

NATURE ON SCREEN: THE IMPLICATIONS OF VISUAL MEDIA FOR HUMAN-NATURE RELATIONSHIPS



Research Article

Reflections from the team: Co-creating visual media about ecological processes for young people

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Abstract

1. Many migratory fish populations are declining, threatened by human-induced pressures such as habitat loss and fragmentation caused by dams, roads, land use change, climate change and pollution. However, public awareness of fish migration and associated human pressures remains limited.
2. It is important to communicate about hard-to-see and complex environmental topics and issues, such as fish migration, with young people, who stand to be the most affected by ongoing global changes. Young people are also at a critical stage in their attitude formation and may be particularly receptive to learning enrichment and engagement for behaviour change about environmental issues.
3. Arts-based methods can be particularly effective in fostering broad personal connections with nature, especially for complex topics like fish migration. The collaborative and creative processes involved in developing such media often lack critique, which limits learning from previous experiences.
4. In this article, we reflect on the co-creation of the *Shout Trout Workout (STW)*, a lyric poem, comic and music video for 8- to 14-year-olds, designed to entertain, engage and enrich learning about migratory fishes and aquatic environments. We chart the process of creation, including conception of ideas, writing the poem, fact-checking and developing the storyline with scientists and creating a comic and music video with visual artists and musicians.
5. We explore some of the challenges and merits of collaborative working, consider the impacts of the COVID-19 pandemic on the creative and initial engagement process and share what we learned about creative input, communication and respect. We also discuss how the experience shaped our thoughts about the nature of co-creation itself, and how in creating STW, collaborators contributed to the process in multiple, nuanced and unanticipated ways (e.g. artistic input, ideas, science, dissemination), representing a spectrum of co-creative practice.
6. We hope that sharing our experiences and reflections is useful and inspiring for other cross-disciplinary collaborations, and for those who aim to create learning

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enrichment and engagement material about ecological processes and environmental issues for young people.

KEYWORDS

co-creation, fish, freshwater ecosystems, migration, poetry, public engagement, reflexivity

1 | INTRODUCTION

By its nature, aquatic life is inherently less visible to human eyes, and so images, such as photographs and video, play a critical role in visually connecting freshwater ecosystems to their would-be stewards – Monroe et al., 2009, p. 581

Around the world, migratory fish species (those that have a substantial proportion of a population moving between distinct habitats like sea and rivers) are an important part of freshwater, marine and even terrestrial ecosystems (McIntyre et al., 2016). From salmon on the Northern Atlantic coasts to waterfall-climbing Gobies on islands of the South Pacific, migratory fishes transport nutrients and provide food to diverse habitats and species, including millions of people worldwide. For these species, migration is critical to individual fitness and population persistence because it enables specialised use of different habitats for growth and reproduction (Lennox et al., 2019; McIntyre et al., 2016). However, many migratory fish populations are under threat. A recent study showed that globally, migratory fish populations have declined 76% in the last 50 years (Deinet et al., 2020). Human-induced pressures include habitat loss and fragmentation caused by dams, roads, land use and climate change, and pollution (Martinuzzi et al., 2014; McIntyre et al., 2016; Tian et al., 2021).

Public awareness of migratory fish species, and the pressures that they face, remains limited (Cooke et al., 2013; Kochalski et al., 2019), with increased calls to improve this world-wide (Twardek et al., 2020). It has long been understood that environmental knowledge and attitudes contribute to pro-environmental behaviour (Hines et al., 1987), and improving awareness about migratory fish species is essential ‘if there is an expectation of [the public] to alter their behaviour, facilitate informed decisions and engage governments or regulatory authorities to take action’ (Cooke et al., 2013, p. 997). With these considerations in mind, it is particularly important to engage young people, who are at a critical stage in their attitude formation and receptive to education and engagement for behaviour change about environmental issues (Harker-Schuch et al., 2020). Young people also stand to be the most affected by ongoing environmental change (Hansen et al., 2013), and scholars have an ethical duty to communicate and engage with these groups about topics that can affect their health and well-being (Cox, 2007). However, engaging young people with scientific concepts can be challenging, particularly when these topics are complex, have little obvious practical value or lack immediacy (Martinez-Conde & Macknik, 2017).

Fish migration is one of these hard-to-communicate topics because it is a complex ecological process that is not easily viewed or perceived (Birnie-Gauvin et al., 2019; Januchowski-Hartley et al., 2020). Furthermore, fish tend to be less charismatic than birds or mammals (Cooke et al., 2013, see also Thomas-Walters & Raihani, 2017) that people are more likely to encounter on a day-to-day basis. How then can we move towards public awareness and engagement with migratory fish and the pressures that they face?

There is great potential for arts-based methods to facilitate both better understanding and communication about migratory fishes in unique and creative ways. Arts-based methods can establish emotional connections with complex topics (Friedman, 2013) and build a deeper level of engagement that includes enjoyment and positive attitudes, rather than focusing solely on knowledge acquisition (e.g. Matias et al., 2020). The project presented in this article focused on integration of three arts-based methods, and the co-creation of lyric poetry, comics and visual media for engagement with young people. Poetry can be effective in exploring human–nature relationships (Dickson & Clay, 2019), and rap—as lyric poetry—has the potential to engage young people by drawing upon different forms of expression and learning (e.g. Elmesky, 2011; Emdin, 2010). Comics also offer a multimodal way to communicate about our natural environment and related topics through words and pictures, offering ‘an effective, flexible form for communicating research’ to a wide audience (Kuttner et al., 2018, p. 397). At the same time, visual media have the potential to lead to attitudinal or behavioural change (Fernández-Bellon & Kane, 2020; Silk et al., 2018; Thomas-Walters et al., 2020) and are particularly suited to making aquatic life more visible (Monroe et al., 2009). While the integration of these arts-based methods for engagement with fish migration is part of our ongoing research, in this article we focus on the process of co-creation, charting and reflecting on our interdisciplinary¹ collaboration.

