a socio-ecological context and more broadly. The interviews we conducted highlighted that successful collaborations require time and space during the early, formative planning stages of project planning to foster the shared understandings that can then inform the subsequent research. The interview data further suggests that this process-led approach is likely to be especially key in any successful integration of the arts into interdisciplinary or transdisciplinary research. The key issues highlighted by the paper include the need to take time to understand the way artistic process can be brought into collaborative projects, initially finding suitable partners for collaborations, building trusting relationships and setting out expectations. Finally, pertinent issues with funding have emerged, such as bias towards one discipline in funding calls, the types of partners that can be brought on to projects, how they are remunerated and the inflexibility of timelines.

To conclude, below we set out four main recommendations that could help overcome these issues and facilitate productive interdisciplinary research, designed to achieve meaningful collaboration between artists and scientists generally across a range of research contexts but from the experience of those in a socio-ecological context.

Firstly, scientists themselves need to better understand the novel engagements that are possible via cross-disciplinary collaborations. At the same time there is a need to recognise the diversity of artistic practice. That is, from a practise that is actively seeking to achieve wider (socio-ecological) change to one that is more focused on the individual pursuit of creativity. This could be achieved by researching different art forms and reviewing how previous cross-disciplinary teams have worked with artists—as referenced in this paper. Understanding the nature of an artist's practice, its objectives and different ways of working, will help find the right collaborative partners and better enable collaborations to be impactful. In order to aid the process of matching scientists and artists, forums or 'dating sites' where they can meet was suggested by interviewees as a potential way forward.

Secondly, time and space are vital to developing good collaborations, as project partners need to build their relationships, not to mention their trust. Part of this entails discussing their expectations of working together, and reaching agreement on the aims, outputs and anticipated impacts of the research project. It is particularly important to discuss the potential of giving an open brief to artists and consider how this might create or facilitate impact. In order to set out and clarify expectations of the different disciplinary partners, clear and transparent memorandums of understanding or terms of agreement should be written at the start of projects. Further, as the process of the art is integral to a successful project, emphasis should be directed towards this rather than the outcome. The subtext here is that desired or favourable outcomes will often arise naturally providing that the *process* of the art is not compromised by the wider transdisciplinary or research objectives.

Thirdly, project leaders and project partners need to recognise that ontological and epistemological equality is essential. Scientists

need to be willing to step into an artist's context and appreciate their world view; artists need to do the same. Spaces which are neutral (i.e. not science or arts-led) would benefit both scientists and artists who want to work together. Further, language differences need to be clarified and understood between the different disciplines. Professional facilitators may be helpful in this respect in bringing world views together and allowing for extended discussion and reflection in order to work out project aims. This could be particularly helpful where principle investigators (PIs) have little experience.

Additionally, the difference and relative merits between artist academics (those actively practicing art as well as those not) and freelance artists need to be considered in order to create equal opportunities. This may involve encompassing a diverse range of artistic practices in collaborative projects.

Finally, funding bodies need to work together to ensure that calls for interdisciplinary teams are equally distributed among the different disciplinary bodies. They need to use language which reflects all disciplinary understandings and better recognise the need for freelance artists through fully costing them into project grants. In addition, the amount of funding and project duration should reflect the time and cost of meeting together to build relationships and iteratively progress the project. Support could be provided through grant funding for new small pilot project collaborations in which relationships can be built and tested, prior to putting applications into larger funding streams.

To understand how partnerships can best be formed and undertaken, we suggest that interested scientists read the recently published 'Guide for socio-ecological sciences and arts interdisciplinary research' (Morrison et al., 2022).

We recognise that there are some limitations to the research presented here. The study was limited to the UK (although some interviewees and participants had experience working on international collaborations), and hence issues surrounding some specifics such as the funding environment and the processes of finding collaborative partners may differ elsewhere. We suggest it would be of use to compare different funding models and collaborative experiences internationally, to identify potential strategies for improving UK arts-science collaborations. Secondly, the context for this research was in socio-ecological projects, and therefore the validity of applying the conclusions more broadly to other research contexts cannot be ensured.

Clearly there is much potential for collaborative science-arts research projects that address current day socio-ecological and other wider challenges, yet there are also significant barriers to building effective partnerships. This paper identifies some of those challenges and potential solutions, providing useful guidance for both scientists and artists as they begin to bridge the disciplinary divide. As Interviewee 7 aptly said: "the time is ripe... and there is so much potential."

AUTHOR CONTRIBUTIONS

J. E. Black: conceptualisation, data collection, writing original draft, reviewing and editing. K. Morrison: conceptualisation, data collection, writing original draft, reviewing and editing. J. Urquhart:

conceptualisation, writing, reviewing and editing. A. Goodenough: conceptualisation, reviewing and editing. C. Potter: reviewing and editing. P. Courtney: reviewing and editing. All co-authors were recipients of the AHRC funding and were involved the research design that led to this paper.

ACKNOWLEDGEMENTS

The authors thank the interviewees and workshop participants for their time and consideration during the data collecting process, without whom this work would not have been possible. Funding for the research was provided by the Arts and Humanities Research Council (AHRC), grant reference AH/T012307/1 through the 'Changing Treescapes' project. The authors also thank the reviewers for their helpful comments on this manuscript.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

Supporting Information related to this manuscript can be found in the [Supplementary Materials](#). The data used for analysis in this manuscript has been stored in the University of Gloucestershire data repository and is available for download via the following link: <https://doi.org/10.46289/DS14PM55>.

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ENDNOTES

¹ For examples see corridor8.co.uk; thenatureofcities.com; and ecoartscotland.net.

² <https://www.uktreescapes.org/collaborator-finder/>.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Data S1. Artist interview questions.

Data S2. Scientist interview questions.

Data S3. Workshop: Engaging with artists in interdisciplinary research.

How to cite this article: Black, J. E., Morrison, K., Urquhart, J., Potter, C., Courtney, P., & Goodenough, A. (2023). Bringing the arts into socio-ecological research: An analysis of the barriers and opportunities to collaboration across the divide. *People and Nature*, 00, 1–12. <https://doi.org/10.1002/pan3.10489>