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Collective storytelling as a river restoration tool: The role of catchment communities in inspiring environmental change

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In Aotearoa New Zealand, catchment communities have been actively working
to restore the health of their rivers, in some cases for many decades. Their
knowledge offers a valuable resource that could motivate and empower
other groups to do the same, making river restoration more effective at large
scales. We spoke to five catchment groups across Aotearoa New Zealand
to conceptualize and define how knowledge sharing through storytelling
could be used as a tool to inspire freshwater restoration action amongst their
own community and elsewhere. Each group created a "Catchment Journey,"
a graphical artwork that told a story of their land and people, and their
restoration activities. Whilst each of these "Journeys" was unique, the following
common elements were important for knowledge sharing: (1) the role of
respected storytellers (e.g., community champions) in influencing restoration
in their community; (2) recognition of responsibility to act (e.g., concern for
future generations, land stewardship, prosperity and community cohesion);
and (3) authenticity (e.g., true and honest stories, including weaknesses,
threats and hardship). Participants recommended including each of these
key elements in collective catchment storytelling to encourage large scale
freshwater restoration.

KEYWORDS

freshwater restoration, water quality, science communication, catchment,
communities, stewardship, emotions, positive

1. Introduction

Globally, freshwater ecosystems (i.e., lakes, rivers, and wetlands) are detrimentally
affected by agricultural practices (Allan, 2004; Carpenter et al., 2011). Scientific evidence
for reducing, and even reversing these impacts, are widespread (Davies et al., 2009; Flávio
et al., 2017; Monaghan et al., 2021). Despite the wealth of scientific research and local
knowledge, the health of many freshwater systems continues to decline (United Nations
Environment Programme., 2021).

GRAPHICAL ABSTRACT
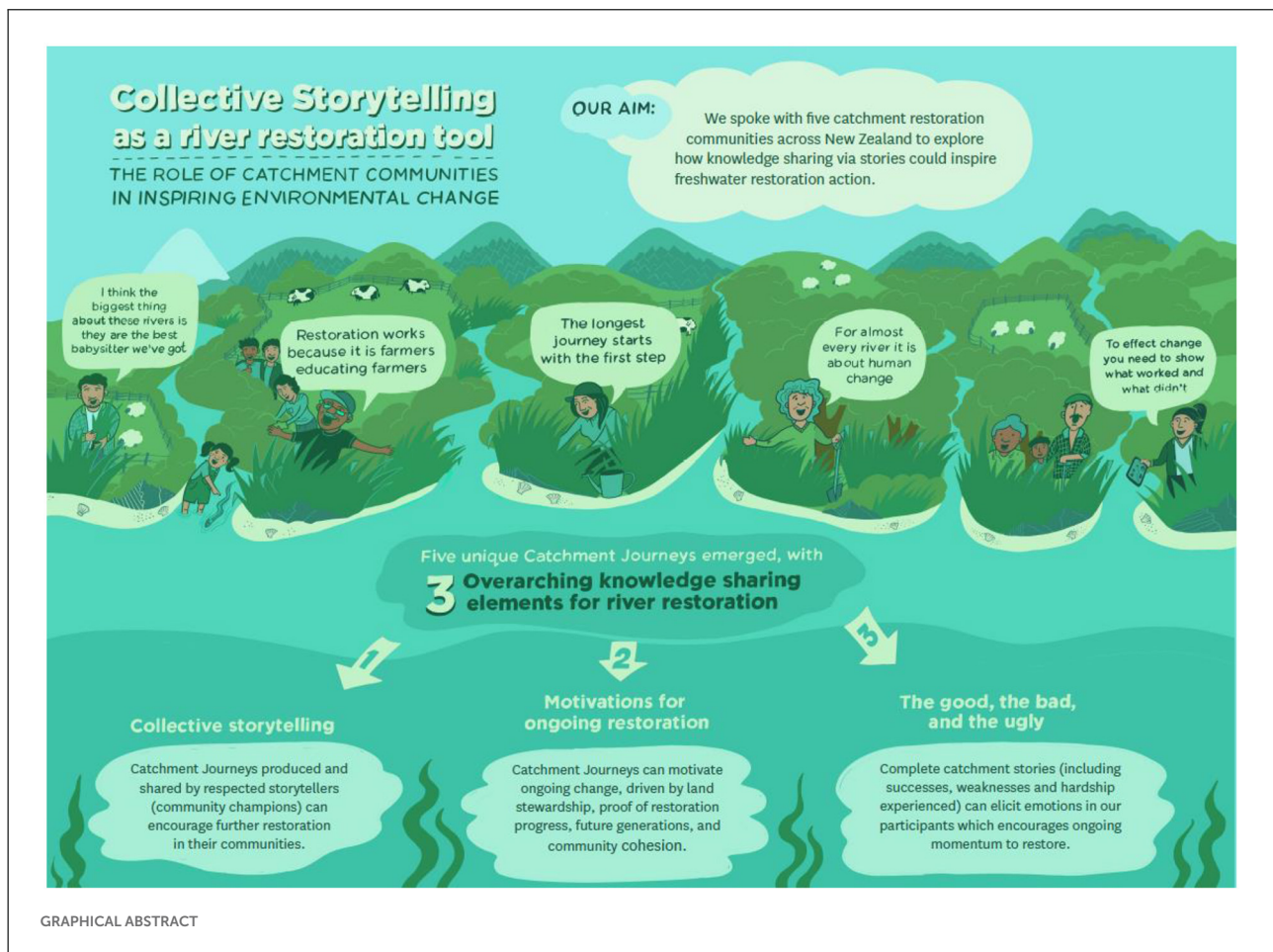
Scientific knowledge exchange often happens between researchers and project managers or advisors in the format of technical reports, policy briefs, and summaries (Schneider and Buser, 2017). While this form of knowledge transfer suits technical audiences, it is often unsuitable for practitioners and non-technical audiences, such as catchment[1] groups. Scientific knowledge also fails to make fertile space for lay knowledge to contribute meaningfully to discussions that focus on environmental problem solving (Turnhout and Neves, 2019; Richardson, 2022). There is compelling evidence, however, that involving key stakeholders from knowledge production, to communication, to solutions is essential in tackling a range of environmental and socially contentious issues (Jasanoff, 2004; Schneider and Buser, 2017; Manyweathers et al., 2020).

In the case of ecosystem restoration, accessibility to clear information is essential for progress to be assessed by different stakeholders across different spatial scales (Doehring et al., 2020). We suggest that catchment stories may be powerful tools

to report on restoration progress, and lessons learnt along the way. Knowledge conveyed through stories aids understanding of complex issues (Rose, 2012), which is necessary for informed decision making (Moyer-Gusé, 2008). If these stories are then also told by the people that do the action on the ground, we hypothesize that story context and language become even further relatable to catchment communities, which is likely to further trigger restoration motivation. Storytelling may also be a powerful tool to convey indigenous knowledge for land management, which is being considered in a parallel component of this study (Ruha et al., 2021).