Initially used to describe customer involvement in product and services development in the 1990s, the term *co-creation* has since been applied more broadly including in public participation and community engagement (Horvarth & Carpenter, 2020). Although often used interchangeably with co-production, the term co-creation

¹Collaboration can take many forms. Multidisciplinary working sees participants sharing their knowledge, but staying within their own disciplinary boundaries, without changing disciplinary perspectives. Interdisciplinary working integrates knowledge from multiple disciplines to produce new knowledge, while the individual disciplines can still be observed. Transdisciplinary working transcends disciplinary boundaries such that the outcome ‘is not recognisable from the original parts’ (Choi & Pak, 2006; Beaumont, 2020, p. 13). While broadly interdisciplinary, we discuss our ways of working in this space in Section 2.2.

is more encompassing (Bransden & Honingh, 2018) and embraces multiple relationships and interactions between artists and other actors, which can involve those with 'significant creative agency' as well as those with 'less so' (Shaw et al., 2021, p. 4; see also Blodgett et al., 2013). Co-production, on the other hand, might require a substantive contribution through artistic skill (Boyd & Barry, 2020). Narrow views of creativity can be unhelpful (Hawkins, 2019), and our perspective is that rather than constituting a rigid dichotomy where endeavours either qualify as 'co-creativity' or not, creative processes can chart a diversity and gradation of experiences (Figure 1; Table 1). In this way, co-creation runs on a continuum from deep through lighter touch involvement, depending on the stage of the creative process and the skills and interests of collaborators (see also Choi & Pak, 2006; Clark et al., 2020).

There are clear merits of co-creating engagement materials, but such projects can also be time-consuming and frustrating for those involved because misunderstandings can arise due to differences in disciplinary approaches, languages, skills and norms (Beaumont, 2020; Fischhoff, 2019). There can also be distinct tensions between artistic licence and faithfulness to the data or topic being conveyed (Leavy, 2018). Co-creation requires reflexivity (Horvarth & Carpenter, 2020), but collaborative and co-creation projects often lack processual accounts (Rayment et al., 2020), reflection, review or critique (Phillips et al., 2020), which can limit learning from previous experiences and impact on our abilities to improve and refine approaches.

The Shout Trout Workout (STW) lyric poem, comic and music video were co-created to enhance engagement, knowledge and understanding about migratory fishes using one fish species, brown trout *Salmo trutta* that is native to some of the team's study region, Wales, United Kingdom as the protagonist. Many populations of brown trout in Wales show anadromous migrations: hatching in freshwaters, migrating to sea as juveniles and returning to natal fresh waters as adults to spawn. While the conservation status of brown trout was listed as 'Least Concern' in 2011 by the IUCN Red List of Threatened Species (Freyhof & Brooks, 2011), the anadromous form of the species has suffered widespread declines over the last few decades, for diverse reasons including habitat degradation, overfishing and climate change (e.g. Aarestrup & Koed, 2003; Thorstad et al., 2015).

To encourage reflection about our collaboration and project, all authors answered six questions (shared post-completion) relating to their experiences throughout, including their motivations, any positives or negatives and associated resolutions, future aspirations as well as any additional reflections (see Supplementary Material for question wording). We also returned to related online discussions and email exchanges between collaborators to remind us of specific decisions during the project (see Figure 1) and as catalysts for reflection. We chart the process of creating the STW, and reflect upon creative input, communication and respect as part of this process. We illustrate our points throughout with quotes from the team, in italics.

2 | CO-CREATING THE SHOUT TROUT WORKOUT

2.1 | The Shout Trout Workout journey

The STW poem, comic and music video were developed over a period of 9 months (March–November 2020) through a collaboration between an environmental scientist (SRJ), a geographer/social scientist (MJT) and an artist (IDG) of the Freshwater Interdisciplinary Research and Engagement (FIRE) Lab at Swansea University, together with a fish scientist (PEJ), an illustrator (EK) and a media production company TankThink (hereafter TT, with contributors WT and RS) (Table 1). Like a river, the STW journey meandered, with ripples along the way, including adjustments and decisions made in response to the COVID-19 pandemic and to creative and scientific input from collaborators (Figure 1; Table 1).

The need for, and interest in, producing engagement material focused on a migratory fish species emerged from project development within FIRE Lab. The original idea was to create a rhymed lyric poem (Poets.Org, 2021) to explore processes and senses associated with fish migration and the River Tawe, Wales. The FIRE Lab team planned to use the poem for in-person engagement with young people and families in Wales for World Fish Migration Day—a biennial global celebration aimed at raising awareness about migratory fishes and the people and ecosystems that depend on them (Twardek et al., 2020). The lyric poem was to be performed by young people along rivers and public green spaces. However, the onset of the COVID-19 pandemic in March 2020 meant that these ideas could not be implemented in-person, and so as learning moved o-line and into the home, so too did STW (Figure 1).

