NIWA
Taihoro Nukurangi

Engaging communities in freshwater monitoring:

benefits and challenges

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Executive summary

From February 2014 to July 2015, nine volunteer community groups took part in a study in which they monitored water quality and other aspects of ecosystem health in streams and rivers across New Zealand. Some groups existed before the study began, and some were formed specifically for the study. After the monitoring study, we interviewed all nine groups (a total of 34 participants) using questionnaires and semi-structured focus-group interviews. The aims were to discover participants' motivations for taking part in the monitoring, the benefits they and their communities had gained, whether monitoring would encourage them to engage in council-led freshwater planning processes, and what support would enable and encourage them to continue monitoring long-term.

Motivations

Environmental concern was a key factor motivating participants to engage in stream monitoring. This concern arose through a variety of factors including careers, recreational activities, individual historical (particularly childhood) connections with water and participation in environmental stewardship practices. Nearly all groups had at least one person with a science background, which gave them a smoother start, but lack of a science background did not limit participation.

Factors motivating and enabling community groups to continue monitoring in the long-term were somewhat different from those motivating them to begin. For individuals, the monitoring served as an opportunity to enjoy nature, as a way to give something back to the community, as a challenge to learn new things and as a 'tool' for environmental advocacy. Participants were motivated by a desire to share their gained knowledge, and when the wider community showed interest in the monitoring they were encouraged to continue. For restoration groups, monitoring is a valuable means to assess the result of their work and to retain their volunteers.

Support

Having proper technical tools reduced the effort and time required for monitoring, which made monitoring more sustainable and enjoyable. Additionally, proper training was key in motivating people in the long term. Clear and simple methods reduced participants' suspicion that the measurements were subjective, giving them greater confidence. Social networks played a crucial role: groups having strong connections with their community were more likely to continue monitoring in the long term, and to engage in follow-up practices (e.g., taking the monitoring methods to schools, or advocating for their stream). Larger community groups that included a diversity of people gave more opportunities for individuals to participate according to their interests. Support from councils and scientists, including training, operational and technical advice, gave community groups a sense of being part of the 'bigger picture' and the sense (and image) of being backed by a professional body.

Benefits to participants

The monitoring increased participants' awareness, knowledge and understanding in several ways. For participants with less background in science, the monitoring increased their understanding of the science process. Though already environmentally sensitized, monitoring stimulated participants to reflect on their own, and society's, relationship with the environment. Many participants did not have specific ecological knowledge of freshwater prior to the monitoring study, and the knowledge gained through monitoring led to a new level of attention to freshwater (e.g., to the life in the stream) and to freshwater issues appearing in the news. By learning about the functional and biological features of a stream, participants' knowledge became more 'constructive', i.e., more useful for producing positive change. The increase in knowledge and awareness in some cases led to

initiating or supporting new environmental practices, including advocacy (via community newspaper articles and websites), passing on monitoring training to others, and integrating new ideas into participants' social relationships. Increased knowledge about freshwater ecosystems gave some participants more confidence to advocate for their stream, and for others, increased their likelihood of engaging in freshwater planning.

Impacts on local communities

The impact on the local community by groups monitoring within a strong social network seemed to be a greater than by those without. Groups supported by a science organisation benefited from greater credibility (particularly with funding agencies). Councils appeared to be more effective in promoting environmental care among local communities when connected with monitoring groups, which have a voluntary and grass-roots image and relationships with the local community. Overall, a strong network served as a medium for community groups and government agencies to exchange resources and release more energy within a local community, thus achieving better environmental outcomes.

1 Introduction

Public participation in ecological monitoring and research (also known as citizen science or community-based monitoring) is increasing around the world (Bonney et al. 2009; Conrad & Hilchey, 2011) and is widespread in New Zealand (Peters et al. 2015b). The growth of public participation in freshwater monitoring has been attributed to increasing public concern with freshwater management issues (Au et al. 2000; Whitelaw et al. 2003), to increasing numbers of environmental restoration initiatives (Peters et al. 2015b), and to government agencies and researchers seeking new ways to collect information and engage the public in environmental issues (Whitelaw, Vaughan, Craig, & Atkinson, 2003). Citizen science programmes may be initiated by individuals or communities, or they may involve volunteers assisting in professional research or monitoring using methodologies developed by or in collaboration with professional researchers (Cooper et al. 2007; Peters et al. 2015a).

In New Zealand, community-based freshwater monitoring (CBFM) as a form of citizen science is gaining momentum as concerned citizens, government agencies, industry, academia, community groups, and local institutions seek new ways to collaborate to monitor, track and respond to issues of common community concern (Peters et al. 2015a). The central Government is strongly encouraging a better-informed public and greater public engagement in freshwater management and planning (MFE 2013, 2014, MBIE 2014), and regional councils in Canterbury, Greater Wellington, Waikato and Hawke's Bay have responded by facilitating collaborative stakeholder processes for regional freshwater plans[1]. In encouraging this collaborative approach to freshwater planning, the Land and Water Forum, influential in the Government's freshwater reforms, opens a possible role for community-based monitoring in highlighting that "if solutions are to be apt, and to be widely accepted, [communities] must be able to bring their own knowledge and experience to bear" (Land And Water Forum, 2012). Citizen science is also being encouraged by the Government's National Strategic Plan for Science in Society (MBIE, 2014). This programme aims to increase New Zealanders' knowledge of, appreciation for, and ability to use science for better social and environmental outcomes, and identifies citizen science as one means to achieving these goals (Cooper et al. 2007). Meanwhile, the growth of citizen science also appears to be motivated from the grassroots. With at least 137 of 600+ community-based environmental restoration groups conducting their own monitoring (Peters et al. 2015a), and several initiatives specifically for environmental monitoring being established or growing over the past few years (e.g., Wai Care, Whitebait Connection, My River, WaiNZ, Choose Clean Water), the New Zealand public is increasingly showing signs of wanting to take greater ownership and control over their local environment, with a clear emphasis on freshwater.

A major benefit of community monitoring is the ability to provide data beyond the collection capabilities of government and research agencies as well as from under-researched places such as private gardens and inner city areas (Carr, 2004; Peters et al. 2015a). With thousands of projects, millions of volunteers engaged globally, and Citizen Science Associations appearing (Bonney et al. 2009), citizen science provides an unprecedented capacity for large-scale, long-term ecological monitoring projects (Danielsen et al. 2005). This surge in activity has been facilitated with increasing access to technologies such as smart phones, and the internet has enabled widespread access to information on these programmes. Nevertheless, volunteer data collection is rarely encouraged by

[1] http://www.gw.govt.nz/ruamahanga-whaitua/, http://www.waikatoregion.govt.nz/healthyrivers/, http://www.hbrc.govt.nz/hawkes-bay/projects/strategic-development/tank/, http://ecan.govt.nz/get-involved/canterburywater/committees/Pages/default.aspx

government or research agencies, and data are rarely used, particularly because of doubts about volunteer data reliability (Sheppard & Terveen, 2011; Peters et al. 2015a). Recently, Storey et al. (2016) showed good agreement between community volunteer and professional (regional council) data for several freshwater variables monitored in New Zealand, suggesting that, as found overseas (Fore, Paulsen, & O'Laughlin, 2001; Canfield et al. 2002; Shelton, 2013), volunteers can collect reliable monitoring data for several important variables when properly trained. Therefore, there appears to be potential to change perceptions, and increase use, of volunteer data.

Citizen science activities can also bring many social benefits, both to participants and the wider community (Hobbs & White, 2012). Community-based monitoring has been found to contribute to initiation of local conservation projects, compliance with conservation laws and increased social capital within the community (Danielsen, Burgess, & Balmford, 2005; Hobbs & White, 2012). Through public engagement, community-based monitoring can play a role in increasing scientific literacy (Bonney, Ballard, Jordan, McCallie, Philips, Shirk & Wilderman, 2009), helping to promote a reconnection between people and nature (Devictor, Whittaker & Beltrame, 2010) and raising awareness of environmental issues (Evans, Abrams, Reitsma, Roux, Salmonsen & Marra, 2005; Bonney et al. 2009; Devictor et al. 2010; Cosquer, Raymond & Prevot-Julliard, 2012). Thus community-based monitoring appears to have potential to fulfil a number of central and regional government objectives, such as empowering communities to engage in regional water planning, as envisaged by the NPS-FM. We discuss this more fully in Appendix A.

Despite the wide acknowledgement of the benefits of citizen science programs, relatively little information is available on *how* to engage citizens widely to create a scientifically literate society, with greater appreciation for and interest in freshwater. Programmes that have been assessed have focused on the influence of nature experience on environmental attitudes and behaviour (Kals, Schumacher & Montada, 1999; Bögeholz, 2006; Schultz, 2011), the science process (Brossard, Lewenstein & Bonney, 2005; Bonney et al. 2009) and the influence on knowledge and beliefs about biodiversity on a local scale (Evans et al. 2005; Cosquer et al. 2012), rather than on what motivates people initially to engage in citizen science activities and what would keep them motivated in the long term, taking into account the role of this learning about and awareness of the local environment. To increase engagement, there is a need for studying these motivations.

Community-based freshwater monitoring may provide rich opportunities both to add data to regional council monitoring networks, and to create an informed public with greater appreciation and interest in local freshwater issues. Yet, the potential of CBFM is rarely utilized, internationally (Sheppard & Terveen, 2011; Buckland-Nicks 2015) or in New Zealand (Peters et al. 2015a). If CBFM is to grow and continue successfully in the long term, an understanding of what motivates people is essential in order to promote and support it. And to establish support from the appropriate agencies, the potential for CBFM to fulfil the objectives of those agencies must be demonstrated.

