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Motivating residents to volunteer for urban waterway restoration: A segmentation approach

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Abstract
Urban landscapes play a crucial role in the health of freshwater ecosystems. The task of protecting and restoring urban freshwater waterways requires concerted efforts from all sectors of society, including volunteers. The recruitment and retention of volunteers is often a challenge for community environmental organizations as urban residents are diverse and influenced by a blend of personal, societal, and environmental factors. We surveyed a representative sample of 1901 urban residents across Aotearoa New Zealand and used the Behaviour Change Wheel framework and audience segmentation to understand the underlying factors influencing volunteering for waterway restoration projects and to identify potential target audiences to recruit new volunteers. We identified four segments within the target audience ("Supportive," "Receptive but unsure," "Hesitant and lack opportunity," and "Reluctant") each with its own unique profile of capabilities, opportunities, and motivations for volunteering. Recommendations for appropriate intervention designs to increase levels of volunteering include providing tailored messaging and events for those who are "Receptive but unsure" or "Hesitant and lack opportunity" and information about volunteering opportunities to "Supportive" individuals. This knowledge lays the groundwork for future initiatives focused on increasing urbanites' volunteering with community freshwater restoration groups.

KEYWORDS
audience segmentation, behavior change, Behavior Change Wheel, freshwater restoration, intervention design

1 | INTRODUCTION

Six of the nine planetary boundaries regulating the stability and resilience of the Earth system have been breached (Richardson et al., 2023), including land-system change, freshwater use, and biosphere integrity. The latter is at particularly high risk due in large part to habitat destruction and mass extinction (Richardson et al., 2023).

Although the nine planetary boundaries are often discussed separately, they are linked and overlapping. Take the case of freshwater use and biosphere integrity: Amidst the intricate interplay of these interconnected boundaries, the urban landscape plays a crucial role in influencing both freshwater ecosystems and overall biosphere health. Within this bigger picture, the need to restore and conserve urban freshwater habitats is an important priority for sustainable urban development (Higgins et al., 2019). The benefits of such restoration efforts range from safeguarding biodiversity and improving water quality to enhancing the quality of life for urban dwellers. The revitalization of urban freshwater ecosystems contributes to improved air quality, temperature regulation, cultural significance, and recreational opportunities, fostering a healthier and more resilient urban environment (Dudgeon et al., 2006; Te Aho, 2018; Tipa, 2009; Vörösmarty et al., 2010).

The task of restoring urban freshwater habitats requires concerted efforts from all sectors of society. While government agencies, environmental organizations, and research institutions play pivotal roles, the active engagement of local communities is equally indispensable (Higgins et al., 2019). In particular, volunteers have had a longstanding central role in nature conservation and restoration (Sloane & Pröbstl-Haider, 2019). Indeed, volunteering not only benefits public goods, but it has also spillover effects by helping to build and maintain individuals' connection to nature, career opportunities, and well-being (Finkelstien, 2009; Guiney & Oberhauser, 2009; Meier & Stutzer, 2007) as well as community building and social cohesion (Asah & Blahna, 2013; Takase et al., 2019). Despite such benefits, recruitment and retention of volunteers is often a challenge for community environmental organizations (Randle & Dolnicar, 2009; Sloane & Pröbstl-Haider, 2019). Moreover, individuals' motivations to volunteer are diverse and influenced by many factors, encompassing a blend of personal, societal, and environmental factors (Clary & Snyder, 1999; Finkelstien, 2009; West & Pateman, 2016).

The large existing literature on volunteering includes work investigating recruitment, initial participation, and retention, both in general volunteering and in environmentally focused volunteering (Fraisl et al., 2022; West & Pateman, 2016). Past literature on recruitment has emphasized the role of informing potential volunteers that opportunities exist and understanding the motivation of current volunteers, enabling better, more targeted marketing to potential volunteers (Asah & Blahna, 2013; Clary & Snyder, 1999; Randle & Dolnicar, 2009, 2012, 2015). Other previous work has identified a dearth of younger volunteers as an important risk, and has thus looked at the motivation of existing young adult volunteers (McDougle et al., 2011). Still other research has noted the lack of environmentally motivated older volunteers and has accordingly generated recruitment programmes aimed at an older demographic who might have more time and resources to become volunteers (Pillemer et al., 2017).

Much of the literature on volunteer recruitment surveys current volunteers to understand their motivation as a means of recruiting new volunteers (Bruyere & Rappe, 2007; Clary & Snyder, 1999; Ding & Schuett, 2020; Ganzevoort & van den Born, 2020; Schuett et al., 2014; West & Pateman, 2016). Although much of this research is insightful and useful, few studies to date have employed representative samples, making it difficult to draw broad generalizations about the motivations of current volunteers and the barriers and enablers for non-volunteers to become volunteers (Randle & Dolnicar, 2015). The present study aims to help fill this gap, specifically as it applies to urban volunteering for freshwater restoration.

Besides recruiting new volunteers, retention of volunteers is important for the ongoing viability of environmental organizations. Indeed, maximizing the potential of committed and high-contributing volunteers is an effective strategy for managing volunteers (Einolf & Yung, 2018). In this case, it may be important to focus on existing (rather than new) volunteers to identify ways to prevent motivation loss (crowding out) and burnout (Measham & Barnett, 2008), although this can prove challenging in practice (Ganzevoort & van den Born, 2020). However, from a sector-wide volunteering perspective, it is also important to attract non-volunteers into the pool of new volunteers (Randle & Dolnicar, 2015) as well as to maximize the mutual benefits for on-going volunteers. This points again to the merit of systematically studying a representative sample of the full population containing both non-volunteers and current volunteers to understand factors that could benefit recruitment and retention of volunteers in the nature conservation and restoration domain. Critically, this requires identification of possible factors that enable or hinder the transition of individuals from non-volunteers into volunteers, making theoretical models of behavioral change particularly relevant.