As the FIRE Lab team looked to move content online, we also decided the lyric poem needed to capture the complete migration cycle of the species and to tell a story (Figure 1). The protagonist of the poem was a brown trout, and the story included elements of predation and human-induced pressures, such as road culverts (see Januchowski-Hartley et al., 2013 for broader discussion), that influence trout behaviour and their migration story (Figure 2). Brown trout were chosen because of the species' importance in Wales and so offered a connecting point with young people and families in the region. Notably, brown trout have also been introduced to rivers around the world, and so there is also knowledge of the species and its relatives, globally. For a story about migration, brown trout are particularly interesting because they have varied migration patterns and associated physiological changes, as represented in the illustrations by EK (Figure 2; Birnie-Gauvin et al., 2019).

Through discussions in April 2020, the FIRE Lab team decided that a video to prompt young people to engage with the poem and learn about fish migration would be useful and could be presented alongside World Fish Migration Day, which was originally to be celebrated in May 2020 but was then postponed until October 2020, considering the global pandemic. In keeping with the short, initially anticipated, timeline to produce a video for release with the May

The STW Journey

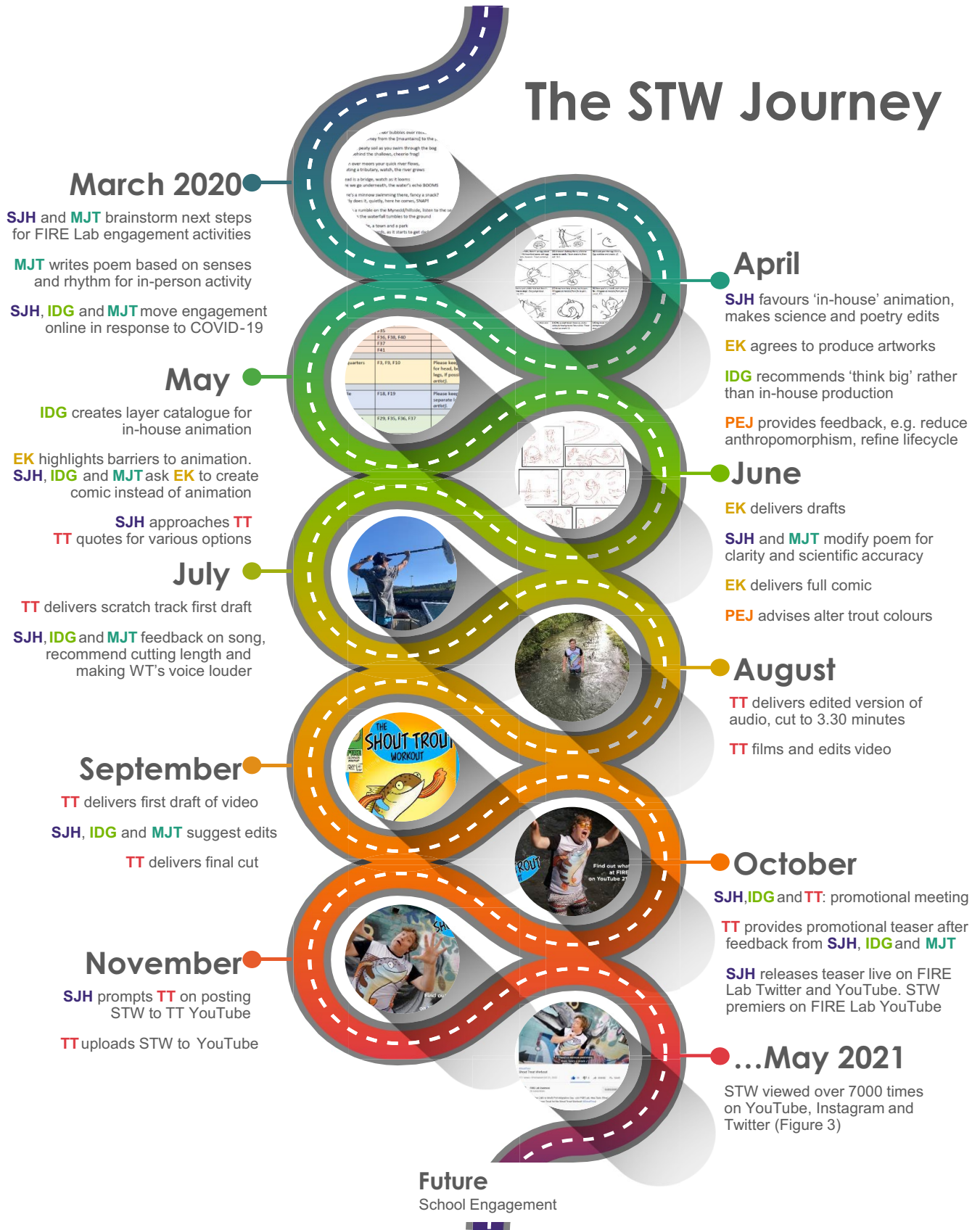


FIGURE 1 The Shout Trout Workout (STW) journey, showing inputs from each team member. Initials refer to: environmental scientist Stephanie Januchowski-Hartley (SRJ), geographer/social scientist Merryn Thomas (MJT), artist Ioanna Daphne Giannoulatou (IDG), fish scientist Peter Jones (PEJ), illustrator Ethan Kocak (EK) and media production company TankThink (TT) with contributors Wes Tank (WT) and Ryan Sarnowski (RS) (July, August, October and November photographs by TankThink)

TABLE 1 Co-creation at each stage of the STW process: *some involvement, **critical involvement, ***led process

	SRJ (environmental scientist)	MJT (geographer/social scientist)	IDG (artist)	PEJ (fish scientist)	EK (illustrator)	TT (media production company)
Idea	***	***	*			
Poem	**	***	*	**		
Storyboard	**	***	**	**	*	
Animation	**	*	***		***	
Comic	**	*	*	**	***	
Audio	*	*	*			***
Video	*	*	*			***
Dissemination	***	*	*			***

World Fish Migration Day, preference was first given to producing an in-house animation for the video (Figure 1).