1.1 Aims

We aimed to provide a better understanding what makes people successful 'carriers' of the monitoring practice in the long-term and how this practice may translate into interest in, and action for, local freshwater issues. We addressed the following main research questions:

- What motivates people to engage in freshwater monitoring?
- What would motivate people to continue, or prevents them from continuing, monitoring in the long term?

- What support or resources would increase participants' interest in and commitment to freshwater monitoring?
- What are the consequences of freshwater monitoring for participants in terms of a) environmental awareness, b) scientific literacy, c) ecological knowledge, and d) social relationships?
- How may engagement in community freshwater monitoring lead to engagement in freshwater management, or environmental stewardship activities more generally?

In addition, we took the opportunity to gain user feedback on NIWA's SHMAK (Stream Health Monitoring and Assessment Kit, Biggs et al. 1998), asking participants how the kit could be improved based on their experiences.

By addressing these questions, this study aimed to expand our knowledge of the benefits, opportunities and challenges of engaging communities in freshwater monitoring as a means of greater appreciation and interest in freshwater issues within the context of a more scientifically literate and environmentally aware society.

2 Methods

This study is qualitative in nature. Qualitative research is often concerned with human environments, individual experiences and social processes (Wester & Peters, 2004). Qualitative research generally starts with the assumption that individuals attach meaning to their social reality and that as a result human action should be considered meaningful. A qualitative research design was considered an appropriate research method as knowledge and beliefs develop and operate within a given social context.

Within qualitative research methods we chose the focus group method. Focus groups are a form of group interview that capitalizes on communication between research participants in order to generate data (Ketelaar et al. 2009). Whereas a qualitative interview is a one-to-one conversation between the participant and the researcher, a focus group involves multiple participants who simultaneously take part in the conversation (Wester, Renckstorf & Scheepers, 2006). People are encouraged to talk to one another, asking questions, exchanging anecdotes and commenting on each other's experiences and points of view (Ketelaar et al. 2009). These group processes can help participants to explore and clarify their views in ways that would be less easily accessible in a one to one interview (Ketelaar et al. 2009). Tapping into interpersonal communication is also important because this can highlight values or group norms and the importance of social capital in reaching goals, which is particularly relevant in a community group context (Ketelaar et al. 2009).

It cannot be assumed that group data are by definition 'natural' in the sense that such interactions would have occurred without the group being convened for this purpose. We did not assume that sessions reflect everyday interactions, but used the group to encourage people to engage with one another and formulate their ideas and beliefs.

2.1 Participants

The participants in this study belonged to nine community groups that had participated in an 18-month monitoring study conducted by NIWA (Storey et al. 2016), during which they had training in stream monitoring methods, and face-to-face contact and dialogue with NIWA and regional councils. Our nine groups and their stream sites were spread from Auckland (two sites) to Nelson (two sites), with one site near Taupo in Waikato, one site in Gisborne District, and three sites in Wellington Region (Fig. 1). The locations also represented a diversity of contexts for monitoring: two urban sites were within a large city (Auckland), another two urban sites were within medium-sized towns, and the remainder (sites with either rural, native forest or exotic forest catchments) were just outside of small towns.

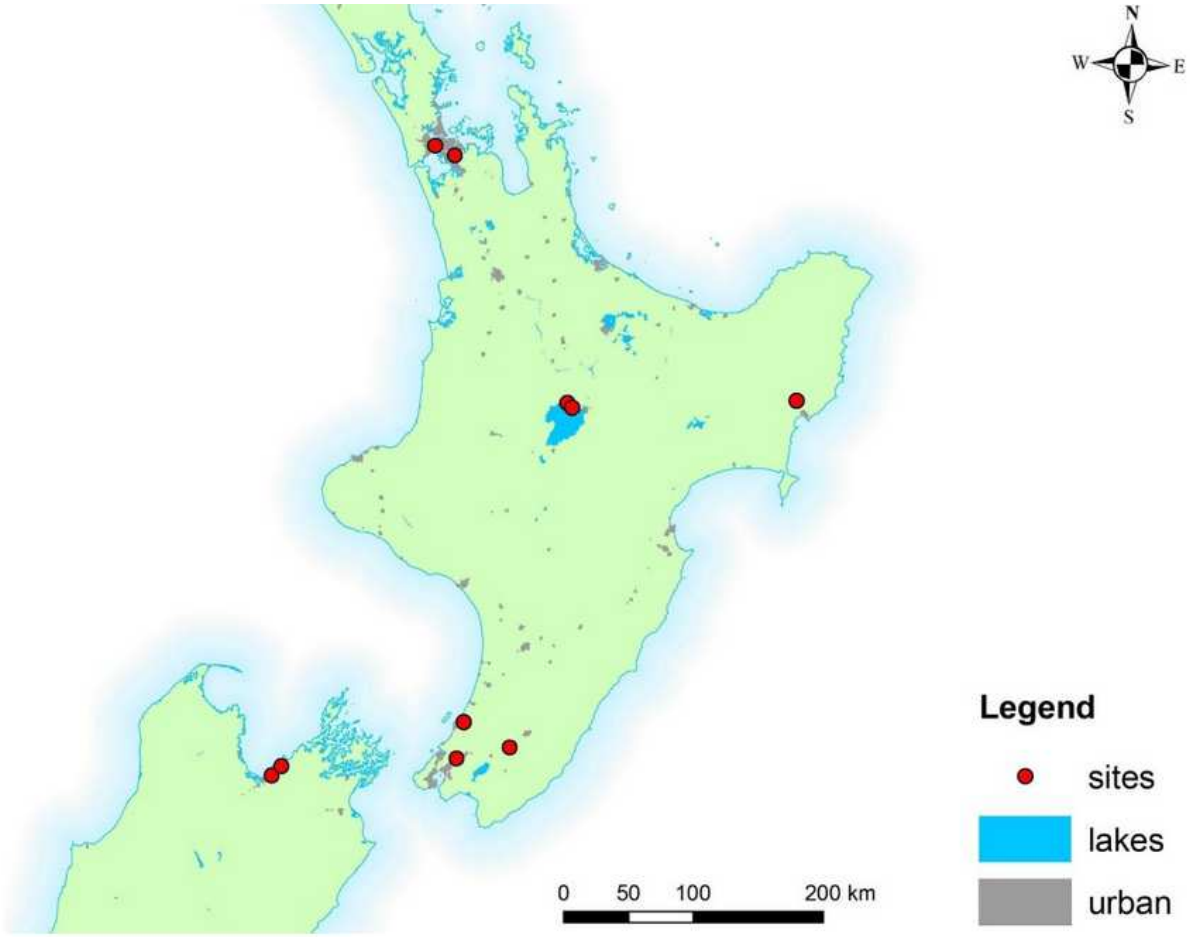

Figure 1: Locations of the nine community monitoring groups.

Respondents belonged to four age categories: <19 (n=4), 20-39 (n=3), 40-59 (n=10) and >60 (n=17). The total sample included thirteen males and twenty-one females. Four respondents were high school students, 17 respondents were retired, 11 were engaged in paid employment, and 2 had no paid employment. Of the 30 post-school respondents, nine have or used to have an environment- or nature-related job, eight have or used to have a natural science-related job and five have or used to have an education-related job. In our experience, this mix of career backgrounds is not unusual for community-based environmental care groups.

Thirty of the focus group participants had joined the monitoring programme from the start, and four had joined at a later stage. Most focus group participants had participated regularly in the monitoring.

The groups had different histories and repertoire of environmental activities: three groups were new, i.e., were formed for the monitoring study; three groups were pre-existing environmental stewardship groups, having experience with stream restoration but not with freshwater monitoring; and three groups were pre-existing environmental stewardship groups having experience with freshwater monitoring. This diversity allowed us to explore the potential influence of social capital and knowledge and skills generation because of experience, on a group's capacity to do monitoring.

The number and variety of participants involved allows us to account for the variation in which the subject of study, community monitoring, takes place (Wester & Peters, 2004). The study was not designed for statistical significance testing. Our results are, therefore, only representative for the particular situations of the respondents. However, that does not necessarily imply that the results we present from the focus groups cannot be applied more widely as contexts offering similar situations often include similar features (Wester & Peters, 2004).

2.2 Data collection

The focus groups were conducted from September to November 2015. The participants were invited by email or telephone. A total of thirty-four respondents participated in this study. On average a focus group contained four participants, ranging from a focus group with two to one with six participants.

Prior to the focus group meeting, the participants were asked to fill out a brief questionnaire (Appendix B) in order to also record some individual comments and information. By filling out the questionnaire *prior* to the focus group session, individual information, not influenced by group norms and values, was acquired. Using the two methods allowed us to capture both contexts in which the community monitoring exists, i.e., the social group process and individual consequences of the monitoring.

The focus groups had an informal character; the sessions were relaxed with a comfortable setting, refreshments, snacks and sitting in a circle for establishing the relaxed atmosphere. They typically lasted one to two hours. Six of them took place in private houses, while one was conducted in a local community building, one at the respondents' school and one at the respondents' work place, all close to the respondents' homes. The researcher explained the 'rules of the game' and each participant was invited to introduce him or herself. During the focus group session, the researcher used a range of group exercises and discussion tools (Fig. 2). Key discussion points were written down on a flip chart which served as guidance. Also during the focus groups, a series of statements were presented to the group and they were asked their degree of agreement or disagreement.