However, for change to happen, communities not only need to understand restoration actions, but need to be motivated to undertake them [Society for Ecological Restoration International (SER) Science & Policy Working Group., 2004; Aronson et al., 2006]. It is well understood that motivation is triggered, and sustained, if knowledge is shared between rural communities, as opposed to "top-down" information provision (Society for Ecological Restoration International (SER) Science & Policy Working Group, 2004; Doehring et al., 2022). Based on this, we explored the role catchment communities

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1 A catchment (also commonly referred to as watershed) is defined as the natural drainage area of rainwater where it gets collected and transported from the source to the sea.

may play as "storytellers" to motivate effective larger scale freshwater restoration.

In our study, catchment communities are a group of people with common interests in freshwater restoration, residing in the same locality (Mannarini and Fedi, 2009). Restoration, in our case, aims to address pressures on Aotearoa New Zealand's freshwater systems, such as pollution in urban, farming and forestry areas. These pressures are commonly caused due to increased levels of deposited sediment, and emerging contaminants (such as pesticides), changing water flows due to increased consented freshwater allocation, and climate change impacts such as more severe localized droughts and flooding (NZ Ministry for the Environment & Stats NZ., 2020). Because catchment communities consist of a multitude of players (including indigenous people, residents, farmers, land stewards, environmental groups, businesses, national and local government agencies, and visitors), their interplay and impact on the catchment can be varied, as can their aspirations, knowledge, perspectives, needs, and priorities. Because of this diversity, restoration actions can often be done in isolation (Morresey and Hellberg, 2015), missing opportunities for more effective collaboration. In addition, obligations for catchment communities to operate in accordance with their "social license" have become more relevant, meaning that they should consider the expectations of society and avoid activities that societies deem environmentally unacceptable (Gunningham et al., 2004; Clark-Hall, 2018).

To overcome some of these challenges and to address the much-needed transformative environmental change (United Nations., 2015; Díaz et al., 2019), researchers are calling for more novel and accessible forms of scientific communication about the environment (Klöckner, 2015). At its foundation, environmental communication is "*interested in all settings and modes of messaging about the environment, but with an emphasis on improving human capacity to address [environmental] challenges in productive ways toward justice and sustainability*" (p. 10; Sjölander-Lindqvist et al., 2022). When applied correctly, the impact of successful environmental communication can be significant (Stoknes, 2017; Sjölander-Lindqvist et al., 2022). For example, McAfee et al. (2019) advocated for greater use of optimism in communicating conservation, which inspired people to behave in ways less destructive, and Fjællingsdal and Klöckner (2020) suggested that board games can be highly effective tools in simplifying complex systems of interconnected environmental issues, such as global warming or freshwater restoration.

We, thus, believe that the potential for pro-environmental change through tailored, and accessible, freshwater restoration communication may be large, particularly, if the communication is specifically tailored to catchment groups based on insights shared by suitable knowledge providers, or storytellers. For "bottom-up" collaboration to be successful, communities need to define a common vocabulary by discussing goals, motivations,

and desired outcomes, which encourages open dialogue for knowledge transfer (Mamykina et al., 2002).

Exploring ways in which catchment communities can use storytelling to communicate their restoration actions could hence make a significant contribution to constructing sustainable futures (Gearey, 2018), including not only the sustainability of ecosystems, but also of catchment communities. Specifically, stories can help build collective identity and empathy of those communities that rely on functioning freshwater ecosystems. But what should this common vocabulary be, which instruments should be used to tell and share a story, and what should their content include? What inspires catchment groups to share their restoration story in the first place, and who would be a suitable narrator? Our research provides insights into these questions by exploring how storytelling may be used as a tool to convey restoration knowledge, and whether there are common elements to help guide their telling.

2. Methods

2.1. Data collection and analysis

Data were collected via five focus groups whereby each focus group represented a different catchment group (i.e., from here on "catchment group"). This form of data collection enabled us to have in-depth discussions with participants, eliciting a wide range of views, perspectives, and understandings of land management issues with regards to large-scale restorations (Bratton and Liatto-Katukdu, 1994; Wilkinson, 1998; Wellings et al., 2000; Cyr, 2019). It also allowed us to gain insight on what storytelling generally meant to the groups, what knowledge should be shared, and how to present the content.

Discussions were held between June and November 2021 across Aotearoa New Zealand (Table 1). Participants were recruited based on recommendations by catchment group leads and individual interests. The spatial spread across the North and South islands of Aotearoa New Zealand provided diverse backgrounds of participants based on their geographical and regional circumstances (Figure 1). This "*ensur[ed] homogeneity within the group and heterogeneity between them*" (Bedford and Burgess, 2002).

All participants were active members of their respective catchment groups, which included farmers, teachers at local primary schools, members of local lifestyle block[2] owners association or urban restoration communities (Table 1). Participants represented a sub-sample of their catchment groups, which generally were much larger. Our research was

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2   A 'lifestyle' block is a smallholding or small farm (<4 ha) run as a hobby, not as a commercial enterprise.

TABLE 1 Summary of catchment groups used in this study.

Catchment group	Number of focus group participants	Total number of catchment group members	Time since establishment	Predominant land use in catchment	Roles/affiliation of participants (*n*)
1	5	20	6 months	Rural	Sheep and beef farmers (2), small landowners/lifestyle block owners (2), mixed land use (goat, sheep and beef; 1)
2	7	209	1.5 years	Rural	Sheep and beef farmers (2), combination of land uses (e.g., dairy, beef; 1), primary school teacher (1), forestry (1), dry stock (2)
3	6	300	7 years	Urban	Retired professionals (6)
4	7	200	2 years	Rural	Dairy farmers (7)
5	5	190	8 years	Rural	Sheep and beef farmers (4), dairy farmer (1)