The FIRE Lab team contacted illustrator EK to produce illustrations that could be the basis for animation and video. EK specialises in science-adjacent cartoons and had worked with SRJ on previous projects. It was also around this time that PEJ agreed to provide scientific advice and input to the STW story and illustrations (Figure 1). The project changed course when EK raised concerns about the team's skillset and timeline, suggesting that an in-house animation might not be feasible (Figure 1). The FIRE Lab team and EK decided that the animation element should be dropped in favour of a still comic. EK notes that although comics are his forte, this switch was a challenge:

probably the most challenging thing was taking what had originally been pitched as an animated video project and translating that into a comic. We had storyboards for that, but that doesn't always completely translate over to a print media piece.² (Illustrator EK).

On the encouragement of artist IDG, it was also decided that the team should engage outside experts to create a professional music video building on the strengths of the lyric poem and comic:

I believed this project should be given the chance to be developed by professionals and not settle for home-made, budget ideas (a tempting idea back then as we were all in lockdown). (Artist IDG).

In response to these suggestions, and further discussions between SRJ and IDG about the production of a music video to broaden the audience with which the project could engage, SRJ contacted TT, a US-based media company dedicated to 'strengthening cultural ecosystems' (TankThink.org, 2021). Through initial correspondence, SRJ proposed the broad idea and purpose of STW to WT, and he expressed interest in collaborating. In a follow-up meeting, SRJ asked WT and TT to create a

video with a similar format to those they created in early 2020 that featured WT rapping Dr Seuss rhymes over Dr Dre beats (Dr. Seuss, 2021). Apart from this initial request, and a suggestion that WT wore a T-shirt bearing an image from the comic, the project was left open for TT's creative input to make the video and associated music (Table 1).

The final stages of development were an iterative process between collaborators, who provided feedback on drafts and first cuts. While we preferred the process to include more extensive piloting with young people, the pandemic made that difficult, and feedback was limited to friends and young family members of the team, who shared their favourite parts of the comic and soundtrack, feedback where they thought something was too long, or unclear and so on. The comic and video were finalised in September 2020, and plans were then made to promote and disseminate both creations in relation to World Fish Migration Day in late October 2020.

The video premiered on the FIRE Lab YouTube channel on 21 October 2020 and was subsequently shared on WT's YouTube channel on 29 November 2020 (Figure 1; Table 1). For Mauser et al. (2013), the co-dissemination of results is part of co-creation, and in our project, sharing the comic and video via our social networks was an essential contribution by collaborators (Figure 1; Table 1). We shared STW via YouTube, Twitter, Instagram and Facebook as well as via the FIRE Lab and FIRE Lab Kids websites. There are several benefits to using social media to engage the public (e.g. NCCPE, 2018), but few of these are realised if posts are not seen. The amount of attention given to the STW video varied depending on how it was disseminated and by whom. For example, MJT's and IDG's personal Facebook profiles (with 302 and 779 'Friends' respectively) collectively garnered 10 'Likes' for the video, while WT's YouTube channel (118,000 subscribers) accumulated >4,000 views in 6 months (November 2020–May 2021; Figure 3).

Comments posted by viewers on the different social media platforms demonstrate engagement, learning and entertainment prior to any further outreach activities commencing (e.g. direct school or public engagement activities). On WT's YouTube channel, a viewer remarked that 'I have been a Trout fisherman for 35 years and that did justice for all the Trout out there'. One viewer commented on WT's Instagram post that she '[used] your videos to improve my listening and to learn new vocabulary', and another said that they 'learned a lot about trout!' along with many comments relating to the work's entertainment value.

²Unlike storyboards, meaning in comics is made through the size and shape of panels, their orientation, composition and relationship with other components, as well as to what happens in each successive frame (Kuttner et al., 2018).