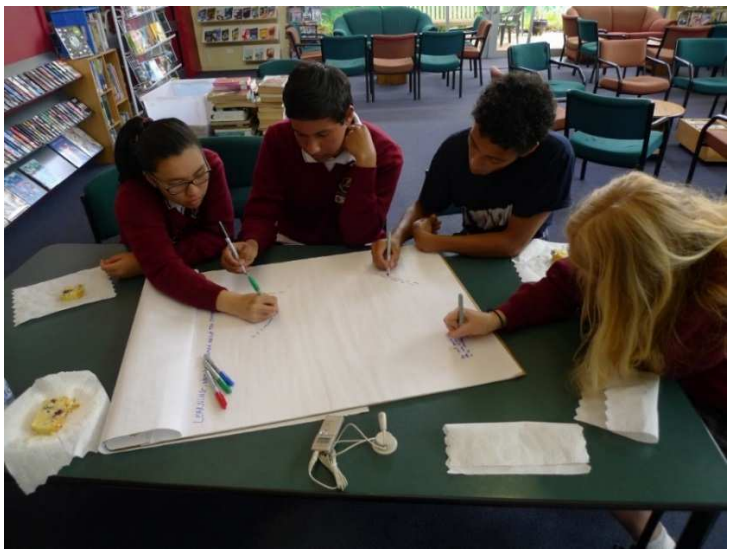

Figure 2: An example of a focus group session where participants were asked about their connection to the stream by using an assignment.

2.3 Measuring instrument

Data were collected by means of a semi-structured measuring instrument, the 'topic list' (Appendix B). This functioned as a guideline for the content, direction and the time of the discussion (Wester et al. 2006). Each topic included an introduction, an open question for the respondents and follow-up questions to trigger further responses.

The topic list was created based on literature through which potential key factors could be identified. These factors include: meaning, material, competence, previous experiences, reciprocity, trust, social capital, science literacy, environmental awareness, ecological knowledge, connection to place and social networks. The topic list was refined as the research progressed. The interview questions were designed to provide opportunity for the participants to address these factors if they were relevant and also were open-ended enough for them to include additional factors not previously explored in literature (Wester & Peters, 2004).

2.4 Analysis

Transcripts of the nine focus groups were made from audio recordings which made it possible to recall in detail what was said by all participants. The transcripts were analysed using qualitative data analysis software (WeftQDA). The software enables passages of text to be manually tagged and indexed into one or more categories drawn from passage content. Category generation is an inductive process whereby recurring key words and/or themes are grouped together to facilitate the interpretation of large bodies of text (Wester & Peters, 2004). Following the conceptual framework and the research question, relevant variables were attributed to the material. Codes were used to describe the meaning of specific part of the material. Exploring the material was central in this phase of the analysis, which resulted in an unstructured list of codes. This list was refined throughout the research process.

In the defining phase we coded the material in a more specific and ordered way, according to which variable or concept the specific part of the material exemplified. Constant comparison played an important role in the analysis, with an emphasis on finding situations that could refine, confirm or correct earlier findings (Wester & Peters, 2004). Whereas at first data were compared with other data, at a later stage in the analysis data were compared with concepts and variables. This refined the development of central concepts. General patterns were then inferred from the comparison of the interviews and we chose representative quotes to highlight each specific concept. Data from the questionnaire were used to back up the inferred patterns from the focus group comparison.

3 Results

3.1 Motivation for becoming involved in stream monitoring

First, all respondents showed a general interest in environmental matters and their motivation to engage in freshwater monitoring came from their concern for the environment. The underlying causes for respondents' motivation showed a series of interconnected relationships with the environment, formed by a mixture of elements gained from past and present experiences such as career experience and recreational activities such as fly-fishing or tramping. An individual history of physical connection with the water appeared to play an important role for a future interest in environmental matter. Typical quotes include examples of experiences from recreational activities throughout their life, living or having lived close to a stream or parents that involved their children in environmental matters[2] [3] [4] [5] [6]. In all focus groups, respondents talked about their motivation to start monitoring because of its value in serving as a 'tool' or 'proof' to express their concern in a robust and constructive way[7] [8].

Second, respondents' careers seems to play an important role for being motivated to start monitoring. Of the thirty respondents (excluding the school group) nine respondents had or used to have an environment- or nature-related job, eight respondents had or used to have a natural science-related job and five had or used to have an education-related job. Among the 11 working respondents, eight were involved in the monitoring because the monitoring was part of or related to

[2] "I'm just trying to re-create my childhood playground. You see the biodiversity is so unique, so it is important to protect it and in a place like Auckland city, it is under threat the whole time. And people don't understand the value of nature and the creek" (focus group 9, female, [age category] >60, retired, pre-existing monitoring/restoration group)

[3] "My dad is a marine biologists. Ever since I was small I was involved with animals. And like, basically everybody in my family likes animals. I think that's what introduced me to animals" (focus group 8, male, <19, student, pre-existing monitoring/restoration group)

[4] "I've been tramping since I was a teenager so therefore I love our bush and our rivers and so an opportunity to do something positive and constructive" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[5] "When I was a teenager, you could drink any water of the stream. When it impacts your activities, you become very conscious. It needs to be protected and this was just a wonderful opportunity to be able to" (focus group 3, male, >60, retired, pre-existing restoration group)

[6] "I lived next to the stream for something like 25 years and I have seen it about the mid 1980 till around about 2000 going down, becoming very polluted and that worried me" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[7] "We all feel a strong connection to this area and we are all well aware that it is under threat. We were anxious about the pollution and so, you want to know why it is happening and what you can do about it. To know what is happening. It's why [there is pollution]" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[8] "People walking along the river have no idea about the health of the river. There is really poor information. Everybody just assumes that everything is okay, that nothing really goes wrong. And we know as a country that it's not the case. And we have to work proactively to maintain [the environment]" (focus group 2, female, 40-59, employed, new group)

their job[9] [10]. Having the knowledge or skills from their occupation motivated them to use them in another context.

Third, recreational activities formed an important motivating factor for engaging in community monitoring[11], or being in contact with the water made respondents aware of the value and the health of the water[12]. Finally, a sense of 'giving something back' to the community appears to be a motivator for getting engaged in community monitoring. Half of the respondents (n=17) were retired and eight of them saw their retirement as an opportunity to do 'their bit' for the community, now they have time[13].

3.2 Motivations for continuing monitoring in the long term

First, respondents' motivation to continue monitoring in the long term related to benefits on a personal level. In particular, the learning element of monitoring gave people personal enjoyment as expressed in eight of the nine focus groups[14] [15]. Expressions relating to being in contact with nature, or just 'being outside' were also mentioned in seven focus groups[16]. Also, the social aspect of the monitoring gave people personal enjoyment, as illustrated by other quotes, e.g., 21 and 25. And last, motivational factors for individuals centred around the collaboration and interaction with NIWA scientists. The opportunity to work with a professional body gave participants a sense of

[9] "My background is in data gathering anyway…. And I am quite happy gathering data" (focus group 3, male, >60, pre-existing restoration group)

[10] "I really liked it [the monitoring]. My degree is in ecology laboratory. I could understand it, I knew exactly what I was doing. Just get the thing and do it. My background is probably why I got interested in the first place" (focus group 5, female, 40-59, no professional occupation, pre-existing restoration group)

[11] "We are interested in the environment and water in particular because we all fly-fish" (focus group 7, female, >60, no professional occupation, new group)

[12] "I always do trout fishing. We spend a lot of time at the river. We walked with our dogs. I was really concerned about what they were putting in the river on the aquatic life. What effect it would have on the river and I saw it [the monitoring] as an opportunity [to change the situation]" (focus group 1, female, >60, retired, pre-existing monitoring/restoration group)

[13] "I have been retired for a while. You start to feel like, well I am not working, what can I do to do my bit for our community. That is part of it as well" (focus group 7, male, >60, retired, new group)

[14] "Just interesting little bits and pieces. It sort of expand your brains. You learn" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[15] "And we made our brains work, it was challenging. A feel good thing" (focus group 7, female, 40-59, employed, new group)

[16] "It was nice to see the stream, the trees to lose their leaves. It's nice to be there out in the early morning. Mist in the winter and sun in the summer. Good being outside. All sort of things. A reason for being out there, being part of nature and observing it. You also see things you wouldn't see otherwise. I guess one of the real positives. It's another part of a project that makes you more connected with nature" (focus group 9, male, >60, retired, pre-existing restoration group)

recognition[17] and pride[18] and the interaction with scientists gave participants the confidence to do the monitoring[19].

The factors motivating groups to continue monitoring in the long term differed somewhat from those of individuals. All six pre-existing groups expressed their motivation to continue monitoring because monitoring is a way to give more 'robustness' to their stream restoration activities[20] [21] [22]. This in turn is important to retain and empower volunteers[23]. Four existing groups also stated that monitoring data is important for writing reports for funding agencies.

3.3 Barriers and solutions to continuing monitoring in the long term

3.3.1 Barriers

In the focus groups, participants discussed barriers to continuing monitoring in the long term as well as solutions that would keep them motivated.