In particular, the Behavior Change Wheel (BCW) (Michie et al., 2014) combines insights from multiple behavior change theories and models, providing a well-rounded perspective on the psychological, environmental, and social factors influencing human behavior. Originally developed to modify health-related behaviors, this framework has proven useful for facilitating a range of pro-environmental behaviors such as water conservation (Addo et al., 2018; Hine et al., 2018), recycling (Allison et al., 2022), litter reduction (Kolodko et al., 2021), reporting stormwater pollution (McLeod et al., 2024), green consumerism (Sundaraja et al., 2021), and wildlife protection (Ma & McLeod, 2023). As far as we are aware, the BCW approach has not been applied to understanding volunteering, particularly in the nature conservation area. Applying the BCW to this context for the first time is another goal of the present study.

The BCW is underpinned by the Capability, Opportunity, and Motivation model of Behavior (COM-B), which integrates the highly disparate behavioral science literature into a single manageable framework that enables the identification of the behavioral drivers and barriers that are most relevant to the issue being investigated (Michie et al., 2014). The COM-B model emphasizes the importance of considering three essential components of behavior: "Capability" comprises an individual's psychological and physical ability/self-efficacy to perform the desired behavior, "Opportunity" explains factors external to the individual that permit or prohibit a behavior such as the physical environment and social surroundings, and "Motivation" describes the cognitive processes that vitalize and guide behavior. Identifying which elements of the COM-B model are most relevant guides practitioner's decision-making about which behavior change techniques are likely to be effective in each context so interventions can be tailored to target the root causes of a behavior and lead to lasting and meaningful behavior change in individuals and communities (van Valkengoed et al., 2022).

Recognizing that potential volunteers are not homogeneous (Asah et al., 2014), segmenting based on demographic, psychographic, and/or behavioral variables provides a deeper understanding of the unique drivers and barriers that each subgroup faces. This knowledge enables the creation of interventions that are more personalized, relevant, and resonant with the intended audience (Hine et al., 2014; Hine et al., 2017; Rundle-Thiele et al., 2017). It allows for the allocation of limited resources more efficiently as interventions can be directed towards the segments that are most likely to respond (Slater et al., 2006). Randle and Dolnicar (2009, 2012, 2015) took a market segmentation approach to volunteer recruitment, yielding insights such as the need for tailored marketing aimed at different groups within a diverse society and the importance of aligning recruitment materials with the pro-environmental and prosocial values of potential new volunteers.

The BCW approach, coupled with audience segmentation, has strong potential to provide new and useful insights, especially for improving recruitment and retention and increasing contributions of existing volunteers. While other research has provided a range of insights into volunteer recruitment methods, there is merit to applying the BCW framework and audience segmentation to a representative sample of the population. This approach provides the ability to both better understand current volunteers as well as identify potential volunteers, ascertaining how the size of the potential groups and described behavioral interventions might encourage more people to volunteer.

1.1 | The present study

This study was part of a larger research project of urban residents in Aotearoa New Zealand (ANZ). Volunteering with a community restoration group was identified as an impactful way by which urban New Zealanders can positively affect freshwater biodiversity outcomes in both the short- and long-term (McLeod et al., 2024), and volunteering has become an increasingly important part of biodiversity conservation in ANZ given limited funding for ambitious national biodiversity goals (Ministry for the Environment, 2022; Sextus, Hytten & Perry, 2024). Volunteer recruitment and retention is an ongoing challenge for many conservation groups in ANZ, and these groups rely on government, NGOs, the private sector, and one another for skills, time, and financial support (McFarlane et al., 2024; Sinner et al., 2022). However, there is scope for increasing conservation volunteering, with a recent study showing just 3% of New Zealanders reported volunteering to improve the health of local fresh waterways (Ministry for the Environment, 2022).

Conservation volunteers in ANZ are highly motivated by a sense of responsibility to right past wrongs and identification with the Māori concept of *kaitiakitanga*, which can be translated to mean guardianship and protection (Heimann & Medvecky, 2022; Walker et al., 2019). However, there is a historical bias such that conservation volunteers are predominantly older and of European ancestry (or *Pākehā*) (MacFarlane, Wallace, Shanahan & Clapcott, 2024). Indeed, the post-colonial history of conservation in ANZ shows a dominance of *Pākehā* worldviews and exercise of power in the conservation sector, while *hapū* and *Iwi* (tribal groupings) try to maintain their own cultural approaches to conservation and environmental management within a context of their absolute sovereignty (*tino rangatiratanga*) to manage their lands, waterways, forests, and resources being systematically denied and undermined (Lyver et al., 2018). The sample population in this study is representative across the ANZ population, and we applied a social marketing-based method to provide insights that may be applicable to potential conservation volunteers across Māori and non-Māori within ANZ. Indeed, it is important to consider how to increase the diversity of conservation volunteers (Randle & Dolnicar, 2012), which we touch on in our section 4. However, it is important to note that from a disciplinary perspective, this study is designed from a European-origin worldview, hence it is beyond the scope of this paper to engage with Māori approaches to environmental management, which would require a *kaupapa Māori* approach (Smith, 2012).