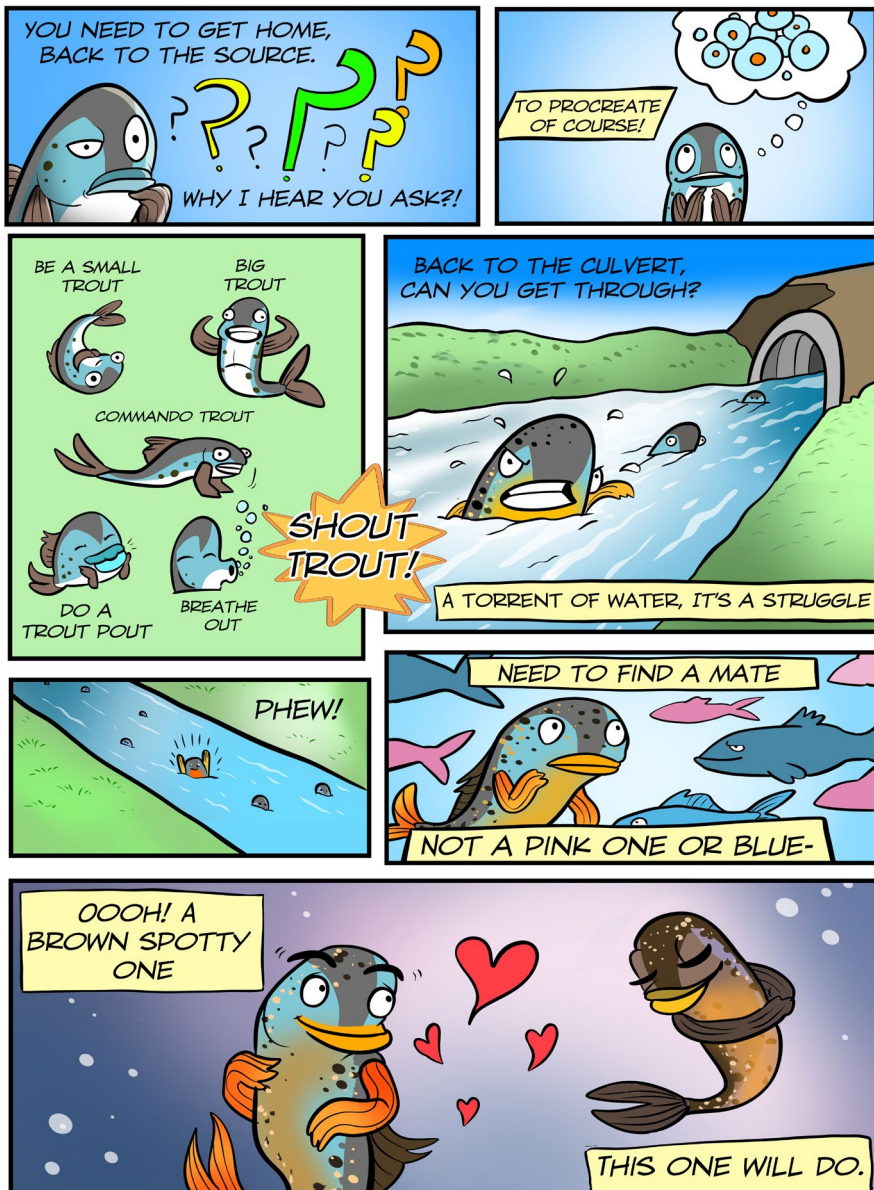


FIGURE 2 A page from the Shout Trout Workout comic (Shout Trout Workout comic <https://firelabkids.uk/shout-trout-workout/>)³ written by Merryn Thomas and illustrated by Ethan Kocak. For the video, see <https://www.youtube.com/watch?v=RuxBMBEAnJk>

While not a panacea, such 'edutainment' combines learning with fun; it can attract and hold learners' attention, as well as stimulating multiple information processing channels (verbal and visual) and motivating viewers to explore topics in greater depth (Okan, 2011).

A longer term goal of the project is to use the comic and video in more targeted fish migration learning enrichment and engagement (e.g. Powell et al., 2018; Sherer & Shea, 2011) with young people in Wales (Figure 1). The COVID-19 pandemic has made dissemination and engagement with schools challenging, primarily because changes in policy by national governments limit planning for either online or in-person activities with classrooms. The FIRE Lab team supplemented initial social media dissemination around the STW video release through visual games and quizzes that were created and shared online in December 2020 through both a science education rotation curation account on Twitter (@NGSS_tweeps; followed by >8,000 people) and a digital magazine, The Green Fuse (2021), designed by and for young naturalists. So far responses to these engagements have been very positive, including an invitation to continue contributing to

The Green Fuse. We have also used the STW to engage members of a local chapter of the University of the Third Age (U3A, 2021) with comics and the future of rivers via an online workshop. The feedback from U3A members was also positive; they shared their own river-related comics and stories about their local rivers, and volunteered to assist the team in the future projects. The FIRE Lab team is currently designing a teacher's pack with educational materials and activities that can be integrated in classrooms by teachers, and we plan to carry out a full evaluation of the impacts of this engagement prior to our broader project finishing at the end of 2022.

Answers to post-completion questions shared by team members also indicated that co-creating STW changed our perceptions, particularly of working creatively. As noted by other interdisciplinary and co-creation teams, on our project we had to think in different ways, reflect on the wider context of our work and move outside our comfort zone (see Clark et al., 2020; Glinkowski & Bamford, 2009; Sleight & Craske, 2017):