FIGURE 1
Examples of **(A)** a template filled in by a focus group, and **(B)** a digitized Catchment Journey.
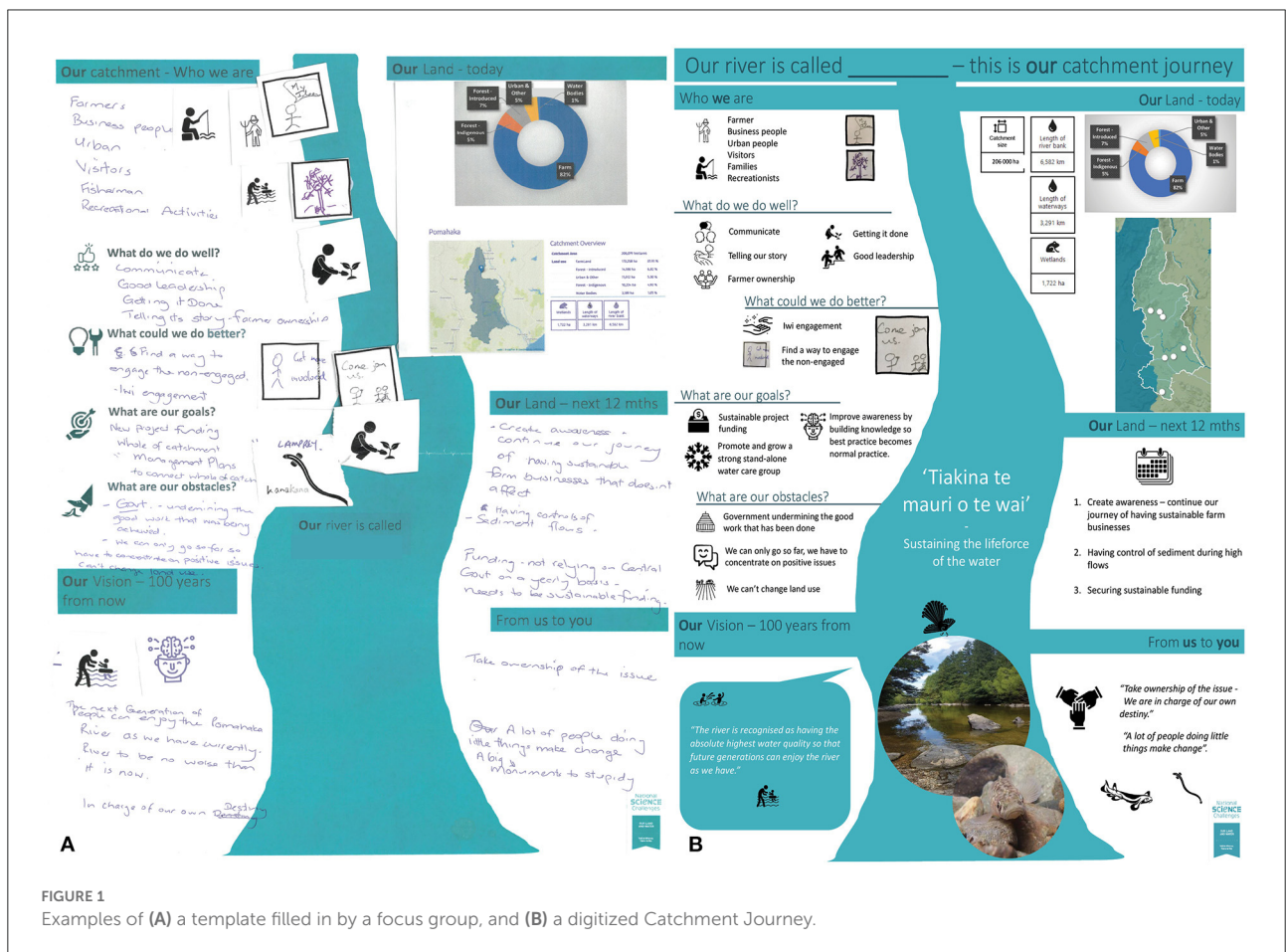
approved by the University of Otago's Human Ethics Committee (D20/03) and adhered to Cawthron Institute's research ethics protocol (CAW-ETH-200804).

2.1.1. Facilitation of focus groups

All participants were briefed about this research by their catchment group leaders prior to us contacting them via

email. Once participants agreed to take part in the research, information sheets and consent forms were sent out prior to the meetings and were returned signed. Focus groups were held in locations suggested by the catchment group leads—community halls ($n = 2$), a private home ($n = 1$), and workplaces ($n = 2$).

The first author facilitated all focus groups. At the beginning of each, participants were reminded about the research project and briefed on the process of the discussion. A "run-sheet" ensured consistency of content and timing for focus group facilitation (Supplementary Table 1). Each discussion had four main parts: (a) introduction to the research project and participants, (b) the creation of a catchment story using a story template provided by the facilitator, (c) discussion about the creation of their catchment story and key insights gained about the template and story creation, and (d) other important points to discuss before the closing of the meeting (Supplementary Table 1). Discussions were recorded using a handheld voice-recorder and transcribed verbatim.

2.1.2. Story creation: Catchment Journeys

In our research, we initially used "story" as an umbrella term whereby each story was made up of a predefined set of headings, or chapters, which provided some form of content guidance for participants. The emphasis of this process of story creation is on an *in situ* construction, and the output's potential use in creating meaning, relevance, and empathy for others. The term "story" is often understood as a narrative with a beginning, a middle, and an end. Catchment restoration is ongoing, following a timeline in which participants discuss catchment restoration actions across the past, present, and future, even though there is often a starting point to restoration (e.g., the forming of a catchment care group or a first planting event). Because of this continuation, we considered the name "Catchment Journey" more appropriate in describing the ongoing process of restoration. We believe that sharing the events along this restoration Journey can be considered one form of storytelling.

We developed a Catchment Journey template to provide guidance for catchment groups on the overarching content that we wanted to capture as part of a group's restoration journey (Figure 1). This included information about the catchment group themselves ("Who are we"), including their group's strengths, weaknesses, obstacles, goals, their long-term vision ["Our vision [x] years from now"], description of already completed and anticipated restoration actions ("Our land today," "Our land—next 12 months"), and a specific message the group wanted to share with others either within their own or with other Aotearoa New Zealand catchments ("From us to you").

Participants were given a paper copy of the Journey template to fill in and printed symbols as examples of things that they could use to further emphasize their Journey content (e.g., a fence symbolizing stock exclusion, a family symbolizing needs for future generations, or an eel symbolizing biodiversity;

Figure 1A). Groups were encouraged to alter the template layout (e.g., change headings) and to create new symbols specific to their catchment group and restoration actions. Providing a Journey template ensured some consistency in content and enabled us to compare specific sections between focus groups. The template was designed based on insights gained from previous research done as part of a national Aotearoa New Zealand research program called "National Register of Land Management Action" (Our Land Water - Toitu te Whenua, 2022).

After the focus group meetings, digital versions of the paper templates were created and sent back to participants for checking accuracy of the content and wording. Any symbols that were created by the focus group were photographed and copied into the digital template (Figure 1B). Each catchment group created their own Catchment Journey, which they were free to share with their wider restoration and land management communities.

2.1.3. Thematic analysis

Thematic analysis was conducted to identify and report patterns (themes) within the data, following Braun and Clarke (2006). In our study, a theme described something relevant about the data in relation to us wanting to understand the suitability of stories as a communication tool that may encourage freshwater restoration. Each theme (and sub-theme) represented some level of "patterned" response or meaning within the data (Braun and Clarke, 2006). Themes were developed across and summarized between all focus groups, which holds the risk of missing important social and cultural differences within and between groups. While we acknowledge that every participant brought a different personal background to our focus groups, our research didn't focus on cultural differences, though it explored a geographical range of catchment care groups across Aotearoa New Zealand. We suggest that future research should explore cultural differences within catchment care groups in greater depth.

The development of a validated and robust coding manual involved an iterative process, where the first author created and refined codes, using feedback provided by the other authors and a research group of science communicators. The codes were then tested by an independent researcher (Lombard et al., 2002; Neuendorf, 2002). A total of 20% of the focus group discussions were tested for inter-rater agreement, calculated as Cohen's kappa and percentage agreement. The final agreement was Cohen's kappa of 0.443 with a percentage agreement of 99%, which was considered sufficient to validate the robustness of the coding manual (Lombard et al., 2002). All data handling was done in NVivo™ 12 (QSR International., 1999).