Urban environments in ANZ are associated with poor and declining freshwater ecosystem health (Booth et al., 2023), a problem common across the world (Higgins et al., 2019; Larned et al., 2016; Te Aho, 2018). Relatedly, survey data indicates New Zealanders who live in urban areas are more dissatisfied with the quality and health of waterways in their region than those from rural areas (Gago et al., 2023). However, many conservation groups operate within urban settings, and are focused on waterways (Peters et al., 2015). Taking these points into consideration, the aim of this study was to identify the factors that encouraged or impeded urban residents' volunteering for urban waterway restoration using both the BCW framework and a nationally representative survey. We contribute to the literature by demonstrating how the BCW framework can be used for volunteering. We segment the population into different groups and provide insights into each group in terms of potential for increased volunteering rates. We thus demonstrate the power of a systematic population-wide approach.

2 | METHODS

2.1 | Participants

A community survey was administered by a market research firm to an online panel. The market research firm used interlocking quotas to ensure that the target sample was representative by age, gender, ethnicity, and location. To be eligible, potential respondents had to be over 18 years of age and to reside in localities where the population exceeds 5000 people, consistent with our focus on urban areas. The questionnaire was reviewed in accordance with the ethical review process of Manaaki Whenua-Landcare Research (application no. 2223/04), within the guidelines of the Code of Ethics developed by the New Zealand Association of Social Science Researchers. This Code of Ethics emphasizes informed consent, freedom from coercion to participate, individual privacy, confidentiality, and sensitivity to participants' circumstances. The survey was undertaken in August–September 2022.

2.2 | Measures

The questionnaire included questions pertaining to demographics, volunteering behaviors, and agreement with potential driver/barrier factors to volunteering, as well as socio-psychological measures. Demographic measures included age, level of education, gender (dummy coded as 0 = male, 1 = female), household composition (0 = no children, 1 = children under 5 years of age only, 2 = children of mixed ages, 3 = school-age children only), and presence of family members who required special care (dummy coded as 0 = no family members with special care needs, 1 = members with special care needs). Volunteering behavior and 16 potential driver/barrier questions are described in Table 1. These questions were measured on a 7-point Likert-type scale. The driver/barrier items were adapted from previous studies (Asah & Blahna, 2013; Ding & Schuett, 2020; Foster, 2018; Pillemer et al., 2017; Schuett et al., 2014), and were all scored as barriers for analysis.

Socio-psychological variables were assessed using a range of psychometric measures. Unless otherwise specified, all responses were rated on a 7-point Likert scale anchored at 1 = "strongly disagree" and 7 = "strongly agree." Refer to Table S1, Supporting Information for further details of items for each construct.

Environmental Concern: Concern for the consequences of environmental problems on the biosphere, oneself, and other people was assessed using the measure developed by Schultz (2001) and validated in New Zealand samples by Milfont et al. (2006). This inventory comprises 4 items for each of the concern types, biospheric, egoistic, and altruistic.

Connectedness to Nature: A measure of individuals' feelings towards nature was assessed using the measure developed by Mayer and Frantz (2004). It consisted of 14 items.

Environmental Self-Identity: Three items were used to assess an individuals' environmental self-identity (van der Werff et al., 2013).

National Environmental Identity: Environmentalism and a "clean-and-green" attitude have been found to be core components of being a "true" New Zealander (Milfont et al., 2020). Three aspects of national environmental identity were measured, namely national identity (Van Bavel et al., 2022), national environmental identity, and feelings towards the protection of biological heritage (items generated from the New Zealand's biological heritage project website: https://bioheritage.nz/goals/stategic-objective/environmental-stewardship/).

Sense of Community: The Brief Sense of Community Scale developed by Peterson et al. (2008) was used to

TABLE 1 Questions to measure volunteer behavior and drivers/barriers to volunteering.

Variable	Question
Volunteering behavior	
Current participation[a]	In the past 12 months, how often have you been involved with a community group that works on freshwater restoration?
Future participation[b]	Within the next 12 months, would you be willing to be involved with a community group that works on freshwater restoration?
Make a donation[b]	Within the next 12 months, would you be willing to make a financial donation to a community group that works to restore freshwater habitats?
Drivers/barriers[c]	
Capability	I am aware of the benefits that restoration actions have on biodiversity in the local waterways' (reverse scored)
	I do not know when local restoration group activities are occurring
	I am unable to join in with physical restoration activities
	I am confident to join a local group (reverse scored)
Physical opportunity	I do not live close to a waterway
	Group activities occur at inconvenient times
	Group restoration activities occur in areas that I cannot get to easily
	I am too busy to participate in group restoration activities
Social opportunity	No one I know participates in group activities
	My community supports group restoration activities' (reverse scored)
	The local Council does not support group restoration activities
	People like me do not participate in group restoration activities
Motivation	I am not interested in participating in groups
	It should not be the general public's responsibility to restore freshwater habitats
	I get satisfaction from working with others to restore the environment (reverse scored)
	I'm reluctant to get involved in community projects due to past bad experiences

Note: Driver/barrier questions categorized as per the Capability-Opportunity-Motivation Behavior (COM-B) model which underpins the BCW framework as described by Michie et al. (2014).
[a]Likert-type scale anchors 1 = “never” and 7 = “very often.”
[b]Likert-type scale anchors 1 = “highly likely” and 7 = “highly unlikely.”
[c]Likert-type scale anchors 1 = “strongly disagree” and 7 = “strongly agree.”

assess the dimensions of needs fulfillment, group membership, influence, and shared emotional connection with an individual's community. It consisted of eight items.