³Shout Trout Workout comic <https://firelabkids.uk/shout-trout-workout/>

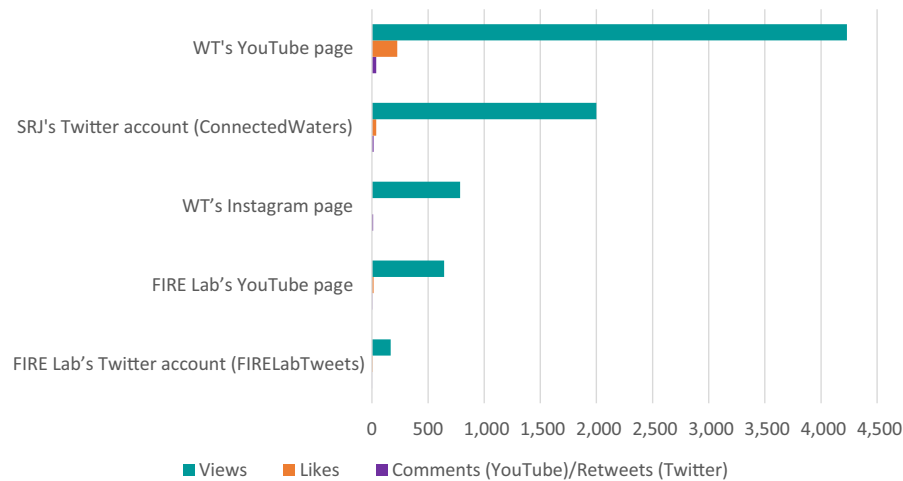


FIGURE 3 Views, Likes and comments (YouTube) or retweets (Twitter) associated with Shout Trout Workout (STW), downloaded on 17 May 2021 (Graph shows communications relating to the final video. The 'premiere' video and related posts were viewed thousands of times prior to the release of STW but are not included. The graph includes views on SRJ's ConnectedWaters Twitter account up to the date the account was closed on 22 December 2020.)⁴

I was initially a little sceptical about the value of the Trout Shout Workout.... However, after seeing the progression of the work to its finished stage I have to say I have changed my mind, and I now see this kind of approach as very valuable. (Fish scientist PEJ).

All collaborators indicated in their responses to post-completion questions that they would contribute to a similar type of creative project in the future, for example

I'd love to do something like this again. It was a blast and I am dedicated to creating fun educational content. (Media artist WT).

I also thoroughly enjoyed being a part of it, being creative, working with and learning from the rest of the team (Geographer/social scientist MJT).

Below we discuss several elements of collaborative work, as well as experiences in our own collaboration and approach to co-creation, that might have facilitated these shared perceptions.

2.2 | Notes on creative input, communication and respect for effective co-creation

While some stages of the project saw collaborators contributing expertise from within their own discipline, at times we worked in a more transdisciplinary way, with researchers becoming 'creators

and collaborators' (Hawkins, 2019, p. 963; Table 1). One example of how STW was co-created through multiple modes of collaboration is when MJT drafted the storyboard for EK to draw upon when creating his illustrations for the comic (Table 1). As noted by Hawkins, who describes herself as 'very bad at drawing', MJT's storyboard (Figure 4) displayed limited artistic skill, but the process of *doing* it caused her 'to slow down' (Hawkins, 2019, p. 973, 974) and think much more carefully about what should be included, how the fish should be represented at each stage of the migration and how the story could be most effectively communicated. In this way, the artistic contributions of a geographer/social scientist (MJT) helped shape other elements of the creation as well as providing information for the illustrator (Figure 4; Table 1).

Another example of the diverse inputs involved in this project was the critical contributions that fish scientist PEJ made to the poem, original storyboard and final comic (Table 1). On his recommendation, several changes were made to the portrayal of fish eggs, yolk sacs, migration timing and fish colourings in the storyboard and comic. It is important to note here that collaborations require negotiation, and at this stage we worked to balance scientific accuracy and artistic licence for engagement purposes. For example, our brown trout travels to sea alone, which is not strictly accurate but may be more likely to generate sympathy than a group of trout (Jenni & Loewenstein, 1997; Grasso et al., 2020; see also Thomas-Walters & Raihani, 2017). The brown trout in STW is certainly expressive in different ways than an average brown trout, and we were aware of potential risks and benefits of using anthropomorphism to engage children with nature (Grasso et al., 2020; Tam, 2019; Thomas-Walters et al., 2020). That said, PEJ felt strongly that the poem should maintain scientific integrity:

I was worried that the comic might be overly dumbing down the science to the point where there was little educational value. (Fish scientist PEJ).

⁴Graph shows communications relating to the final video. The 'premiere' video and related posts were viewed thousands of times prior to the release of STW but are not included. The graph includes views on SRJ's ConnectedWaters Twitter account up to the date the account was closed on 22 December 2020.

<p>(25) Down towards a city where street lamps glow. Swims towards a city with the sea beyond. Sunset colours. XXLS. <i>Immature.</i></p>	<p>(26) Repeat chorus sections (in orange, above) but as an <i>immature</i> trout (see diagram).</p>	<p>(27) Swimming in the ocean, feel salt on your scales, rolls around enjoying the sea. LS. <i>Immature.</i></p>	<p>(28) See the little boats with wind in their sails. Sticks head out of water, looks at boats bobbing. Sunny day. XLS. <i>Immature.</i></p>
<p>(29) Look all around you, left and right. Trout like you everywhere, sheer delight! Looks around, many trout. Turns and smiles. XLS. <i>Immature.</i></p>	<p>(30) You grow much stronger, Kisses biceps. LS. <i>Marine adult.</i></p>	<p>(31) meet many friends. But this isn't how our little story ends. Friend enters from left and right, twinkle on teeth as smiles. LS. <i>Marine adult.</i></p>	<p>(32) You need to get home, back to the source. Why I hear you ask?! Question mark over head. MS. <i>Marine adult.</i></p>