3. Results and discussion

3.1. Focus group dynamics and social settings

Establishment of each catchment group ranged from 6 months to 8 years prior (Table 1), so that each group was on a different time trajectory in terms of anticipated and already achieved restoration within their catchment. However, groups that only recently established a "formal" group may have already been actively restoring their river. For example, Catchment Group 4 has existed for "only" 2 years in the current format but catchment freshwater restoration (mainly stock exclusion and riparian planting) in their wider region had been occurring since the late 1990s.

Within each focus group, all participants knew each other from working together as part of their catchment group, with some also being related (e.g., siblings) or in a relationship (e.g., husband and wife). Because of the familiarity amongst participants, dynamics in the groups were generally relaxed, which was expressed by friendly banter and joking. There were no indications of participants feeling peer-pressured by other participants, nor of under-, or over-disclosure of either details of their lives or information about themselves. In all instances, group members appeared to be enjoying interacting with each other, offering their point of view, and learning from each other. The interactive aspect of the focus groups allowed participants to agree with each other (e.g., *I can totally relate to what you just said.*—CG1), but also question one another, or explore different points of views (e.g., *Yeah, I have a slightly different take.*—CG4). This open form of communication provided important insights into the practice of knowledge production and knowledge sharing in the form of stories, which we further discuss below.

3.2. Catchment Journey creation

Each catchment group created their own Catchment Journey during our meetings, which ranged in length from 1 h 40 min to 2 h. One person acted as scribe to fill in the blank template spaces on behalf of their group. Participants responded positively to filling out the template, which triggered a chain of responses [i.e., synergistic effect (Hay, 2016)]. Discussions shifted from original questions asked by the convenor to other, related topics (e.g., discussions that started on the topic of sustainable land management shifted to debates about inspiring change to restore river ecosystems and how knowledge sharing in form of storytelling could be a key driver in initiating this change).

Many participants mentioned that it was useful for them to have the time to reflect on their catchment group's current and future aspirations. Catchment Journeys allowed each group to tailor their messages to contextualize conditions specific to their group such as their social

settings (e.g., time since group establishment, size and diversity of group, levels of engagement within group), their geographical location (e.g., high or low rainfall area), or their political situation (e.g., functioning relationship with regional authorities). Verbatim transcriptions of each group's self-identified strengths, weaknesses, opportunities, threats, visions, and "take-home" messages are summarized in Table 2.

3.3. Thematic analysis: Three overarching elements of knowledge sharing for river restoration

Each Catchment Journey was different, however content analysis identified three distinct elements across all Journeys, creating an "Archetype Catchment Journey."

3.3.1. Catchment Journeys should be produced and shared by authentic storytellers to encourage action-based change

The first commonality between all Catchment Journeys was the concept of "community-based ownership of story" or "bottom-up storytelling." This principle was mentioned by every catchment group during focus group discussions. It describes the concept of sharing knowledge by communities of practice that actively restore their river catchments to improve freshwater ecosystem health. Common land management practices included planting vegetation along a river or fencing waterways to keep out livestock. Participants felt that if knowledge is produced and shared by those communities, they have the "power" to tell their story and could motivate others to do the same.

> [A]nd this is why [restoration] works, because it is farmers [...] educating farmers.—CG5

As part of bottom-up storytelling, participants highlighted the importance of diverse (plurivocal) storytellers within the same community. A plurivocal story allows people to tell an inclusive story that considers distinct circumstances and knowledge while facilitating connection among diverse participants operating in different places (Goldstein et al., 2015). In our study participants recognized that their communities consist of a wide range of people with various backgrounds and that every one of them has different experiences and perspectives about on-land freshwater restoration.

> [A]nd the people up near the mountain are different to the people down in the coast.—CG4

They felt that Catchment Journeys needed to encompass this diversity by having a range of storytellers.

TABLE 2 A summary of the strengths, weaknesses, opportunities, threats, and long-term visions for five catchment groups as captured in their Catchment Journeys, as expressed by focus group participants.

	Catchment group 1	Catchment group 2	Catchment group 3	Catchment group 4	Catchment group 5
Who we are	Our catchment consists of farmers and life-stylers.	Entire catchment is part of the catchment collective. We see it as a place for everyone in the catchment.	The group has existed in some shape or form since 1977.	"Mountain to sea" catchment group	Farmers
	Some of us have been in this catchment for 130 years.	We started mostly as sheep and beef farmers in the upper catchment.	We are a group of residents who advocate and work for an improved river with a rich and sustainable ecosystem.	Intergenerational catchment	Businesspeople
	We have a long-term vision (~1,000 years) because we are only 'passing through'.	We are inclusive and impartial.		Mixed community within the catchment (dairy, towns, life-stylers)	Urban people
	We deeply care for our river.				Visitors
					Families
					Recreationist
Strengths ("What do we do well?")	We keep out stock. We plant along our river.	We organize stakeholder talks to share and learn information about our catchment. We monitor water quality. We inspire communities to improve our freshwaters.	We work well together and have a strong voice within the council and wider community. We plant and care for trees. We monitor river health. We engage communities through advocacy, education, and planting.	We are farming sustainably and update our practices. We formed a catchment group. We have good relations with our district and regional councils.	Communicate Telling our story Farmer ownership Getting it done Good leadership
Weaknesses ("What could we do better"?)	Communicate with each other. Record and report our actions better.	Build up trust, a track record and practical plan that sees results. Provide more support to bring in more people. Build on information provided in Farm Environmental Plans.	Encourage sustainability by attracting a wide range of ages. More educational efforts.	Work together as a community. Sharing of information and lessons learned. 'Farming 101, inspire' Tell our story to engage and inform.	Iwi engagement Find a way to engage the non-engaged.
Opportunities ("What are our goals?")	To have as many people in the catchment on board as possible. Caring for the river together without being embarrassed.	Weaving community together around our river.	A clear, clean flowing river.	Knowing the 'now' to plan the future Maintain the ability to farm. Cultural survey and engagement.	Sustainable project funding Promote and grow a strong standalone water care group Improve awareness by building knowledge so best practice becomes normal practice

(Continued)

TABLE 2 (Continued)

	Catchment group 1	Catchment group 2	Catchment group 3	Catchment group 4	Catchment group 5
Threats ("What are our obstacles"?)	[Ongoing costs and time commitment for] maintenance. [Lack of] time. Perceptions [by others]. Costs [involved in restoration].	Time poor Persuading more to join. Little catchment coordination	Forestry industry Governmental bureaucracy Resistance to change Small group	Different information from trusted sources. Lack of guidance on data collection.	Government undermining the good work that has been done. We can only go so far; we have to concentrate on positive issues. We can't change land use.
Vision (length/duration of vision set by catchment group)	A river in good health that is fishable and swimmable. We will achieve this by improving its water quality (1,000 years).	We want to be resilient in the face of climate, social, regulatory changes. A river swimmable in the summer, sufficient water for everyone and for the river ecosystem. People are thriving, Te Taiao [the environment] is thriving, and we are all prosperous and peaceful. (4 Generations from now)	The majority of the catchment under continuous forest canopy with a healthy diverse ecosystem (1,000 years).	Healthy land, healthy water, healthy communities. Supporting the river catchment community by showcasing and promoting sustainability and the best land and water management practices. (Indefinite)	The river is recognized as having the absolute highest water quality so that future generations can enjoy the river as we have (100 years).
Take home message for the journey reader ("From us to you")	It is important to share what we know about Land management and restoration: the things that worked and the things that didn't work. You need the will to restore then an idea will turn into action. Sometimes you don't have the time or the money for restoration. As long as you keep the thought in your mind it will happen one day.	We need to find funding and work with like-minded stakeholders to improve our rivers for the sake of our grandchildren. The involvement of the community is key.	We believe that good relations with other stakeholders (council, iwi, landowners, and forestry companies) helps to produce successful outcomes. Question everything.	The Community is doing great work such as planting. Iwi engagement needs to be meaningful and based on respect and trust.	Take ownership of the issue—we are in charge of our own destiny. A lot of people doing little things make change.