Spirituality: To assess the degree to which spirituality acts as a possible determinant for both theistic and non-theistic respondents, we used the modified six-item spirituality scale developed by Hodge (2003). Each item was measured using a 10-point scale where 0 = absence or zero amount of the attribute and 10 = the maximum amount of the attribute.

2.3 | Quantitative data analysis

Data from the survey was initially tested for compliance to the assumptions for parametric statistical analyses: normality (frequency distribution plots, Sharpiro-Wilk test), outliers (boxplots for univariate and Mahalanobis distance for multivariate), homogeneity (Box M test), and multicollinearity (collinearity diagnostics in SPSS) (Thode, 2002). We conducted a Latent Profile Analysis (LPA) to classify residents into homogenous segments based on their responses to consolidated COM-B factors. We firstly conducted the LPA to identify the optimal number of latent profiles using all 16 COM-B factors. The relative model fit was assessed using the Bayesian information criteria (BIC; Schwartz, 1978), relative entropy (Ramaswamy et al., 1993), and the Lo–Mendell–Rubin likelihood ratio test (LMR; Lo et al., 2001). A significant p-value from the LMR test ($p = .05$) indicated that the given profile solution fitted the data significantly better than the solution with one fewer profile groups. The LPA was conducted in MPlus 8.9 (Muthén & Muthén, 2017). The quality of the LPA was then tested to ensure that our identified segments were meaningful and not simply artifacts of the observed variables used to define them. To accomplish this, we examined the degree to which the segments associated with other observed variables that were not used to define the segments, including demographics (age, gender, education level, family status) and socio-psychological variables (Environmental Concern, Connectedness to Nature, Environmental Self-Identity, National Environmental Identity, Sense of Community, and Spirituality). The relationship between the segments and distal outcomes (e.g., current participation, future intentions to participate, and willingness to donate) were examined to determine whether the identified segments were predictive of participation, and hence useful for practitioners to target in behavior

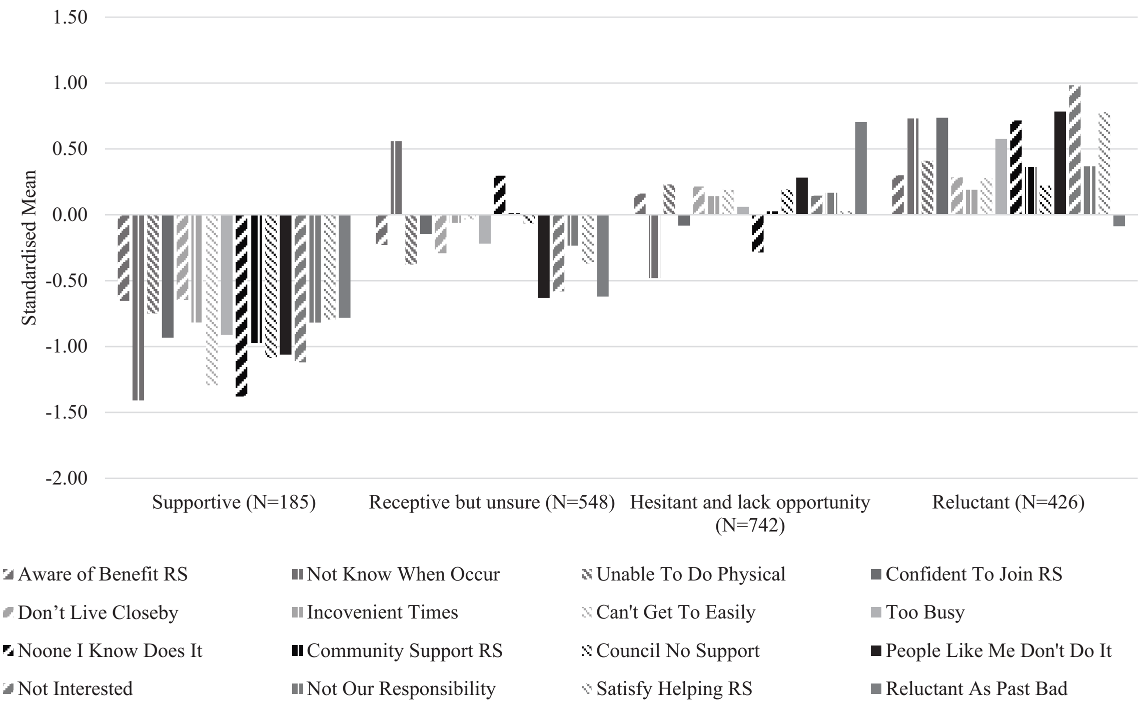

FIGURE 1 Agreement with COM items (scored as barriers) across the four identified segments.

change interventions. These analyses were conducted using MANOVA and Pearson chi-squared tests.

3 | RESULTS

3.1 | Participants

The final sample comprised 1901 participants. The average age of the survey respondents was 47.2 years (±17.0, range 18–90). Over half of the respondents were female ($n = 1098$, 58%), with 794 (42%) male and nine identifying as non-binary. Just over 13% of respondents self-identified as belonging to the Māori ethnic group (252), lower than the 17% of the population estimated to be Māori (Stats, 2021). A variety of education levels were represented in the survey, with 559 (29%) having completed secondary education, 394 (21%) having a trade or technical qualification, 680 (36%) having completed an undergraduate degree, 140 (7%) having completed a higher degree, and 128 (7%) stipulated no qualifications or were unsure. A large proportion of the respondents ($n = 1203$, 63%) were members of households containing only adults (≥18 years old). The remaining respondents had children present in their household, 182 (10%) had only children less than 5 years of age, 121 (6%) had children of mixed ages, and 395 (21%) had only school-age children. A small number of respondents 128 (7%) had someone that needed special care in their household.