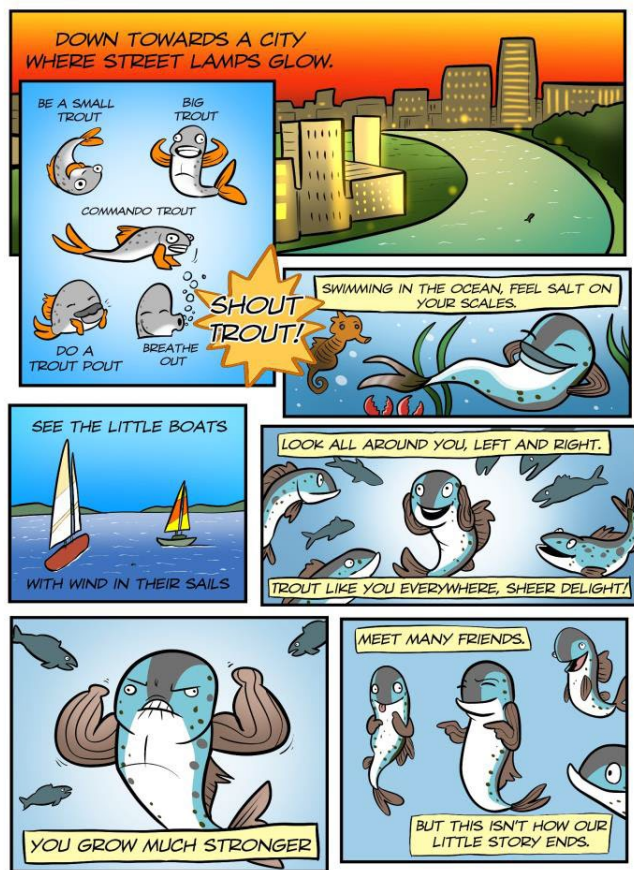
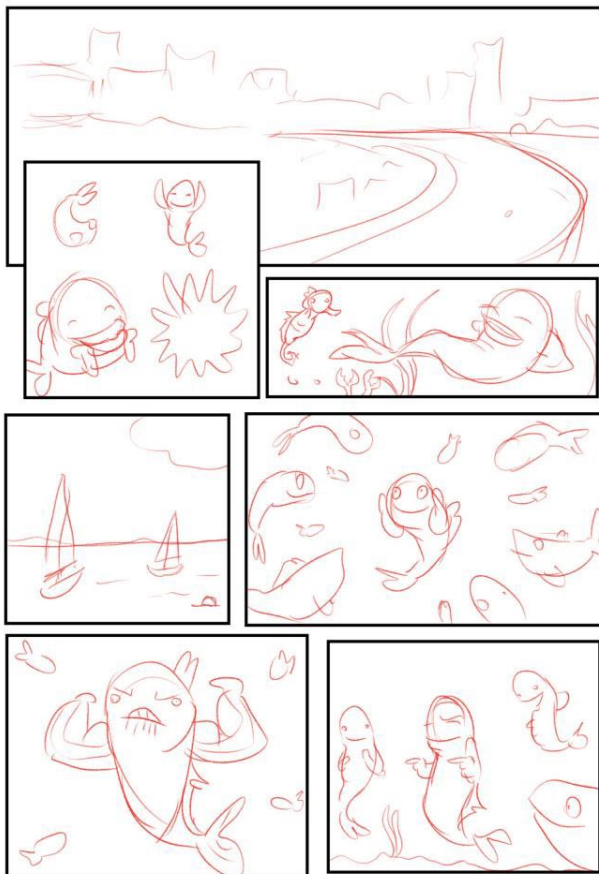


FIGURE 4 From Merryn Thomas's animation storyboard (top) to Ethan Kocak's comic draft (bottom left) and final comic (bottom right)

We made widespread edits based on PEJ's feedback, and believe these had no detrimental effect on the storyline.

While different collaborators were encouraged to contribute throughout the STW journey, clear leadership and role definition enabled us to draw upon each member's appropriate knowledge and experience while negotiating tensions around the uncertainties that can arise about who does what and who is in charge in creative collaborations (Boyd & Barry, 2020; Kelton & Saraniero, 2018). Key to this was the management of the processes and communications between different team members by SRJ. It also helped that MJT and FIRE Lab team represented their scientific and artistic vision for the comic and music video together ahead of time in the form of the animation storyboard that could be shared with PEJ, EK and TT up front. We believe this was an important step in facilitating communication between team members. The storyboard acted, essentially, as a boundary object, being 'both adaptable to different viewpoints and robust enough to maintain identity across them' (Star & Griesemer, 1989, p. 387; see also Maclean & TBYB Inc, 2015). In this way, it enabled FIRE Lab to communicate their interests while forming a flexible basis that EK and TT could draw upon for their creations. This was particularly important in this project, where all interchanges had to be online (due to COVID-19 and collaborating overseas):

The main thing that I found hard was working in isolation from colleagues that I had only really met a few times (or not at all), when usually I would just pop down the hallway or across the room to sound them out. (Geographer/social scientist MJT).

Indeed, dispersed online collaboration can lead to a variety of problems including biased group discussion (Hightower & Sayeed, 1995), unevenly distributed information (Cramton, 2001) and miscommunications (Kruger et al., 2005). Horvarth and Carpenter (2020) recommend that co-creators share time, space and meals together to build trust-based relationships, which was of course impossible in our case. Channelling communications through SRJ, who had worked with some of the collaborators before (SRJ with EK; SRJ with IDG) afforded a degree of 'mutual knowledge' (Cramton, 2001) and ease in speaking straightforwardly to each other's strengths and limitations.