A main barrier for keeping motivated is the lack of avenues for using the monitoring data. The three newly-established groups, especially, reported on this barrier[24]. Keeping motivated also seems to depend strongly on the amount of interaction with a professional body. Having the confidence in doing the 'right' thing and removing suspicion of subjectivity appears to be very important for participants to keep motivated[25]. Another barrier for continuing monitoring in the long term is the

[17] "If we had input communication with the NIWA people, that encouraged us and kept us enthusiastic, so if that was missing then I think the groups could sort of. I think that is certainly a box to tick. Really helpful in maintaining the commitment of the group. To feel that it is appreciated. It is a recognition" (focus group 2, female, 40-59, employed, new group)

[18] "And to have time with NIWA scientists has been pretty cool too" (focus group 9, female, 20-39, employed, pre-existing restoration group)

[19] "And talk to [science staff] about things and… Understanding how the tests worked. I mean with the *E. coli* thing, you are able to learn how the tests worked. Which is good, good way of learning. How to use them. You need confidence in what you are doing, that you are doing the right thing" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[20] "to know what is happening [with the water quality]" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[21] "collecting the data allows you to see the changes over time. If you don't have any records, then you don't know" (focus group 9, female, >60, retired, pre-existing restoration group)

[22] "The water quality has improved, the data is pretty important in celebrating the successes" (focus group 9, female, >60, retired, pre-existing restoration group)

[23] "From my perspective it's [monitoring] really important to keep people involved, volunteers. If we didn't do monitoring we didn't have any results of what their achievements are. So you can see that the water quality is improved because of this and this and you have been part of the process of getting it from here to here. And I think you need to be able to give that information. It feeds back to people's work. As an encouragement of continuing what they were doing. And see that they are actually achieving something" (focus group 9, female, >60, retired, pre-existing restoration group)

[24] " it [their monitoring work] has to feed back". And "We don't want to just waste time. Our time is precious to all of us. The testing has to be for a reason" (both quotes focus group 7, male, >60, retired, new group)

[25] "When you are doing a job like that [monitoring], you want to know whether...we had no idea whether we were doing it [monitoring] right or wrong. You need confidence in what you are doing, that you are doing the right thing" (focus group 2, female, >60, retired, new group)

time investment in monitoring[26]. Also, monitoring is a rather 'abstract' activity compared to, for example, planting[27].

3.3.2 Solutions

Flowing from the motivational factors and barriers, all respondents put forward solutions that would keep them monitoring in the long term. The proposed solutions centre around the idea of developing networks involving multiple players who can provide support and interpret and implement the results of the monitoring[28]. Respondents identified both mutual support among monitoring groups[29] and scientific support from experts[30]. The idea of developing a wider context for supporting groups and networks helps to fulfil the desire of the participants to exchange stories and experiences out of interest and for keeping up best practices[31]. Developing better relationships among organisations would lead to efficiencies, which also appears to increase motivation[32].

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[26] "Planting is different from taking it back down to the monitoring project. That [monitoring] is quite an involvement in people's time. You go to a planting day and then you just go home. But with the monitoring you do have to do it every month on that particular day. It's not for everybody…you need a lot more commitment" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[27] "The tricky thing with water quality monitoring is that it does take a lot of time to see results. With planting, you see the result. People do not see a direct result of their work" (focus group 9, female, >60, retired, pre-existing restoration group)

[28] "I think whatever we do, we can't do it alone. It has got to be part of a wider perspective. Also the interpretation of the data, we can't do it. We want to know if we interpreted it in the right direction" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[29] "Support for networks, to be able to bring people together so that you can maintain best practice and exchange of stories and practices. If you are operating in different areas and you have a few visits from a school and they want to do it [monitoring] for the long term there has to be some mechanism to come back. Supporting networks are really helpful"(focus group 6, female, 20-39, employed, pre-existing monitoring/restoration group)

[30] "More guidance or training, more information. An expert that would say it [the right method], to have the confidence" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[31] "It might be quite useful to compare what we were doing with other groups. To have more contact with other groups…. If we could have, somehow a comparison with other groups. Just more information. Talking about a problem; we had this problem what would you do? And how were you doing it? They might have an idea that would help us with what we were doing. And it's nice to have contact with people who also like to do it. Also to see totally different environments. I mean we are in a city, and others could be in a totally different environment. We don't know anything about what they were doing, about their results and who they were. It would be interesting to know"(focus group 9, male, >60, retired, pre-existing restoration group)

[32] "One of the things I would like to see though, is that for the future, there is a number of people already monitoring in this stream. Regional council every month, there is another council for consent compliances and then us monitoring in the stream as well. It would be great to pull that all together and sit down maybe first and talk about what we do and then come to a sort of an agreement. There is different people monitoring for different reasons and we never see each other's results. It would be great to acknowledge to all work to a common aim. And we could for example monitor at different spots that are not seen as important for the regional council but are important for the whole system"(focus group 3, female, 40-59, employed, pre-existing restoration group)

Other benefits of networks

From different perspectives, respondents also described how a robust network of different stakeholders who work towards a common aim is important in achieving goals to improve the state of the environment[33].

Participants noticed the benefits of drawing upon each other's strengths, as described by one respondent who was able to expand the monitoring to include local schools because of the relationship-building as a result of the monitoring program[34]. In this example, the collaboration with NIWA gave the group more credibility when approaching organisations (e.g., funding organisations, media agencies, project partners with ideas and plans. On the other side, the community group can play an important role in realising ideas and plans of formal organisations, thereby pooling each other's strengths to achieve greater environmental outcomes. This idea was expressed by a respondent who works at an environmental institute, and therefore could also observe the situation from a formal organisation's point of view[35].

Ways to involve the wider community

A range of practical solutions to involving the wider community were suggested in all of the focus group discussions. These solutions arise from respondents' desire to share their knowledge and underlying practices with the wider community, or to make other people more aware of streams and the issues facing them[36] [37].

[33] "A whole lot of people marching in the same direction, drawing on each other's strengths. And I think also people like the regional council that we are good at as a little society is getting people to planting days. We have got the community connections, they want something done and we say we can do that for you, how can you help us? It's a win win for all of us" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[34] "... [realising expanding monitoring activities to schools] because the relationship that we have developed from NIWA and the regional council. We were meeting them each month. We formed a relationship with them. That's why it was easy for me to say, like I want to do this with the schools and to get them on board. It's a network"(focus group 7, female, 40-59, employed, new group)

[35] "You can be an environmental scientist and say we have a problem here and here, but when you have citizens involved, they can have a voice that you can't have as a scientist"(focus group 4, male, 40-59, employed, pre-existing restoration/monitoring group)

[36] "Another thing for me is that, 'okay, we have this data and how do we communicate it in a way that it is more accessible than just charts, we actually want more story telling of science. Arts and creativity to get it together and share the story in the community. A narrative, what it means" (focus group 5, female, 40-59, employed, pre-existing restoration group)

[37] "At the moment the only thing that is made public is the *E. coli* for swimming. There are other parameters people might want to know and if we explain what all the parameters do and are"(focus group 3, female, 40-59, employed, pre-existing restoration group)

3.4 Consequences of monitoring for environmental awareness, ecological knowledge, scientific literacy and social relationships

3.4.1 Scientific literacy

Participants did not tend to comment specifically on the scientific process during the focus group sessions. However, some clear signs of increased scientific literacy could be detected from the discussions, related to what they had learned about the science process from monitoring. Apart from the eight respondents who have, or used to have, a natural science related job, therefore being familiar with the scientific process already, in nearly all focus group discussions (n=8), respondents reported on 'getting the hang of' using scientific methods to measure water quality[38]. Eleven respondents expressed their enjoyment of conducting scientific research, and enjoyed noticing that they were increasingly learning about how to 'properly' measure water quality.

3.4.2 Ecological knowledge and environmental awareness

Though many participants had environmental knowledge from recreational activities, involvement in environmental stewardship activities, or even in-depth knowledge from their career, most had little specific knowledge on freshwater ecosystems when they began to participate in the program. We detected strong gains in freshwater ecosystem knowledge[39].

As mentioned previously (Section 3.1 Motivation), all respondents were environmentally sensitized prior to participating in the program. However, all focus groups revealed that the gained knowledge of freshwater ecosystems increased participants' awareness even more. In all discussions, participants reported on their acquired interest in the functional and living features of nature as a result of the monitoring which generated a new level of attention to freshwater[40]. Doing the monitoring, participants had to actively pay attention to the water and life in the water specifically. Things that people used to see in or around the water without being particularly interested were now given real attention[41]. The combination of their environmental awareness with personal empirical observations made participants' awareness more 'constructive', or robust as it relates to the functional features of nature, rather than for instance, only the aesthetic or emotional

[38] "First [the trainer] showed us the invertebrates and we all had to look at and identify them. It took me about 10 minutes to identify them, and I couldn't identify, but that was because I was looking at a stick. Now I can tell you what they are, so I came a long way to know what is a stick and what is an invertebrate. And I read online university papers on chemistry and one on water. Which I wouldn't have done if I hadn't being doing this" (focus group 7, female, 40-59, employed, new group)

[39] "Since I have been doing monitoring, you just think or you are aware of what is there [in the water]. And learning to identify species, and see them and you are like 'yeah I know what that is', that's interesting. It was interesting to see what's there" (focus group 5, female, 40-59, employed, pre-existing restoration group)

[40] "I look in the water now. It catches your eye. Definitely looking at stream habitat, definitely much more" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[41] "And we found much more bugs that we didn't know of. It made of much more aware of the bug life in the stream. It's amazing when you look at the stream, you think it's just water, but then when you look at the water in the tray and then suddenly it starts to move" (focus group 3, female, 40-59, employed, pre-existing restoration group)

connection to nature[42] [43]. Additionally, in eight of the nine focus group discussions, respondents showed capability of understanding the impacts on freshwater ecosystems and the wider environment. They used their generated knowledge to work out their own position (e.g., consumption choices), as well as the impact of society, in relation to the health of the environment [44]. One respondent reported increased attentiveness to freshwater issues in other contexts[45]. And in all focus group discussions participants highlighted freshwater issues, for instance: how dairy industry impacts could be better managed, how to divide responsibilities for managing streams among the stakeholders (including the community) and where and to what extent recreational activities (e.g., camping) should be allowed.

3.4.3 Social relationships

Because the monitoring takes place within the framework of social networks and within a social process, it has consequences for social relationships as well as for individuals.

First, this means that there is a *social process within the group*. In eight of the nine focus group discussions, respondents expressed enjoyment about working in a group with like-minded people[46]. Participants felt 'strong' as a team and in a group where shared understandings and joint action seemed to legitimize their beliefs[47]. Also, this social interaction within the group seemed to facilitate and empower individual learning. Respondents in seven of the nine focus group discussions expressed feeling more confident in doing their activities for the stream with other people[48]

Second, community monitoring takes place within the broader framework of social networks, in other words there is a *social process within the wider community*. The monitoring was a topic of conversation with neighbours, friends and family. While doing the monitoring, every group had been actively approached by other community members who were curious about what they were doing.