Most of the respondents (1538, 81%) have never volunteered in community group waterway restoration activities, although 157 (8%) had volunteered but not often, 155 (8%) had sometimes volunteered, and 51 (3%) had volunteered often. When asked about the future intentions to volunteer in the next 12 months, 341 (18%) were willing, 901 (47%) were somewhat willing, 396 (21%) were slightly willing, and 263 (14%) were not at all willing. When asked about their willingness to donate to a group undertaking waterway restoration, 134 (7%) were willing, 729 (38%) were somewhat willing, 480 (25%) were slightly willing, and 558 (29%) were not at all willing.

3.2 | Audience segmentation

We conducted an LPA using the items measuring the COM factors to gain a better understanding of the homogeneity of the drivers and barriers across respondents and the unique profile of any segments identified. The results indicated that our respondents could be classified into four segments (Figure 1). The 4-profile solution had the highest entropy value, and the LMR test indicated that it fitted the data significantly better than a 5-profile solution (Table 2). We named the four segments

"Supportive," "Receptive but unsure," "Hesitant and lack opportunity," and "Reluctant."

We then examined the degree to which the identified segments associated with the other observed variables that were not used to define the profiles. MANOVA results indicated significant differences between the four segments and all the measured socio-psychological variables (i.e., Environmental Concern, Connectedness to Nature, Environmental Self-Identity, National Environmental Identity, Sense of Community, and Spirituality): Wilk's $\lambda = 0.69$, $F(24, 5465) = 31.08$, $p < .001$, $\eta^2 = 0.12$; refer to Table 3 for more details. There were significant differences between the four segments across all measured demographic variables; age ($F = 4.98$, $p = .002$, $\eta^2 = 0.01$), gender ($X^2 = 8.50$, $p = .04$, $r = 0.03$), education level ($X^2 = 28.01$, $p = .01$, $r = 0.09$), household composition ($X^2 = 19.40$, $p = .02$, $r = 0.01$), and presence of family members who required special care ($X^2 = 9.72$, $p = .02$, $r = 0.01$) (Table 4). In addition there were significant differences between the four segments across behavioral variables (MANOVA results: Wilk's $\lambda = 0.61$, $F(9, 4612) = 116.10$, $p < .001$, $\eta^2 = 0.15$) (Table 3).

TABLE 2 Model fit indices for the Latent profile analysis solutions.

Profile solution	BIC	Entropy	LMR
2	110441.52	0.764	$p < .001$
3	109904.77	0.763	$p < .001$
4	109644.09	0.792	$p < .001$
5	109519.63	0.773	$p = .157$
6	109386.75	0.790	$p = .288$

Abbreviations: BIC, Bayesian information criterion; LMR, Lo–Mendell–Rubin likelihood ratio test.

3.3 | Characteristics of the identified segments

The characteristics of the identified segments are useful for behavior change practitioners to target their interventions. Our identified segments varied across most of our measured variables. These are illustrated in Table 5 for ease of comparison and detailed below.

Members in the "Supportive" segment (185, 10%) are the most likely to be currently volunteering, the most willing to volunteer in the future, and willing to donate. On average, they have the lowest agreement with all COM-B barriers. Members in this segment tend to be older, less likely to have young children in their

TABLE 3 Differences between behaviors and psychometric scales across the four segments.

	Supportive ($N = 185$) Mean	Receptive but unsure ($N = 548$) Mean	Hesitant and lack opportunity ($N = 742$) Mean	Reluctant ($N = 426$) Mean	Segment differences F	η^2
Current participation[a]	2.54c	1.15a	1.83b	1.03a	106.79*	0.14
Future participation[b]	5.44d	4.78c	3.73b	2.47a	262.55*	0.29
Make a donation[b]	3.90c	3.11b	3.22b	2.14a	66.69*	0.10
Environmental concern	6.13b	6.04b	5.47a	5.44a	58.53*	0.09
Connectedness to nature	5.31d	4.87c	4.56b	4.33a	85.15*	0.12
Environmental self-ID	5.86d	5.47c	5.10b	4.72a	59.16*	0.09
National environmental ID	6.26b	6.09b	5.37a	5.43a	87.18*	0.12
Sense of community	5.22d	3.95b	4.23c	3.45a	101.59*	0.14
Spirituality	6.11d	4.92b	5.51c	4.21a	26.28*	0.04

Note: Means with different letters (in rows) differ significantly at $p < .05$ Tukey HSD. η^2 (partial eta squared) indicates effect size.
[a]Mean scores for current participation using scale: 0 = never, 7 = very often.
[b]Mean scores for future participation and donation: 0 = not at all willing, 7 = extremely willing.
*$p < .001$.

TABLE 4 Demographic characteristics across the four segments.