During the latter stages of the process, SRJ's role extended to synthesise feedback from the FIRE Lab team to other collaborators, providing a balance in relation to the video's length, information content and scientific integrity, while working to maximise the artists' own interpretation and contribution. Because we were keen to maintain the aesthetic value and engagement potential of the visual media we were creating, it was imperative that artists EK and TT were afforded creative freedom, and that each member of the team respected and trusted the input from other members (see Beaumont, 2020; Dixon et al., 2011; Halpern & O'Rourke, 2020; Sleight & Craske, 2017). As discussed above, the storyboard offered an anchor (Star & Griesemer, 1989) from which the entire team could start from and adjust. We sought to strike a balance so that

the artists expressed their creative freedom and that the art we co-created was not only for sharing science but also of high aesthetic value and engaging for broad audiences (Friedman, 2013, p. 7; Clark et al. 2020). EK notes,

everyone on the team was very open to suggestions and pretty much gave me free reign to design the comic (Illustrator EK).

This respect for contributors' creative freedom, rather than one person dictating their own vision upon the collaborators, permeated each stage of the process. The form of the poem was MJT's choice, the drawing style and form was entirely EK's and the style adopted for the music video was TT's own. The collaborators were chosen because of their specific set of skills and/or aesthetics, and each brought their own angle to the project. For example, while the original storyboard was based around the River Tawe in Wales, when creating the comic illustration, EK reinterpreted the original sketches in such a way that the comic's landscape echoed of the River Tawe valley, but with a global appeal (Figure 4; Table 1). Similarly, TT's decision to record water sounds from a boat afforded the audio a unique sound and distinctively connected it to the underwater environment; something that the FIRE Lab team had not anticipated.

3 | DISCUSSION

We presented the Shout Trout Workout: a lyric poem, comic and music video designed to entertain, engage and enrich learning about migratory fishes and aquatic environments for 8- to 14-year-olds. We charted the process of creation, and reflected on creative input, communication and respect. Here we draw out the following three themes that arose while charting and reflecting on STW: a) the impacts of the pandemic, b) the importance of flexibility and c) how the process of developing the STW has shaped our perspectives on co-creation.

In an ideal world, collaboration might involve sharing time, meals and activities together (Clark et al., 2020; Horvarth & Carpenter, 2020). Comic artist Ryan Alexander-Tanner even moved into Professor Bill Ayers' house for 6 months so that they could create their comic *To Teach* together (Kuttner et al., 2018). For many reasons, not least COVID-19, such a deep collaboration was not possible for our project, and we were restricted to online exchanges. The pandemic also drove significant changes in the nature of the engagement, the timelines we worked to and our methods of sharing outputs with young people. We were also unable to pilot early versions of the comic or video with a wide sample of children, relying on family and friends for feedback, because the pandemic meant that in-school and in-person engagements were not permitted. We were fortunate to have members of the team who were experienced in online communication and were able to draw upon their existing networks as well as foster connections with emerging community-led initiatives (e.g. The Green Fuse magazine, online workshops).

One thing we learnt early on in the process of creating the STW was therefore how to be flexible in response to external drivers (e.g. changing engagement format, communicating collated feedback for smooth online working). We also needed to be flexible to respond to internal drivers (within the team), for example when illustrator EK raised concerns about the time-scale and skillset required to create an animation, and when scientist PEJ suggested the poem was too anthropocentric. Indeed, the journey to creating STW was not straightforward and involved what might be thought of as 'dead ends' and time-consuming U-turns (e.g. drafting a performative poem about senses that later evolved into a still-comic poem about fish migration, creating a layer catalogue for an animation that did not eventualise). Far from being a waste of time, however, these 'rifles' formed an important part of the process, and ultimately led to a more dynamic and thoughtful creation about a brown trout's migration story.

Finally, our experience of developing STW showed us that while clear role definition and communication are paramount, some flexibility in creative input is also important. Indeed, in our project we found that co-creation can play out in nuanced ways and take a multitude of forms: from offering scientific steers, to providing a boundary object as a basis to build upon (Star & Griesemer, 1989), ensuring a smooth process through diplomatic communication and co-disseminating outputs. Importantly, collaborators contributed in unanticipated ways, showing the importance of openness and flexibility in the approaches to expertise and co-creative process. Our experience thus contributes to a broader understanding of co-creation as not only relevant for those with 'significant creative agency' (Shaw et al., 2021, p. 4) but something that can be practiced on a spectrum and in myriad ways. We hope that our reflections will be useful and inspiring for other co-creative partnerships aiming to make engagement material related to ecological processes for young people.

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CONFLICT OF INTERESTS

Merryn Thomas and Stephanie Januchowski-Hartley are Associate Editors for *People and Nature*, but were not involved in the peer review and decision-making process.

AUTHORS' CONTRIBUTIONS

S.R.J., M.J.T. and I.D.G. conceived of the ideas; M.J.T., I.D.G., E.K., W.T., R.S., P.E.J. and S.R.J. substantially contributed to the development of the Shout Trout Workout, as detailed in the manuscript; M.J.T. and S.R.J. led the writing of the manuscript, with contributions from all the authors. All the authors gave final approval for publication.

DATA AVAILABILITY STATEMENT

Quantitative data for Figure 3 (social media viewing data) are publicly available through SRJ's FigShare account at <https://doi.org/10.6084/m9.figshare.14770671>.

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