Expressions are verbatim.

Well I don't think we should be telling iwi stories ourselves, that's up to the iwi to tell them.—CG4

If these storytellers were then also authentic, restoration knowledge transfer was considered likely to be successful by our participants.

What we're trying to capture here is our narrative of what we ourselves are doing, and yet actually a very large part of our narrative is influencing others to cause them to be doing things. And if that's left out of the equation, then it basically drops a large portion out of the whole picture of what we are doing, and what we have done. But it needs to come from us, the people doing the work.—CG3

Authentic storytellers hold an authority to tell their story, which then becomes "*true to the teller, the audience, the moment, and the mission*" (p. 53; Guber, 2007). This allows social learning to happen, encouraging individuals and/or catchment communities to become communities of practice, developing their own agency as they learn from the actions and experiences of their champions. This brings listeners to a place of understanding that moves and captivates them, which has been shown to ultimately provoke action for change (Green, 2004). A CG1 participant explained what this learning could look like.

I'm a newcomer, so I was learning what's gone well and what works. I don't want to make someone else's mistake, I can't afford to already, so if I go "Oh this works well—cool—they say ribbonwoods grow well," I will do that, too.—CG1

In our study, "catchment champions" held all traits of authentic storytellers, which enabled them to energize others to then commit to freshwater catchment restoration. "Catchment champions" in our research were individuals, or entire catchment groups, whose influence encouraged restoration in their own communities.

Previous research has highlighted the value of "catchment champions" as storytellers to encourage freshwater restoration (Gearey, 2018; Doehring et al., 2022). Our findings, too, suggest that having an inspiring storyteller is important for Catchment Journeys to enthuse others within their own catchment. Catchment Journeys were told by locals, about their own actions, to share with others who may use their knowledge and experiences. This made Catchment Journeys true to the teller, and the listener, which our participants felt strongly about. It allowed our catchment communities to articulate a collective identity that transcended spatial and temporal limits, strengthening, and shaping a community into a coherent and plurivocal vision of their future. While this concept is more commonly known as "collective action" or "collective management" (Ostrom, 1990), we believe that "collective storytelling" (referred to earlier as community-based

ownership or bottom-up storytelling) is a key mechanism in enabling successful catchment restoration.

For collective storytelling to be successful, communication needs to be a two-way affair (De Groot and Zwaal, 2007) whereby both the storyteller and the listener share an understanding of restoration. Our participants, also, emphasized the critical role of audiences. For example, some participants stated that their stories would change depending on who the audience was, acknowledging that audiences, even within a single catchment, can differ.

[W]e'd write [our journey] very differently, yeah totally, depending on whether it's a public or a private audience.—CG3

In the context of sustainable land management, social learning through collective engagement has been shown to increase uptake of restoration actions that improve water quality (Blackstock et al., 2010; Phillips et al., 2010; Barnett, 2014). If the information then also stems from an experienced and trusted source, in our case catchment champions, action-based change triggered by social learning is even more likely to happen in rural communitites. For example, Lankford et al. (2004) showed that recommendations for farmers on good catchment management was partly ignored in their study if they were made by scientists, but Robinson (2006) showed that if recommendations for farmers on Environment Farm Projects were faciliated and encouraged by other farmers, uptake within the community was improved. Similary, Brown and Roper (2017) showed that farmers are more likely to adopt new practices and technologies after seeing them demonstrated, but that demonstration needed to be undertaken within farmer networks.

Apart from exploring the roles storytellers and listeners have in collective storytelling, we also explored what drives catchment communities to restore their catchments in the first place, and how this drive may be sustained into the future.

3.3.2. Land stewardship through community cohesion motivates freshwater ecosystem restoration

All our participants expressed the overarching need to work toward a "healthy river" by restoring freshwater ecosystems as portrayed in their "Visions" (Table 2).

We're in this together, we're all wanting the same thing. I don't think you'd go through this valley and find anybody that doesn't want the river to get better. I don't think you would find that.—CG1

Each catchment group in this study was already actively working toward their visions by restoring their waterways through sustainable land management actions (e.g., reducing

fine sediment and nutrient concentrations entering the river through stream side planting and fencing; constructing new, or enhancing existing wetlands; having active farm environmental plans that outline sustainable land management practices and progress). Participants in our study recognized that freshwater restoration is part of a bigger picture that includes more than just the physical environment. Connections were specifically referred to (see "Visions" in Table 2).

> So, everything is connected, and to understand those connections changes completely the way that you see things, because then you're not [restoring] because you should, you're [restoring] because it's an important part of the wider picture.—CG2

The concept of community coherence appeared to be a main determinant for the success of catchment restoration for our participants and was mentioned as a goal by three of the five groups (e.g., *Weaving community together around our river*, CG2; Table 2). For our participants, an interwoven catchment community also meant that working collectively was likely to achieve much bigger goals than restoring rivers individually.

> A lot of people doing little things make change.—CG5
> I think that there's those opportunities around lifting the helicopter off just what your problem is on your farm and bring it to a catchment where it's neighbors helping neighbors.—CC4

A CG2 participant also mentioned that strengthening their community through restoring their river would not only benefit them for the purpose of freshwater restoration, but also for different future challenges, such as flooding due to climate change.

Our results showed that the success of ecosystem restoration was highly dependent on the functioning of a catchment community. For example, a community that "works together" was recognized as a "Strength" (CG3; Table 2), but a lack of community engagement, for example in the form of a small catchment group or lack of collaboration, were either seen as an obstacle (CG3) or a weakness (see "obstacles" for CGs 2, 4, and 5; Table 2).

> I think the main goal would be to have as many people on board as possible pulling the same way. Many people—residents, farmers, lifestylers just going in the same direction.—CG1

Sandercock (2003) found that through the crafting of community stories, diverse players found common threads that bound them to a shared vision and allowed opposing parties to work out catharsis and healing. In our study, catchment groups that "pulled the same way" were also able to focus on restoring

their freshwater ecosystems in the long term, which was a key driver for inspiring change.

> The longest journey starts with the first step, and I think that's what we're on—the longest journey probably.—CG1

Participants in our study agreed that ecosystem restoration is an ongoing process, and not a short-lived aspiration. Our findings revealed that there were a range of factors that played key roles in keeping catchment communities motivated to reach their visions. For example, the concept of ongoing care for waterways was regularly linked to *intergenerational catchment management* (CG4), but particularly to the need to restore freshwaters for future generations (Table 2).