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[42] "The streams that we thought were clean they weren't as clean and wonderful as we thought. Especially with the *E. coli* and the nitrogen level. The fact that it looks clean doesn't necessarily means it's clean. The stream we are looking at are clean enough that the traits survive in them, but still it's quite a surprise to see what is there, when you think it looks good" (focus group 1, female, >60, retired, pre-existing monitoring/restoration group)

[43] "And you are doing it once a month so you do get the bigger picture of it then just going for a swim or walking along it every morning. And that's also that regular connection; a bigger picture through time as well" (focus group 5, female, 40-59, employed, pre-existing restoration group)

[44] "I fish those rivers, one of the things with fly-fish, you lift up stones and see what's there and you get an idea of the quality. But not as much as with sampling. And when you do monitoring, you really start thinking what the impacts on the stream are. I think you keep more an eye on it" (focus group 4, male, 40-59, employed, pre-existing restoration/monitoring group)

[45] "…this national water quality standard stuff that is often in the news; you have a better understanding about what they talk about. I think you take more notice of them as much as understanding, you sort of understand about water quality and cows in the stream" (focus group 9, male, >60, retired, pre-existing restoration group)

[46] "We were enjoying it as a group because we socialised around it, our Wednesday morning thing" (focus group 7, female, >60, retired, new group)

[47] "A lot of individuals can get nowhere but once people start getting proactive, there is obviously a positive outcome" (focus group 3, male, >60, retired, pre-existing restoration group).

[48] "Things like the comparison testing. We all had a look because it's a bit more objective. And then we agreed on something when all of us saw that. We kind of, we were all looking and we came to an agreement. We shared our answers and came to a conclusion" (focus group 2, female, 40-59, employed, new group)

Social interaction within the wider community was reinforced by respondents' (n=30) desire to share their knowledge and underlying practices[49] [50].

One respondent mentioned that the site of the monitoring functioned *"almost as a small forum, discussions that go on that come by the river that you wouldn't necessarily have otherwise*" (focus group 4, male, 40-59, employed, pre-existing monitoring/restoration group).

The six pre-existing groups had developed a stronger network over the years compared to the three newly established groups. They showed a stronger dissemination of beliefs and knowledge within the community and therefore their activities seemed to have a wider impact in terms of involving the wider community. Social exchange between different stakeholders in the community has built a network that can be mobilized to facilitate action. This helped in creating a wider context and meaning for the monitoring[51]. There were some clear examples where the pre-existing groups integrated community monitoring in their wider repertoire of activities such that monitoring was attributed meaning in the 'bigger picture' of improving the state of the environment[52].

The social process that revolves around the monitoring seems to function as a catalyst for the development or reinforcement of beliefs and practices, as people feel 'legitimised' and strong in a group. Additionally, the social interactions occurring in a wide network may mobilize a variety of people to collaboratively work towards the common aim of improving the state of the environment.

3.5 Spill-over to other practices

As mentioned earlier, the monitoring contributed to increased attentiveness to the water. This new level of attention triggered new ways of thinking about the water and the impacts on the water. Eight of the nine focus group discussions revealed that the combination of new knowledge and increased awareness motivates people to engage more in environmental stewardship practices. One respondent stated that because of the monitoring she got engaged in another environmental initiative.

Another example of a spill-over practice is one respondent's interest in university papers on chemistry and water as illustrated in quote 13. Furthermore, six of the nine groups expanded their monitoring practices, together with other stakeholders, to schools. Participants used the knowledge

[49] "Lots of people care, but when we have been at the site we had people, when we were getting the bugs and the insects, and the people were really interested in what we were doing when walking by. Wow, that's great, great you are doing that. Those are the people who live in the area. They were really pleased to see that people were doing this" (focus group 1, female, >60, retired, pre-existing monitoring/restoration group)

[50] "You meet people all the time. And they say 'you are doing a great job, keep up the good work. It has been a really good community based thing. We have been living in this area for about 28 years. And we are meeting neighbours that we haven't met before"(focus group 5, female, >60, retired, pre-existing restoration group)

[51] "A whole lot of people marching in the same direction, drawing on each other's' strengths. And I think also people like the regional council that we are good at as a little society is getting people to planting days. We have got the community connections, they want something done and we say we can do that for you, how can you help us? It's a win win for all of us" (focus group 3, female, 40-59, employed, pre-existing restoration group)

[52] "Everybody, it's not only about planting, if people want to do a study on insects then they are more than happy to. It depends on what they want to do. It's all contributing to the overall" (focus group 3, female, 40-59, employed, pre-existing restoration group)

acquired from monitoring to train teachers and children. In all discussions, the importance of children being in contact with nature was emphasized[53] [54]. Drawing upon their own individual history that sensitized them to the environment, many participants see this contact as a way for the new generation to understand the value of nature. As well as schools, respondents in all focus groups reported on pro-actively engaging the wider community in environmental stewardship practices.

A difference in the extent of spill-over practices can be detected between the pre-existing groups and the newly established groups. The pre-existing groups had a stronger sense of mission and had a stronger network, and therefore their monitoring practices seemed to have a wider impact in community. Their shared beliefs and knowledge from previous experiences allowed them to understand the value of monitoring and integrate it in other practices better compared to 'younger' groups. The stream restoration groups integrated the monitoring in their repertoire of stream restoration activities and extended the monitoring to other contexts. In contrast, the new groups struggled to understand the purpose of monitoring[55].

In nearly all focus group discussion, participants expressed their increased confidence to 'stand up' for their stream based on the acquired knowledge on freshwater ecosystems. For some participants, the acquired knowledge on freshwater ecosystems increased their likelihood of engaging in freshwater planning. However, they also expressed their concern about investing time in an additional activity (a freshwater planning stakeholder group) on top of their existing stream monitoring and restoration practices. Engagement in future practices also seems to depend on the strength of an individual's relationship with the environment. The stronger the relationship with the environment (based on a variety of motivations) the higher the chance these intrinsic motivations may contribute to the internalisation of pro-conservation behaviour, or the engagement in freshwater planning.

3.6 Feedback on SHMAK

Based on their experience with using the monitoring kit (which was based on NIWA's SHMAK kit, with some additions), all respondents gave feedback on the kit.

[53] "It's not sort of part of normal life anymore [being outside in nature], especially in Auckland to hang out in the stream, so I think it's really important that is stays part of kids' experience"(focus group 9, male, >60, retired, pre-existing restoration group)

[54] "People have to be resourced. We are finding the young kids that we have taught [in monitoring] are entering the sciences in those fields. There may be a generational thing happening there, that's why it's so important with the young kids, even though they don't go on there that path, they have the skills and they will draw upon the experiences" (focus group 6, male, >60, employed, pre-existing monitoring/restoration group)

[55] "We don't want to just waste time. Our time is precious to all of us. The testing has to be for a reason" (focus group 7, male, >60, retired, new group)

Measuring pH with the indicator strips and nitrate with the chemical test kit were considered to be too open for interpretation. Better instructions were required, responding to the difficulties people encountered using the kits[56] [57].

Measuring *E. coli* was considered an involved and challenging task. All participants agreed that the instructions (which included both an instructional video and written instructions) were very clear. However, depending on participants' interest they either very much enjoyed doing this challenging task, or they found it too much effort. One of the respondents suggested using a spare room to conduct all the steps, as it is a precise work and that involves many steps.

Most feedback was put forward for identifying invertebrates. First, in eight of the nine focus groups, respondents reported that they found the invertebrate identification the most interesting aspect, as they could clearly connect it to the health of the stream. Most feedback centred around the fact that identifying the invertebrates was too time-consuming. Alongside the time issue, responses included; "*it was just complex*", "*we bended so long that we had stiff necks*", "*you have to be patient*" and "*it is a lot of guess work*". Some respondents suggested making the identifying activity more ergonomically-friendly and many would prefer to record only presence/absence rather than abundance. One respondent suggested refining the equipment[58].

Measuring periphyton was considered too subjective by eight of the nine groups. As one respondent explains: "*What you call sludge, I call it … you know"* (focus group 3, female, 40-59, employed, pre-existing restoration group). A suggested solution involved making clear and simple indicators[59].

[56] "… colour comparing, the strips we were using. If you put them [the colour comparing strips] in the water for a minute which is what they suggest you do and you pull it out and read it straight away you get a really incorrect reading. You have to sit and wait for a few minutes because it changes the whole time. And where do you put it? All the rubbish can get on it and it changes all the time. Far too open for interpretation" (focus group 3, male, >60, retired, pre-existing restoration group)

[57] "The little spoon that you pick up. The problem is that you can just dip in it and pick it up or you can dip it on and sort of squeeze it on the side of the container. There are several ways you can pick the stuff up. Also it sticks to the spoon, and sometimes then it won't dissolve. The replacement one was fine" (focus group 1, female, >60, retired, pre-existing monitoring/restoration group)

[58] "In the white tray we use for the invertebrates you use a ring. It's very difficult to get the ring on the firm plastic because of the gravel and make sure the invertebrates can't come in and out. So I would make a thicker one, so that it is hanging over the top so you can grab on to it and let it down firmly on the plastic. Make a thicker ring with a good sharp edge on the bottom" (focus group 4, male, 40-59, employed, pre-existing monitoring/restoration group)

[59] "An example of an indicator: scratch the rock and if you have it under your nails it is periphyton, a clear handling. If it sits on the rock its sludge, if it's there then its sediment etc." (focus group 3, female, 40-59, employed, pre-existing restoration group)

4 Discussion

4.1 Motivations for beginning and continuing in freshwater monitoring

We found that environmental concern is a key motivational factor to engage in environmental monitoring, consistent with previous studies (Evans et al. 2005; Cosquer et al. 2012; Hobbs & White, 2012). Our participants developed a unique set of skills, beliefs, knowledge and understandings through time, developed from past and present experiences, which were necessary to become a 'carrier' of a certain practice. Our findings agree with others' (e.g., Shove and Pantzar, 2005 Thøgersen & Crompton, 2009; Cosquer et al. 2012) that the underlying causes for people's motivation can be a mixture of diverse factors including history, location, recreation and career background. Experiences can provide people with skills, understanding and motivation that could be the underlying cause for engaging in a certain practice (Thøgersen & Crompton, 2009).