	Supportive ($N = 185$)	Receptive but unsure ($N = 548$)	Hesitant and lack opportunity ($N = 742$)	Reluctant ($N = 426$)	Segment differences		
	Mean	Mean	Mean	Mean	F	p-value	η^2
Age	51.23b	46.84a	46.01a	47.83a	4.98	.002	0.01
	N (Z_{Resid})	N (Z_{Resid})	N (Z_{Resid})	N (Z_{Resid})	χ^2 (df)	p	r
Gender							
Female	97 (−1.5)	331 (1.5)	408 (−2.0)	262 (1.8)	8.50 (3)	.04	0.03
Male	88 (1.5)	217 (−1.5)	334 (2.0)	164 (−1.8)			
Education							
Postgraduate	11 (−0.8)	44 (0.7)	61 (1.1)	24 (−1.6)	28.01 (12)	.01	−0.09
Undergraduate	91 (4.0)	196 (0.0)	260 (−0.5)	133 (−2.2)			
Trade certificate	35 (−0.6)	113 (−0.1)	153 (−0.1)	93 (0.6)			
Secondary high	40 (−2.4)	167 (0.7)	212 (−0.6)	140 (1.8)			
No qualification	8 (−1.4)	28 (−1.8)	56 (1.1)	36 (1.6)			
Household							
Adults only	126 (1.4)	342 (−0.5)	450 (−1.9)	285 (1.8)	19.40 (6)	.02	−0.01
Children <5 years	10 (−2.0)	52 (−0.1)	72 (0.2)	48 (1.3)			
Children mixed ages	14 (0.7)	45 (2.1)	44 (−0.6)	18 (−2.1)			
School-age children	35 (−0.7)	109 (−0.6)	176 (2.5)	75 (−1.8)			
Special care							
Yes	15 (0.8)	25 (−2.4)	64 (2.6)	24 (−1.0)	9.72 (3)	.02	0.01
No	170 (−0.8)	523 (2.4)	678 (−2.6)	402 (1.0)			

Note: Means with different letters (in rows) differ significantly at $p < .05$ Tukey HSD. η^2 (partial eta squared) indicated effect size. Z_{Resid} is adjusted standardized residual, where $Z_{\text{Resid}} > |2|$ is significant at $p < .05$. r is Pearson's correlation coefficient.

households, and more likely to have a degree than respondents with other segments. On average, they scored the highest across all psychometric measures, indicating they have a strong environmental identity, connection to nature, sense of community, and spirituality.

Members in the "Receptive but unsure" segment (548, 29%) do not currently participate but are willing to do so in the future, although they are only somewhat willing to donate. Their main barriers to volunteering are not knowing when group activities exist and not knowing other participants. Compared with the other segments, members in this profile are more likely to have a child (of any age) in their household and to not have a household member requiring special care. They have a relatively strong environmental identity but a weaker sense of community than those in other segments.

Members in the "Hesitant and lack opportunity" segment (742, 39%) do not currently participate but are somewhat willing to participate in the future and donate. Their main barriers to volunteering are awareness of the benefits of restoration activities, they do not live close to waterways, the activities occur at inconvenient times, they cannot get to activities easily, and they have had bad volunteering experiences in the past. Compared with the other segments, members in this profile tend to be male and more likely to have school-aged children and a household member requiring special care compared with respondents in other segments. They have a weaker environmental identity than the "Receptive but unsure" segment, but a stronger sense of community.

Members in the "Reluctant" segment (426, 22%) do not currently participate and are the least willing to volunteer in the future and donate. They have the

TABLE 5 Comparison of differences of measured variables across the identified segments.

	Supportive (*N* = 185)	Receptive but unsure (*N* = 548)	Hesitant and lack opportunity (*N* = 742)	Reluctant (*N* = 426)
Volunteering behavior				
Current participation	Most likely	Not likely	Not likely	Not likely
Future participation	Most likely	Likely	Somewhat likely	Not likely
Make a donation	Likely	Somewhat likely	Somewhat likely	Not likely
Main barriers to volunteering				
Capability	-	Aware of activities	Aware of benefits	Aware of activities or benefits, not confident to join
Physical opportunity	-	-	Don't live close-by, can't get to easily, inconvenient times	Too busy
Social opportunity	-	Knowing other participants	-	No community support, people like me don't participate
Motivation	-	-	Bad past experiences	No interest, not responsible, gain no satisfaction
Demographics				
Age	Oldest	-	-	-
Gender	-	-	More likely male	-
Education level	Most likely to have degree	-	-	Less likely to have degree
Household composition	Less likely to have children	Most likely to have children	More likely to have school-age children	Less likely to have school-age children
Family members-special care	-	Least likely	Most likely	-
Socio-psychological dimensions				
Environment concern	Strongest	Strong	Weaker	Weakest
Connection to nature	Strongest	Strong	Weaker	Weakest
Environmental self-ID	Strongest	Strong	Weaker	Weakest
National Env. ID	Strongest	Strong	Weaker	Weakest
Sense of community	Strongest	Weak	Strong	Weakest
Spirituality	Strongest	Strong	Weaker	Weakest

highest barrier agreement with all barriers except “Reluctant as had a bad experience in the past.” Compared with respondents in other segments, members of this segment are less likely to have school-aged children or an undergraduate qualification. On average, they scored the lowest across all psychometric measures indicating they have a weaker environmental identity, sense of community, and spirituality than the other segments.

4 | DISCUSSION

The need to restore and conserve urban freshwater habitats is central to sustainable urban development. Given the important role that urban residents' behaviors play in safeguarding and restoring freshwater biodiversity, our study sought to: (1) extend existing social and behavioral science literature in freshwater management, and (2) lay the groundwork for future initiatives focused on increasing urbanites' volunteering with community freshwater restoration groups.

We surveyed a representative group of urban residents in ANZ and used the BCW framework and audience segmentation to help understand the underlying determinants of volunteering for urban freshwater ecosystems and identified potential target audiences to recruit new volunteers or increase levels of volunteering. We identified four segments in relation to volunteering for urban freshwater restoration, each with its own unique COM-B profile. Through designing our survey with questions on capability, opportunity, and motivation, we were able to understand decisions about volunteering for each segment and point to potential interventions to increase their levels of volunteering by overcoming specific barriers, recognizing, of course, that further co-development work is required for community stakeholders who possess more extensive knowledge of the target audiences and particular contexts (Michie et al., 2014). Indeed, there are many freshwater contexts and relevant behaviors in ANZ alone, let alone globally, and we do not make any claims of comprehensive coverage of all these; rather, we aim to provide insights for future work in this area, where relevant.