> [We need] to improve our rivers for the sake of our grandchildren.—CG 2
> You talk to most farmers that have been around for a long time and they don't want to stuff up their land. They usually want to leave it to their kids, so you try and pass on something that's worth passing on.—CG1
> Future generations can enjoy the river as we have.—CG5

The importance of long-term restoration and sustainable land management was emphasized by the length of each group's vision, which were set to 100 years/4 generations (CGs2 and 5, respectively), 1,000 years (CG1 and 3) or indefinite (CG4) (Table 2). CG1 acknowledged that *it's going to take a wee while* (CG1) to restore river water quality in their catchment. The duration of their visions in other focus groups was *over generations* (CG5) to see improvements in freshwater health. This is because a key component adding to complexity of catchment restoration is the lag in time between restoring before a response to actions can be seen. For example, lag times can range from between <1 year (for fecal bacteria waste management) to over 500 years (for sediment erosion control at a catchment scale) (Meals et al., 2010). Our participants recognized these lag-effects and adjusted their restoration visions accordingly.

Restoring freshwater ecosystems for future generations, regardless of the envisaged timespan, requires determination and ongoing motivation of current and future catchment groups. Participants expressed an intrinsic drive to restore their catchments, which was based on *the will to restore* (CG1; Table 2) and *their feelings for the land* (CG5) because they *deeply care for [their] river* (CG1). This fundamental desire to restore, and the connection to the land, are powerful drivers for action. We wanted to further investigate how catchment groups would *sustain* this drive to last for the duration of their visions and what role effective communication may play in this context.

3.3.3. The good, the bad, and the ugly: Comprehensive storytelling, including successes and failures, is needed to sustain restoration momentum

The Catchment Journeys documented in this project were emotionally charged and included uplifting information (e.g., restoration successes such as return of a specific fish or bird species) as well as details about hardship, and failure. They were "unconditional" stories. Unconditional stories such as these can connect people through memory, emotion, and the granularity of a life lived (Gearey, 2018). One CG4 participant described the importance of unconditional stories and the need of sharing.

> *Exciting to be farming and feeling the pain, living and breathing what farming challenges there are at the moment, but also full of optimism for the [catchment] groups and what they're looking to achieve. But no-one has captured their story. No-one in New Zealand has captured the story of the progress that they have done.—CG4*

Many participants were affected by the stories told by their community members with emotional responses ranging from elated and happy to empathetic and sad, depending on whether group members focused on strengths and opportunities or weakness and threats. Catchment Journeys that are emotional are likely to affect the listener, triggering emotional responses. Emotional responses evoke interest and engagement in readers and listeners (Green, 2004; Lambert, 2013; Huang and Grant, 2020).

While the role of emotions is too often disregarded in the physical sciences, it is well-understood and accepted in social science disciplines that content, which evokes high emotional arousal triggers action (Hemmings, 2005; White, 2009; Berger, 2011; Berger and Milkman, 2012; Nelson-Field et al., 2013). Emotions have been shown to be one of the most potent means researchers can use in terms of igniting an audience's engagement and potentially understanding (Carrus et al., 2008; Speckemeier and Tsivrikos, 2021; Wang et al., 2021).

By understanding the emotions that shape experiences, we can come to appreciate the meaning we make out of them (Davies et al., 2019). Then action-based change may be triggered, communities may be strengthened, and some of the discussed obstacles overcome. Below, we elaborate our participants' responses and emotions and the implications for comprehensive restoration storytelling.

3.3.3.1. The good: Positive storytelling inspires ongoing restoration

In our research, participants noted that if Catchment Journeys were to elicit positive emotions, ongoing momentum to restore may be triggered. Examples of positive emotions included gratitude for financial support to restore, hope for future generations to be able to enjoy the rivers, and pride of

the restoration already achieved. For example, one participant in CG5 had started to fence off his waterways 17 years ago to reduce impacts on the river caused by his livestock. Now, he said, that he was proud that he and his wife had fenced off all four km of riverbanks on their land and planted on average *a couple of thousand trees a year* along the fences.

Other participants talked about their restoration achievements with similar passion, listing the different kinds of restoration actions done by themselves or their group. This passion turned to elation when participants were able to show progress made over time as proof of the change they had initiated (through, for example, photographs), but also the potential change that could be made.

> *You don't necessarily always feel like you're achieving much and then you look at pictures. We've been there seven years now and it's like: "Actually this doesn't even look anything like what it did when we moved here." So then you feel like you are achieving something.—CG1*
>
> *Seeing the photos of 50 years ago now is quite inspiring for someone like me who has just got a blank canvas.—CG1*

Stories of exemplary actions serve as inspirations (Sandercock, 2003) and our participants agreed that sharing knowledge on restoration actions was considered a "positive thing."

> *I can only see [sharing restoration progress] as being a positive thing. That it's showing that there's work going on, and we want to share it with everyone because it is a positive thing.—CG4*
>
> *I was thinking of it more as a community to show what we are achieving as opposed to showing off, so that people are like, "Actually we are doing some amazing stuff."—CG1*

Being able to positively influence wider communities to change their behavior toward improved land management (e.g., increasing the extent of their restoration actions, helping restoration communities to take action that is most effective) should be the goal of successful restoration science communication. This is *because almost every river—it's about human change.—CG3*

By providing an opportunity to act in a positive way, for example through involvement in a community-based restoration project, people are able to gain a sense of accomplishment and efficacy, based on their feeling of making a meaningful contribution to positive change (Ryan et al., 2001; Martinez and McMullin, 2004; Leigh, 2005; Rogan et al., 2005). Our research confirmed sharing restoration success, such as the "good work" and "what has worked," was perceived to create an ongoing momentum to enable long-term freshwater restoration, as suitably phrased by a CG5 participant.

If you want to effect ongoing change you need to show what is working and have some positive stories out there.—CG5

3.3.3.2. The bad: Including threats and challenges as part of restoration storytelling creates empathy and trust

Some participants also raised the point that to encourage ongoing restoration momentum, Catchment Journeys should not only include positive stories, but also restoration actions that "did not work" and why they didn't work.

It is important to share what we know about Land Management and restoration: the things that worked and the things that didn't work.—CG1

To be quite honest, I know lots of people in the valley that have been here for a wee while and they would [be happy] to [tell] their story. But ours is not all positive like this—it's certainly not—it's certainly a very unhappy little river especially through the middle there.—CG1

Some of the restoration stories our participants shared included hardship and failure, such as the story told by one CG1 participant who explained that his neighbor's cattle managed to enter his land and significantly damaged some of his waterway plantings that he had worked on for the last 20 years.

So that work can be undone in … three days they were in [amongst the planting].—CG1

Stories such as this caused other catchment group members to feel empathetic toward this farmer (*It's heart-breaking, isn't it?*—CG1) and many participants recognized that for Catchment Journeys to have a lasting impact, they will have to include stories that share failure and hardship, because such is the "real world." Catchment Journeys created by participants in our study reflected parts of the "real world" and included sections that focused on what catchment restoration groups could do better to restore their catchments (weaknesses) and what obstacles each group experienced that hindered their restoration (threats).