Motivations for continuing monitoring long-term involved a combination of new (acquired through the monitoring) and existing elements. Some people enjoyed being in contact with nature, and the activities associated with being outside, as found by Hobbs & White (2012). Undertaking nature recording is linked to health and wellbeing benefits and stress relief (Hobbs & White, 2012). Learning from results for the bigger picture as well as learning on a local scale can give participants enjoyment (Hobbs & White, 2012; Peters et al. 2015a). Additionally, the rigidity of the scientific process can give many individuals a sense of purpose that allowed them an excuse to do an activity that they already enjoyed (Hobbs & White, 2012). Like previous studies, we found participants enjoyed social benefits enjoyed through communication with like-minded people (Evans et al. 2005; Cosquer et al. 2012), and 'giving something back' to the community (Hobbs & White, 2012).

Many citizens are also motivated by the hope of influencing local policy and decision-making processes through sharing of collected data (Milne et al. 2006; Conrad & Daoust, 2008). In a study of macro-invertebrate monitoring in the United States, 19 percent of participants surveyed indicated that they considered influencing policies and legislation to be a main goal of their monitoring programme (Nerbonne & Nelson, 2008). When asked about the reasons for monitoring, nearly one third indicated influencing local planning decisions and providing data for adding their stream to the list of impaired streams (Nerbonne & Nelson, 2008). Among environmental NGOs across Canada, one third of respondents indicated influencing decision-making was the most meaningful way to engage volunteers in monitoring (Kebo and Bunch, 2013). Similarly (as we also showed), volunteers engaged in community water monitoring can lose motivation and experience burnout when there is a lack of a wider context, e.g., when the community monitoring data is not linked to management (the trap of "monitoring for the sake of monitoring"; Sharpe and Conrad, 2006). In our study, monitoring gave participants evidence to support their environmental concern, providing them with basic facts about the impacts on their stream which enabled them to act. Our study complements Nerbonne and Nelson (2008) by describing the different motivations and types engagement underlying the aim of influencing policies and legislation. However, in contrast to Nerbonne and Nelson (2008) and Kebo and Bunch (2013), the main goal of monitoring for our participants was realising a healthy stream and increasing the community's appreciation for the environment. For some participants this might involve influencing policies by joining freshwater management stakeholder group, whereas for others it would involve communicating beliefs, practices and monitoring outcomes through the wider community, or restoring a stream for its own sake and to make the stream and its surrounding more appealing for people to visit and appreciate.

We showed that as well as individual motivation, contextual factors such as social and technical aspects are crucial to enable community monitoring. Others (Spaargaren & Van Vliet, 2000; Shove et al. 2012) have also shown that resources and infrastructure play a key role in shaping the practice of monitoring. Having newly-formed as well as pre-existing groups in our sample allowed us to account for the influence of social capital, that pre-existing groups had developed over time, on the existence and growth of community monitoring. We showed that people operating in an isolated group faced difficulties with making sense of the monitoring and to some extent lacked the experience, skills and resources to expand or place monitoring in a wider context. This confirms findings of previous studies that citizens engaged in community monitoring can face many resource and social capital related challenges (Milne et al. 2006; Peters et al. 2015a). By contrast, operating within a social network, trust and the norms of reciprocity enable resource exchange with project partners and the wider context allows participants to make more sense of the monitoring activity (seeing the result of their restoration work, building partnerships and retaining their volunteers).

Based on insights such as those above, several studies recommend ways to increase the potential of community monitoring. In a study on the use and value of citizen science data in New Zealand, interviewees (government agencies and community volunteers) put forward a range of solutions for developing and implementing robust monitoring programmes (Peters et al. 2015a). They emphasised the importance of strong networks for supporting groups. For progressing community monitoring, their solutions centred on cohesive long-term support from resource management agencies by increasing groups' capacity for carrying out science. Effective partnerships appeared to be critical for sustaining groups' activities in the long term as many groups require technical, administrative and operational support in order to build group capacity and achieve their project objectives (Peters et al. 2015b). An example of a proposed solution was to have a 'science advisor' for groups (Peters et al. 2015a). Evans et al. (2005) describe how interactions with scientists seem to empower citizens by making them feel like they were important partners in the research process. These recommendations contribute to retaining volunteers as it is key for volunteers to know they are part of "the bigger picture" (Evans et al. 2005; Hobbs & White, 2012) and to know that their work is "making a difference" (Thody, Held, Johnson, & Marcus, n.d.), and that they are not just "monitoring fort the sake of monitoring" (Thody et al. n.d.). All studies have shown that monitoring is highly resource intensive for any party involved, and requires a high amount of social capital to maintain consistent, quality data records (Danielsen et al. 2005).

4.2 Consequences of monitoring for environmental awareness, scientific literacy, engagement in freshwater issues, social relationships and spill-over practices

We showed that repeated monitoring can be an important way of increasing knowledge, awareness and attentiveness regarding the local freshwater environment. We showed that after the monitoring, people took more interest in the living or functional characteristics of their local environment. We found that actively paying attention to the water created a self-perpetuating cycle: the more understanding participants had of freshwater ecosystems the more attention they paid, which in turn improved their understanding. In addition, participants' personal empirical observations of the stream and the life in it made their previous knowledge and awareness more robust as it related to the functional aspects of nature, rather than for instance, only aesthetic aspects or emotional connection (Ross, Medin, Coley, & Atran, 2003). Having even limited scientific knowledge has an important place in evaluating the human impact on ecosystems.

We noted an increase in understanding of science among participants who had no formal scientific training. Other studies have found that in community monitoring, sharing data between experts and non-experts resulted in increased scientific literacy for the public and awareness among scientists of community concerns, contributing to the democratization of science (Conrad and Hilchey, 2011).

The consequences for participants in citizen science activities in terms of scientific literacy, skills, environmental awareness and ecological knowledge are interrelated and show many feedback loops (Evans et al. 2005). Evans et al. (2005) and Kraseny & Bonney (2005) showed that, regardless of their level of education, community members who participated in two bird monitoring programmes gained ecological knowledge and some participants showed some clear examples of scientific thinking. Participants of the Neighbourhood Nestwatch programme (Evans et al. 2005) came to view their property differently. By making detailed observations, participants felt more connected to their backyard birds, and their levels of concern about the welfare of the birds increased. Hence, nearly all participants increased their awareness of the birds and habitat in their backyard and some participants showed a totally new level of attention.

We also found some evidence that as well as increasing attentiveness to local ecosystems, monitoring increased participants' awareness of local environmental issues, as found by Evans et al. (2005). Through the monitoring, our participants appeared to be 'primed' to pay attention to freshwater issues in the news. Further, their acquired knowledge stimulated reflection on freshwater issues, for instance: how dairy industry impacts could be better managed, how to divide responsibilities for managing streams among the stakeholders (including the community) and where and to what extent recreational activities near streams (e.g., camping) should be allowed.

As well as benefits to individuals, participating in a citizen science programme may have significant benefits for social relationships (Evans et al. 2005; Cosquer et al. 2012, Hobbs & White 2012; Peters et al. 2015a). Evans et al. (2005), for example, found that when monitoring is involved in environmental management, it can contribute to empowerment and increased social capital (including trust). Cosquer et al. (2012) found that participating long-term in a butterfly monitoring programme gave participants a feeling of belonging to a community.

The ideas, beliefs, knowledge and skills that develop from attentive and repeated monitoring can lead to initiating or supporting new practices (Cosquer et al. 2012). Adopting one pro-environmental practice can increase the skills and knowledge necessary to adopt another related practice, or facilitate learning about environmental problems (Thøgersen and Crompton 2009). These practices may include advocacy (spreading beliefs and knowledge through the wider community by newspaper articles, websites), passing on monitoring training to others, integrating new ideas into participants' social relationships and additional activities in or around the stream like recreation or stream restoration practices.

We showed that through monitoring, participants develop more robust knowledge to give interpretation to their environmental concern in a more constructive way. Having this knowledge, people feel the desire to share their experiences and the underlying practices with the wider community and integrate these new ideas and knowledge into the different social relationships that revolve around their environment. Again, a social network contributes to disseminating ideas and knowledge into the wider community as it helps to make sense of the monitoring and increases the capacity of groups to do so. Operating in a local, familiar context also seems to be important. Participants' attentiveness to freshwater combines with everyday occupations and thoughts which may reinforce the personal construction of knowledge and action in one's familiar setting. This is

consistent with previous studies that highlight the importance of the local and familiar setting of citizen science programmes for stimulating pro-conservation behaviour on a local scale (Cosquer et al. 2012). Evans et al. (2005) argue that attachment to an ecological 'place' and understanding the local environment are vital for taking local action and active participation in the community. Therefore, monitoring could be a valuable means of locals 'owning' and caring for their stream and its catchment and creating a more informed public that appreciates science and support, or initiate local conservation laws.