4.1 | Segments and potential interventions

First, members of the "Supportive" segment (roughly 10% of our sample) would be the easiest group to encourage to volunteer given that many have volunteered already. These individuals possess a strong environmental and community identity, have the lowest agreement with all COM-B barriers, and generally express a willingness to volunteer in the future. Thus, they may only require simple information about upcoming events and reminders to attend. Indeed, basic information about upcoming events was recently found to be as effective as targeted messaging for recruiting new urban restoration volunteers for the Fairfield Project volunteer group in Kirikiroa|Hamilton, ANZ (Maris et al., 2024). This group is most likely to form the core of a volunteering group, and a subset of this group is also likely to be highly committed, so consideration also needs to be given sustaining their volunteering effort and avoiding burnout (Einolf & Yung, 2018; Measham & Barnett, 2008; Randle & Dolnicar, 2009). Methods to achieve this include providing volunteers with choices so they can match tasks with their own intrinsic motivations, providing acknowledgement and on-going support, and avoiding over-burdening them with heavy workloads and expectations (Ganzevoort & van den Born, 2020; Measham & Barnett, 2008; West & Pateman, 2016).

Members of the "Receptive but unsure" and "Hesitant and lack opportunity" segments would be attractive targets for recruitment as they would capture a large proportion of the population, at 29% and 39%, respectively. Most members of these profiles do not currently volunteer but have expressed some willingness to do so in the future. The main barriers to tackle for the "Receptive but unsure" segment, who have a relatively strong environmental identity, would be their awareness when group activities were occurring and their reluctance due to not knowing other volunteers. Hence, groups wishing to recruit from this segment should consider running events focused on allowing new volunteers to try it out (West & Pateman, 2016). Such events could be advertised online and through local networks such as schools and community newsletters and would ideally include messaging about socializing with like-minded people. This group has a relatively high environmental concern and identity, so images or messaging could emphasize the positive environmental impact of urban freshwater restoration or conservation volunteering (e.g., Maris et al., 2024; Prysby, 2020). Vignettes within messaging could be a useful way to highlight these benefits of volunteering (West & Pateman, 2016); this additionally adds another motivation for volunteer groups to collect information on their environmental successes (Jones & Kirk, 2018). While community groups doubtless hold a great deal of information on successful and unsuccessful recruitment methods, this topic has received inadequate analysis in the literature (Prysby, 2020); hence, it would be useful to probe this topic with both groups and to different recruitment methods (as noted in the next subsection).

The barriers to volunteering are more diverse among the "Hesitant and lack opportunity" segment. Similarly to "Receptive but unsure," top barriers included a lack of information and not knowing other volunteers, so the types of advertising described in the previous paragraph may also resonate with this group. However, members of this profile also had a stronger sense of community, so messaging could additionally focus on community-building aspects of volunteering. This group also highlighted bad previous experiences volunteering, so it is important to focus on providing a supportive and enjoyable environment at volunteering events (West & Pateman, 2016). For example, the importance of providing social time at volunteering events has been highlighted in other work (Sextus et al., 2024). Another important consideration is how a volunteering group can be part of a community of practice in which knowledge is shared and in which participants are actively involved in building meaning, social communities, and collective identities (Bradbury & Middlemiss, 2015). Such communities of practice can help to share knowledge about engaging volunteers while building commitment and community cohesion to help continue to motivate existing volunteers, although this is not a given (Lawson et al., 2017; McAllum, 2012). Additionally, it should be noted that members of this segment expressed a lack of time for volunteering, so designing tasks and events for this group that are simple and quick (but still meaningful) may be important for recruitment and retention (Measham & Barnett, 2008; West & Pateman, 2016).

Finally, members in the "Reluctant" segment, who faced the strongest and most widespread set of barriers to volunteering, would be the most difficult group to recruit. Members in this segment could be shifted to "Hesitant and lack opportunity" by initially using education to address their lack of awareness. Noting that this segment is a minority (22%), they would be the lowest priority to target for volunteering recruitment efforts, especially if resources are scarce, so organizations would get a "bigger bang for their buck" initially focusing on the other segments (Randle & Dolnicar, 2015).

4.2 | Practical implications, limitations, and future research

This research investigates barriers and drivers for potential new volunteers, with the aim of supporting the development of mechanisms for recruiting new volunteers and thus increasing time spent volunteering among potentially willing groups within the urban population. The insights point to information and messaging that could influence audience segments. Engagement experts and volunteer organizations can take these insights and generate recruitment and retention methods to trial within their own contexts.

However, there is the practical matter of finding the means of reaching these groups. Low-cost methods include word of mouth, sharing on social media, and local newsletters. These methods can be both effective at reaching willing volunteers and affordable for groups with limited financial resources, but may rely on existing networks and thus reach people who are already volunteering and are less diverse than the wider population (Prysby, 2020; West & Pateman, 2016). Other methods with a low financial cost include door-to-door and targeting stories in relevant local media. Blanket or "scattergun" communication methods such as mail drops and paid online advertising may require more resourcing (West & Pateman, 2016). There may be opportunities for sponsorship or collaboration with local businesses and local government to help get their messages out; this may be more attractive to these stakeholders if there is research supporting the effectiveness of recruitment methods. This paper and other studies could help fill this role (e.g., Maris et al., 2024), but there is more that can be done. It is important to incorporate the experience and knowledge of local practitioners in terms of both understanding what works in their area with their target audience and matching the volunteer recruitment method with the requirements of the volunteers. For example, a small, tight-knit community requiring a group of committed volunteers for a specific project may rely on door knocking whereas a larger project in a diverse urban area may be better to focus on mass communication (Prysby, 2020; West & Pateman, 2016).