In addition to the environmental challenges related to freshwater restoration, social obligations for farmers to act responsibly in accordance with their "social license to operate" added further challenges to our participant's restoration journeys, as explained by one CG4 participant.

[W]e're under pressure here. We've got 13–14-odd neighbors now who complain about cowshed noise—they complain about dust. We're zoned rural but it's rather urban now, and it depends on who your neighbor is. We put new baffles, and everything, in the cowshed a few years ago to make

it quieter, and I don't milk as early as I used to in the mornings so hopefully that makes people a little bit happier, but who knows. We've got a lot of issues like that.—CG4

By providing a safe space for participants to discuss threats and challenges, true and honest knowledge could be shared. Honesty has been shown to create trust, which is a key factor for social license to be granted (Woodward, 2017). That social license is something our participants strived to achieve or maintain.

The goal must be for us to maintain our ability to [farm]. It's our social license to be able to continue farming.—CG4

However, we were interested to note that despite the considerable political and cultural challenges associated with agriculture (many exacerbated by climate change) in Aotearoa New Zealand (NZ Ministry for the Environment & Stats NZ, 2020), our participants did not dwell on these topics during our discussions. Instead, they focused on finding pragmatic solutions to improve river health in their catchments through comprehensive, and emotional, knowledge sharing.

3.3.3.3. The ugly: Better communication of freshwater restoration is needed to inspire change

Freshwater restoration is ongoing, and our participants recognized the need to communicate any learnings that happened along this journey. This would allow catchment communities to raise awareness about what restoration has already been achieved and what else is needed to achieve their long-term visions.

Knowing the "now" to plan the future—CG4

In our study, a hunger for improved communication within and across catchment communities was apparent. All five catchment groups mentioned communication and education of community members as a weakness or a threat in their Journeys (Table 2), emphasizing the need for improved communication within (and beyond) their communities to encourage freshwater restoration. Of the 28 weaknesses or threats statements, ten specifically mentioned communication or education as an issue (e.g., *Communicate with each other*—CG1, *Persuading more to join.*—CG2, *More educational efforts*—CG3, *Sharing of information*—CG4, *Find a way to engage the non-engaged*—CG5; Table 2).

For CG1 it was *important to share the things that worked and the things that didn't work*, but they recognized, along with CG3 that they could do better at educating and engaging others about what has, and what hasn't worked (Table 2). In contrast, Catchment Groups 2 and 5 explained that they already did well in *telling their story*, thereby inspiring communities to improve their freshwaters (Table 2).

Because Catchment Journeys are told by the people of the catchment about their restoration work and any associated successes and failures, our participants showed an increased interest in the example story we shared with them as part of the story creation process. We believe that their engagement was enhanced by their emotional response (Bandura, 1986) and positive affect (Longnecker, 2016) resulting from participation in the collective act of storytelling in the focus group. They were able to relate to the experiences of the "champion" catchment group.

This sharing of catchment journeys means that catchment champions may not only act as role models for their own, but also for other catchment communities, thereby expanding the potential reach and impact of their shared knowledge significantly, as explained by this CG2 participant:

> *So, where you've got a tight community, and you're introducing better information and more informed and encouraging action, [members of that catchment group] are taking on more issues outside of [their own] catchment. And so, there's other strong groups that are now saying, okay, let's absorb this [knowledge] on catchment restoration.—CG2*

Bandura (1986) explains this principle as "socially-guided learning," which influences cognitive development as humans turn to others who are well-informed for advice on matters of concern. By observing "modeled expertise," (Bandura, 1986), not only from within their own, but also from other catchment groups, our participants appeared to express increased interest about restoring their catchments.

While we acknowledge the importance of sharing restoration knowledge as widely as possible and to as many restoration practitioners as possible, our project did not investigate this aspect. However, we anticipate that future research as part of the National Register of Land Management Actions project will address this knowledge gap.

3.4. Using Catchment Journeys to inspire wider action-based change: Theoretical considerations

For the interpretation of our results, we referred to the "Koru Model of Science Communication" (Longnecker, 2016) to help us map our findings into pathways for closing the gap between knowledge and action through storytelling.

The Koru model focusses on the response of individuals to information, presented in our case as Catchment Journeys. Factors impacting an individual's engagement with information depends on internal and external factors. Internal factors determine a person's self-perceived identity and include values, beliefs, attitudes, skills and behavior (Figure 2). External factors that impact engagement with and use of information include

the social norms of the community, the support available to the individual, and whether an individual can control their own response and behavior. Together these internal and external factors influence how an individual may (or may not) engage with information. In our study, focus group discussions exemplified important internal and external factors, helping us to understand how Catchment Journeys may consolidate existing understanding and influence participants to create and use new knowledge (Figure 2).
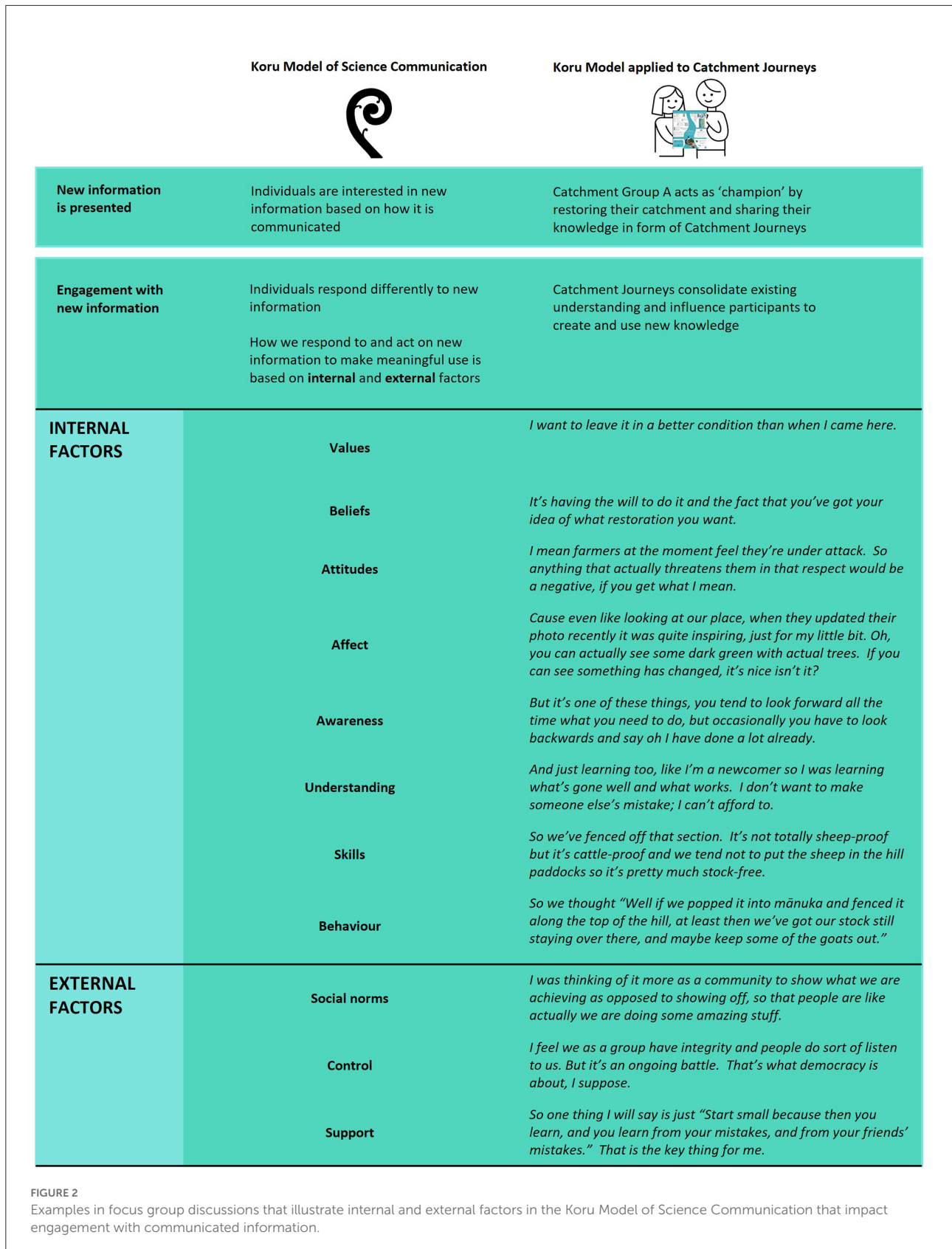
However, understanding how to restore a catchment does not automatically result in people doing so, with a gap between possession of environmental knowledge and adoption of pro-environmental behavior (Kollmuss and Agyeman, 2002; Naustdalslid, 2011). We did not assess the impact of Catchment Journeys on retention and reproduction processes and will be conducting future research to explore this further.