5 Conclusions

Our findings offer a contribution to the citizen-science field from the perspective of the community volunteers. This study is unique in that it involved three different types of community groups (three new groups, three pre-existing restoration groups and three pre-existing monitoring/restoration groups) who all had been participating in the same freshwater monitoring programme. This allowed us to account for the influence of social capital, that pre-existing groups were more able to develop over the years, as well as experience in environmental advocacy. We have shown that past and present experiences play an important role in being motivated to engage in monitoring in the first place, for community monitoring to exist and grow, and the initiation and support for new practices. We have shown the importance of reciprocal activities within social networks to build trust, facilitate action, realize resource efficiencies and achieve greater environmental outcomes. Working within a strong social network fosters, and brings along the skills and ideas that foster the conditions in which monitoring- and other related practices can exist and grow.

6 Recommendations for supporting community monitoring

Because community-based freshwater monitoring involves a unique combination of scientific, education and resource management objectives, it requires innovative technical tools, motivational recruitment strategies, and new management techniques to survive and grow. Based on the analysis above, we recommend the following to develop a sustainable and effective system of community-based freshwater monitoring in New Zealand:

1. **Give excellent training**

   Training is important to improve the quality of volunteer data, but also to give participants the confidence they are doing 'the right thing', thereby decreasing volunteer burnout. Training media (e.g., videos) can provide a cost-effective means to train a large number of participants as well as giving community groups the resources to train other groups, expanding the monitoring network. However, media and resources lack the relationship-building benefits (see below) that face-to-face training provides. If training media are used as an alternative to face-to-face training, it is essential that the media involve video or animations that allow participants to observe how 'the expert' handles the material and makes decisions during the process. Training instructions must be very basic and easy to understand in order to enable public participation.

2. **Provide citizen scientists with feedback on their data, its context and interpretation**

   Providing citizen scientists with feedback on their results is crucial in maintaining their motivation to continue monitoring in the long term. Personal feedback through face-to-face contact, reports or e-mails has the value of encouraging community groups and providing opportunities for discussion. However, context and basic interpretation could be provided by easily accessible tools such as online platforms or smartphones apps. Online platforms can provide immediate feedback, e.g., as graphs that show the results of the work over time or in the context of other monitoring sites.

3. **Share results with the wider community**

   Sharing the results with the wider community is another important means of keeping volunteers motivated. Volunteers are strongly motivated by a sense of 'making a difference', which requires having their results seen by the community and especially by decision-makers. In addition, by presenting the results in a form that interests and is understood by the public, the wider community could be made more attentive to freshwater issues. For example, connecting basic water quality information to familiar, appealing aspects such as fishing, swimming, or valued species may be effective; or 'storytelling' of the groups' experiences and activities. A regular column in a local newspaper or council newsheet, which reports on local environmental monitoring and trends may motivate monitoring groups.

4. **Develop an online community**

   An online forum for communication among participants within and between regions can fulfil their desire to compare results, share experiences, ask questions of each other and experts, and exchange best practices. An online community can help meet people's desire to work with like-

minded people towards a common aim, thereby strengthening their values and beliefs. Belonging to a community strengthens the conditions in which new ideas, beliefs and modes of action are formed (Cosquer et al. 2012).

5. Foster local leadership

For community monitoring to survive and to grow, local leadership is crucial. There must be a core of participants with advanced levels of experience to provide local leadership. Leaders who have a clear sense of mission and are willing to invest time in environmental advocacy initiatives should be considered very valuable as giving a purpose to the monitoring maintains the motivation of volunteers and increases interest from the wider community.

6. Build wide networks to combine strengths and resources

Embedding monitoring within networks that include multiple agencies and stakeholders is important in order to unlock and maintain the available energy within the community. Working within such a network increases the potential that different people will find an activity that fits their interest, while still working towards a common aim. Investing in collaboration structures for ongoing communication and sharing of resources may lead to better environment outcomes by:

- building trust between different stakeholders
- creating resourcing efficiencies
- facilitating action.

Community groups often provide a first point of call for community members who want to engage in environmental activities. Additionally, their voluntary, 'grass-roots' character can sometimes produce greater good-will from other stakeholders than is achieved by government agencies. Government agencies and science institutions, on the other hand, can help to increase community groups' capacity for carrying out environmental or science related activities.

7. Build institutional leadership

As today a variety of groups and individuals carry out monitoring, achieving region wide or nationwide benefits of monitoring requires cohesion and shared objectives among volunteer monitors. This requires new leadership and ongoing support by local and central government and science institutions.

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8 References

Arnstein, S.R. (1969) A ladder of citizen participation. *Journal of the American Institute of planners*, 35(4): 216-224.

Au, J., Bagchi, P., Chen, B., Martinez, R., Dudley, S., Sorger, G. (2000) Methodology for public monitoring of total coliforms, Escherichia coli and toxicity in waterways by Canadian high school students. *Journal of Environmental Management*, 58(3): 213-230.

Biggs, B., Kilroy, C., Mulcock, C. (1998) New Zealand stream monitoring and assessment kit: Stream monitoring manual, version 1. *NIWA Technical Report 40*, NIWA Technical Report 40: 150. http://www.niwa.co.nz/sites/default/files/import/attachments/peri_complete.pdf

Bögeholz, S. (2006) Nature experience and its importance for environmental knowledge, values and action: Recent German empirical contributions. *Environmental education research*, 12(1): 65-84.

Bonney, R., Ballard, H., Jordan, R., McCallie, E., Phillips, T., Shirk, J., Wilderman, C.C. (2009) Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education. A CAISE Inquiry Group Report. *Online Submission*.

Brossard, D., Lewenstein, B., Bonney, R. (2005) Scientific knowledge and attitude change: The impact of a citizen science project. *International Journal of Science Education*, 27(9): 1099-1121.

Buckland-Nicks, A. (2015) Keys to Success: A Case Study Approach to Understanding Community-Based Water Monitoring Uptake in Governmental Decision-Making. Dalhousie University, Halifax, Nova Scotia, Canada: 214.

Canfield Jr, D.E., Brown, C.D., Bachmann, R.W., Hoyer, M.V. (2002) Volunteer lake monitoring: testing the reliability of data collected by the Florida LAKEWATCH program. *Lake and Reservoir Management*, 18(1): 1-9.

Carolan, M.S. (2006) Science, expertise, and the democratization of the decision-making process. *Society and Natural Resources*, 19(7): 661-668.

Carr, A.J.L. (2004) Why do we all need community science? *Society & Natural Resources*.

Collins, H.M., Evans, R. (2002) The third wave of science studies of expertise and experience. *Social studies of science*, 32(2): 235-296.

Conrad, C.C., Hilchey, K.G. (2011) A review of citizen science and community-based environmental monitoring: issues and opportunities. *Environmental Monitoring and Assessment*, 176(1-4): 273-291.

Conrad, C.T., Daoust, T. (2008) Community-based monitoring frameworks: Increasing the effectiveness of environmental stewardship. *Environmental Management*, 41(3): 358-366.

Cooper, C.B., Dickinson, J., Phillips, T., Bonney, R. (2007) Citizen science as a tool for conservation in residential ecosystems. *Ecology and Society*, 12(2): 11.

Cosquer, A., Raymond, R., Prevot-Julliard, A.-C. (2012) Observations of everyday biodiversity: a new perspective for conservation? *Ecology and Society*, 17(4): 2.

Cuthill, M. (2000) An interpretive approach to developing volunteer-based coastal monitoring programmes. *Local Environment*, 5(2): 127-137.

Danielsen, F., Burgess, N.D., Balmford, A. (2005) Monitoring matters: examining the potential of locally-based approaches. *Biodiversity & Conservation*, 14(11): 2507-2542.

Devictor, V., Whittaker, R.J., Beltrame, C. (2010) Beyond scarcity: citizen science programmes as useful tools for conservation biogeography. *Diversity and distributions*, 16(3): 354-362.

Evans, C., Abrams, E., Reitsma, R., Roux, K., Salmonsen, L., Marra, P.P. (2005) The Neighbourhood Nestwatch Program: Participant Outcomes of a Citizen-Science Ecological Research Project. *Conservation Biology*, 19(3): 589-594.

Fore, L.S., Paulsen, K., O'Laughlin, K. (2001) Assessing the performance of volunteers in monitoring streams. *Freshwater Biology*, 46(1): 109-123.

Geczi, E. (2007) Sustainability and public participation: Toward an inclusive model of democracy. *Administrative Theory & Praxis*, 29(3): 375-393.

Hobbs, S.J., White, P.C. (2012) Motivations and barriers in relation to community participation in biodiversity recording. *Journal for Nature Conservation*, 20(6): 364-373.

Kals, E., Schumacher, D., Montada, L. (1999) Emotional affinity toward nature as a motivational basis to protect nature. *Environment and behaviour*, 31(2): 178-202.

Kebo, S., Bunch, M.J. (2013) Canadian ENGOs in governance of water resources: information needs and monitoring practices. *Environmental Monitoring and Assessment*, 185(11): 9451-9460.

Ketelaar, P.E., Hentenaar, F., Kooter, M. (2011) *Groepen in focus: In vier stappen naar toegepast focusgroeponderzoek*. Den Haag: Boom Lemma.

Krasny, M., Bonney, R. (2005) Environmental education through citizen science and participatory action research. *Environmental education and advocacy: changing perspectives of ecology and education. Cambridge University Press, Cambridge*: 292-320.

Land and Water Forum (2012) Second report of the Land and Water Forum: Setting limits for water quality and quantity, and freshwater policy and plan-making through collaboration. Land and Water Trust, Wellington: 94. http://www.landandwater.org.nz/

Milne, R., Rosolen, S., Whitelaw, G., Bennett, L. (2006) Multi-party monitoring in Ontario: Challenges and emerging solutions. *Environments*, 34(1): 11.

Ministry of Business Innovation and Employment and Ministry for Education (2014) A Nation of Curious Minds. *A national strategic plan for science in society.* July 2014.