4. Conclusions

Encouraging freshwater restoration, while delivering value to society, requires supplementary approaches and tools to science communication. These approaches and tools need to apply to a wide network of researchers and practitioners. In this paper, we developed storytelling as a potential tool to communicate freshwater restoration actions at catchment scales to inspire others within their catchment to follow suit. We did this by exploring how a catchment community can engage in collaborative construction of "collective narrative." We conclude our research with two take-home messages:

Firstly, creation of Catchment Journeys encouraged collective narrative. This allowed common identity to be built through bridging different ways of knowing among people who are already working together to restore their rivers. Our participants showed an interest in the example story we shared with them as part of the story creation process, and this appeared to facilitate the creation of their collective Catchment Journey. While we have not empirically tested the "from knowledge to action" process, we hypothesize that "collective agency" is likely to trigger ongoing future restoration momentum within individual catchment groups, as it has in the past. Participants in our study left the focus group discussions with apparent positivity and motivation "to get out there and restore."

Because Catchment Journeys are created by the people of the catchment about their restoration work and any associated successes and failures, they have potential to stimulate action-based change in other restoration communities. In fact, three of the five catchment groups in this study have subsequently shared their Catchment Journey with a range of audiences, such as their wider catchment groups, their local councils, agricultural extension practitioners, and other river restoration communities across Aotearoa New Zealand. Further research related to this

	Koru Model of Science Communication	Koru Model applied to Catchment Journeys

New information is presented	Individuals are interested in new information based on how it is communicated	Catchment Group A acts as 'champion' by restoring their catchment and sharing their knowledge in form of Catchment Journeys
Engagement with new information	Individuals respond differently to new information How we respond to and act on new information to make meaningful use is based on **internal** and **external** factors	Catchment Journeys consolidate existing understanding and influence participants to create and use new knowledge

INTERNAL FACTORS		
	Values	*I want to leave it in a better condition than when I came here.*
	Beliefs	*It's having the will to do it and the fact that you've got your idea of what restoration you want.*
	Attitudes	*I mean farmers at the moment feel they're under attack. So anything that actually threatens them in that respect would be a negative, if you get what I mean.*
	Affect	*Cause even like looking at our place, when they updated their photo recently it was quite inspiring, just for my little bit. Oh, you can actually see some dark green with actual trees. If you can see something has changed, it's nice isn't it?*
	Awareness	*But it's one of these things, you tend to look forward all the time what you need to do, but occasionally you have to look backwards and say oh I have done a lot already.*
	Understanding	*And just learning too, like I'm a newcomer so I was learning what's gone well and what works. I don't want to make someone else's mistake; I can't afford to.*
	Skills	*So we've fenced off that section. It's not totally sheep-proof but it's cattle-proof and we tend not to put the sheep in the hill paddocks so it's pretty much stock-free.*
	Behaviour	*So we thought "Well if we popped it into mānuka and fenced it along the top of the hill, at least then we've got our stock still staying over there, and maybe keep some of the goats out."*
EXTERNAL FACTORS	Social norms	*I was thinking of it more as a community to show what we are achieving as opposed to showing off, so that people are like actually we are doing some amazing stuff.*
	Control	*I feel we as a group have integrity and people do sort of listen to us. But it's an ongoing battle. That's what democracy is about, I suppose.*
	Support	*So one thing I will say is just "Start small because then you learn, and you learn from your mistakes, and from your friends' mistakes." That is the key thing for me.*

FIGURE 2
Examples in focus group discussions that illustrate internal and external factors in the Koru Model of Science Communication that impact engagement with communicated information.

project will attempt to quantify the potential of Catchment Journeys to stimulate action-based change.

Secondly, stories in the form of Catchment Journeys appeared promising as a freshwater restoration communication tool. This unique form of storytelling allowed each catchment group in our study to carefully tailor their messages to contexts specific to their group and catchment, such as their social settings (e.g., time since group establishment, size and diversity of group, levels of engagement within group), geographical location (e.g., high, or low rainfall area) or their political situation (e.g., functioning relationship with regional authorities).

Despite the uniqueness of each Catchment Journey, our research showed that there are overarching elements, which should be part of freshwater restoration communication to inspire pro-environmental behavior within catchment groups. We suggest that this "Archetype Catchment Journey," if included in restoration communication, would be valuable for large scale freshwater restoration. Moreover, the insights gained from our findings on communicating complex environmental processes can be applied to other environmental restoration such as biodiversity or matters such as climate change.

Data availability statement

The datasets presented in this article are not readily available because participants were advised that any data collected as part of the research will not be made publicly available. This would have substantially restricted participation in the research. Requests to access the datasets should be directed to kati.doehring@cawthron.org.nz.

Ethics statement

The studies involving human participants were reviewed and approved by University of Otago's Human Ethics Committee (D20/03) and Cawthron Institute's research ethics protocol (CAW-ETH-200804). The patients/participants provided their written informed consent to participate in this study.

Author contributions

KD: substantial contributions to the conception or design of the work, as well as the acquisition, analysis, interpretation of data for the work, drafting the work or revising it critically for important intellectual content, provides approval for publication of the content, and agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated

and resolved. CC: substantial contributions to the conception and design of the work and analysis and interpretation of data for the work and revising the work critically for important intellectual content. RY: substantial contributions to the conception and design of the work and revising the work critically for important intellectual content. NL: substantial contributions to the conception and design of the work, contributions to the analysis and interpretation of data for the work, and revising the work critically for important intellectual content. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2022.1061634/full#supplementary-material

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