MFE (Ministry for the Environment) (2013) Freshwater reform 2013 and beyond. Wellington: Ministry for the Environment.

MFE (Ministry for the Environment) (2014) National Policy Statement for Freshwater Management. Wellington: Ministry for the Environment.

Nerbonne, J.F., Nelson, K.C. (2008) Volunteer Macroinvertebrate Monitoring: Tensions Among Group Goals, Data Quality, and Outcomes. *Environmental Management*, 42(3): 470-479. 10.1007/s00267-008-9103-9

Peters, M., Eames, C., Hamilton, D. (2015a) The use and value of citizen science data in New Zealand. *Journal of the Royal Society of New Zealand*, 45(3): 151-160.

Peters, M.A., Hamilton, D., Eames, C. (2015b) Action on the ground: A review of community environmental groups' restoration objectives, activities and partnerships in New Zealand. *New Zealand Journal of Ecology*, 39(2): 179.

Ross, N., Medin, D., Coley, J.D., Atran, S. (2003) Cultural and experiential differences in the development of folk biological induction. *Cognitive Development*, 18(1): 25-47.

Schultz, P. (2011) Conservation means behaviour. *Conservation Biology*, 25(6): 1080-1083.

Sharpe, A., Conrad, C. (2006) Community Based Ecological Monitoring in Nova Scotia: Challenges and Opportunities. *Environmental Monitoring and Assessment*, 113(1): 395-409. 10.1007/s10661-005-9091-7

Shelton, A.M. (2013) The accuracy of water quality monitoring data: a comparison between citizen scientists and professionals. Saint Mary's University, Halifax, Nova Scotia, Canada.

Sheppard, S.A., Terveen, L. (2011) Quality is a verb: the operationalization of data quality in a citizen science community. *Proceedings of the 7th International Symposium on Wikis and Open Collaboration*.

Shove, E., Pantzar, M. (2005) Consumers, Producers and Practices Understanding the invention and reinvention of Nordic walking. *Journal of consumer culture*, 5(1): 43-64.

Shove, E., Pantzar, M., Watson, M. (2012) *The dynamics of social practice: everyday life and how it changes*. Sage Publications.

Spaargaren, G., Van Vliet, B. (2000) Lifestyles, consumption and the environment: The ecological modernization of domestic consumption. *Environmental Politics*, 9(1): 50-76.

Storey, R., Kin, E., Wright-Stow, A.E., Davies-Colley, R., Stott, R. (in review) Reliability of community-based monitoring data: a basis for increased community involvement in freshwater decision-making.

Thody, C.M., Held, R.J., Johnson, R.J., Marcus, J.F. Grassroots Conservation: Volunteers Contribute to Projects and Foster a Supportive Public.

Thøgersen, J., Crompton, T. (2009) Simple and painless? The limitations of spill over in environmental campaigning. *Journal of Consumer Policy*, 32(2): 141-163.

United Nations Conference on Environment and Development (UNCED) (1992) Agenda 21: The United Nations programme of action from Rio. Retrieved from http://www.freedomadvocates.org/download/research/agenda21/Agenda21-Earth%20Summit-The%20United%20Nations%20Programme%20of%20Action%20From%20Rio.pdf

Wester, F.P.J., Peters, V.A.M. (2004) *Kwalitatieve analyse: uitgangspunten en procedures*. Coutinho Bussum.

Wester, F.P.J., Renckstorf, K., Scheepers, P.L.H. (2006) *Onderzoekstypen in de communicatiewetenschap*. Alphen aan den Rijn: Kluwer.

Whitelaw, G., Vaughan, H., Craig, B., Atkinson, D. (2003) Establishing the Canadian community monitoring network. *Environmental Monitoring and Assessment*, 88(1-3): 409-418.

Appendix A Public participation in decision-making

Decision-making involving complex environmental issues needs to take public concerns and stakeholder views into consideration in order for it to achieve desired results. Public participation is seen as key to sustainable development (Geczi, 2007; UNCED, 1992) and can act to redistribute power by including citizens in priority setting, policy development, and other processes affecting their future (Arnstein, 1969). Public participation in environmental governance involves the contribution of knowledge as well as involvement in the decision-making itself. The basis on which the public contributes knowledge (e.g., through citizen science) can vary greatly, according to three main types of governance (Conrad and Hilchey 2011): (1) consultative or functional governance, where the public contributes knowledge requested by the government that makes decisions. The purpose of community-based monitoring is to provide early detection of issues of environmental concern, which can then be investigated by scientific experts (most often government) (Whitelaw et al. 2003; Conrad and Daoust 2008); (2) collaborative governance, where the public works with government to decide what knowledge is needed and also contributes this knowledge. The monitoring itself is often governed by a board or group representing as many facets of the community as possible: private landowners, the general public, businesses, government, universities, etc. Many catchment authorities or councils in Canada and USA are governed in this way by multi-party organisations; (3) transformative governance, which is community-led with varying levels of input from partners. Typically the monitoring group is formed out of a crisis, and focuses on a specific issue with the hopes of initiating government action. The transformative model involves the community in every stage of the monitoring program, from defining the problem through communicating the results and taking action. In this case, the role of the scientist is to advise and guide community groups rather than to set their agendas

These types of governance structures reflect a range from 'top-down' to 'bottom-up' structures, where citizens become increasingly involved in governance. Community monitoring connected to local management and action can lead to community empowerment (Danielsen et al. 2005) and stronger partnerships between community groups and their project stakeholders, including scientists (Carr, 2004). At the same time, participants may broaden their skills in fieldwork and increase their environmental knowledge (Conrad & Hilchey 2011). In this setting, participants may be empowered to carry out scientific studies in contrast to contributory forms of citizen science where participation is mostly limited to the provision of data. Pros and cons have been suggested for all three governance structures, with most positives being associated with collaborative governance. However, there is there is evidence that ". . . long-term economic and environmental success [comes about] when people's ideas and knowledge are valued, and power is given to them to make decisions independently of external agencies" (Pretty et al. 1995, p. 60; cited in Conrad and Hilchey 2011).

Whether public participation happens through top-down or bottom up governance structures, the inclusion of community stakeholders can lead to decision making that is more informed and locally relevant (Carolan, 2006) The inclusion of community stakeholders is also recognized in the United Nation's Agenda 21 which recommends that local communities should be consulted and included in making decisions about the uses of local natural resources. By including communities in the decision making process, design and implementation phases of water management and planning, they gain knowledge and a sense of power that enables and encourages them to take charge of their environment including its uses and values (Cuthill, 2000).

Increased public participation enables the consideration of facts and information beyond science in decision making, which is especially important in the face of complex and uncertain problems (Carolan, 2006). Collins and Evans (2002) describe the role of interactional expertise in promoting greater contributions from the public to decision making processes, for example by informing experts of local knowledge or the public of scientific knowledge. Involving citizens in both the collection of scientific information and participatory processes is one such way to start bridging the gap between science, public participation, and decision making.

Appendix B Questionnaire

General Information

- Name:
- Age: ☐ <19 ☐ 20-39 ☐ 40-59 ☐ >60
- Gender:
- (Previous) Occupation:

1. What is the name of the site/stream where you do the monitoring?
2. For how many years have you lived in this area?
3. How many group members participate on an average monitoring day?
4. For how long have you been involved in the community monitoring group?
5. How did you get involved in the community monitoring group?

6. Have you previously been involved in groups related to or similar to the community monitoring group?

   Yes ☐ No ☐

   If you answered 'yes' to the question above:

   What groups have you been involved with?

7. Did you have a connection with the stream/site **prior** to your involvement in the community monitoring group?

   Yes ☐ No ☐

   If you answered 'no' to the question above, skip question 8 and continue from question 9.

8. Please indicate to what extent you disagree or agree with the following options

   Your connection with the site/stream originates from:

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Comments
Occupation						
Recreational activities						

Environmental activities (voluntarily)						
Close proximity of the stream to my house						
Other:						

9. What motivated you to become involved in NIWA's community monitoring study? **The desire to …**

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Comments
Contribute to data collection						
To learn more about freshwater						
To learn more about the local environment						
To contribute to the environment						
Other:						

10. Please indicate to what extent you disagree or agree with the following options. I gained knowledge **prior** to the monitoring study about natural freshwater ecosystems through the following activities:

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Comments
Occupation						

Recreational activities						
Environmental activities (voluntarily)						
Close proximity of the stream to my house						
Other:						

11. My knowledge on natural freshwater ecosystems increased after participating in the monitoring study

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

12. I am familiar with scientific thinking and methods…

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Comments (optional)
Prior to participating in the program						
After participating in the program						

13. - Participating in the community monitoring group strengthened my connection with the stream/site

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

- Participating in the community monitoring group made me think more about the stream/site

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

- Participating in the community monitoring group made me talk more about the stream/site with other people

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

- Participating in the community monitoring group increased my level of activities for, on or around the stream/site, apart from the monitoring study

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

14. Based on my experiences with the community monitoring group, I will continue monitoring in the long term

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

15. The following statements are about possible support from the regional council and/or scientists. Please indicate to what extent you disagree or agree

- I value encouragement from regional council staff in order to continue monitoring in the long term

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

- I value encouragement from scientists in order to continue monitoring in the long term

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

- I value face to face contact with regional council staff in order to continue monitoring in the long term

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

- I value face to face contact with scientists in order to continue monitoring in the long term

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

- I value interaction with scientists over the phone or by email in order to continue monitoring in the long term

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

- I value training by scientists in order to continue monitoring in the long term

Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

16. Are there activities you got involved with due to your involvement in the community monitoring?

Yes ☐ No ☐

If 'yes', please indicate what activities:

THANK YOU FOR YOUR TIME!