A logical next step to build a better understanding of the diverse communities and groups that exist across ANZ is in-depth research using qualitative methods (Bible & Clarke-De Reza, 2023; Sextus et al., 2024). Such activities may include interviewing conservation groups about what has and has not worked to recruit and retain volunteers. Further research can be undertaken to test different messaging and recruitment methods, including by partnering with specific groups to build on existing knowledge and aspirations (Maris et al., 2024; Prysby, 2020). Such research should be conducted as randomized control trials or field experiments (Harrison & List, 2004; Maris et al., 2024; Nisa et al., 2019). These trials require measurement of appropriate outcome variables that align with program goals, random assignment into control and treatment groups, and appropriate statistical testing (Murnane & Willett, 2010). Testing with a range of different groups could be helpful to understand the extent to which the findings from a national-level, quantitative study such as this can be applied to individual groups working towards specific ends within specific communities (Prysby, 2020).

A drawback of formal testing is the expense, particularly when it involves employing people with appropriate expertize. Indeed, it should be noted that while behavior change frameworks like BCW provide the potential for developing low-cost recruitment methods, they often rely on costly background research to determine interventions, as was the case here with a nationwide survey (Carlsson et al., 2021; Ibrahim et al., 2019). While such research may be able to be funded through academic funding pools, it is generally inaccessible to most volunteer organizations. Nevertheless, the insights provided here can be communicated to volunteer organizations to provide guidance about how to increase their volunteer recruitment and retention. We note that authors of this article have done so through producing guides targeted at volunteer groups, presenting to volunteer group networks, and running a workshop with volunteer groups to brainstorm volunteer recruitment and retention methods that the volunteer groups themselves could implement. https://data.bioheritage.nz/dataset/so2-kaitiakitanga-stewardship.

Notwithstanding the research gaps noted above, behavioral interventions generally have a degree of context specificity, meaning that care must be taken when extrapolating results (Mertens et al., 2022). Additionally, the long-term effectiveness of behavioral interventions is a research gap that should ideally be addressed (Nielsen et al., 2021). Regardless, volunteer organizations may be able to informally trial different methods in their localities; further support on skills and methods to undertake easy trials using rules of thumb and simple evaluations would also potentially be helpful.

5 | CONCLUSION

In this paper, we applied the BCW framework and audience segmentation to study volunteering for urban freshwater restoration. We carried out a nation-wide survey in urban areas of Aotearoa New Zealand that included questions on current and future volunteering behavior and COM-B barriers. We have demonstrated the value of this approach in understanding how to increase volunteering rates, given the present challenges to biodiversity. This work suggests basic information about volunteering opportunities be provided to those who are "Supportive" and tailored messaging and events for those who are "Receptive but unsure" or "Hesitant and lack opportunity." A natural next step is for volunteer organizations to use these findings to develop and informally trial such methods to increase volunteering rates, alongside formal research to help establish the effectiveness of these methods.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in the New Zealand Bioheritage data repository at https://doi.org/10.34721/so2-fwsurv.2c.

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REFERENCES

Addo, I. B., Thoms, M. C., & Parsons, M. (2018). Barriers and drivers of household water-conservation behaviour: A profiling approach. *Water*, *10*(12), 1794. https://doi.org/10.3390/w10121794

Allison, A. L., Lorencatto, F., Michie, S., & Miodownik, M. (2022). Barriers and enablers to food waste recycling: A mixed methods study amongst UK citizens. *International Journal of Environmental Research and Public Health*, *19*(5), 2729. https://doi.org/10.3390/ijerph19052729

Asah, S. T., & Blahna, D. J. (2013). Practical implications of understanding the influence of motivations on commitment to voluntary urban conservation stewardship. *Conservation Biology*, *27*(4), 866–875. https://doi.org/10.1111/cobi.12058

Asah, S. T., Lenentine, M. M., & Blahna, D. J. (2014). Benefits of urban landscape eco-volunteerism: Mixed methods segmentation analysis and implications for volunteer retention. *Landscape and Urban Planning*, *123*, 108–113. https://doi.org/10.1016/j.landurbplan.2013.12.011

Bible, J., & Clarke-De Reza, S. (2023). Environmental volunteers endorse diverse motivations: Using a mixed-methods study to assess initial and sustained motivation to engage in public participation in science research. *Citizen Science: Theory and Practice*, *8*(1), 52. https://doi.org/10.5334/cstp.506

Booth, P., Hughey, K. F. D., Kerr, G. N., & Stahlmann-Brown, P. (2023). *New Zealand environmental perception survey: 2022* (Manaaki Whenua-Landcare Research Contract Report LC4207). Manaaki Whenua Landcare Research.

Bradbury, S., & Middlemiss, L. (2015). The role of learning in sustainable communities of practice. *Local Environment*, *20*(7), 796–810. https://doi.org/10.1080/13549839.2013.872091

Bruyere, B., & Rappe, S. (2007). Identifying the motivations of environmental volunteers. *Journal of Environmental Planning and Management*, *50*(4), 503–516. https://doi.org/10.1080/09640560701402034

Carlsson, F., Gravert, C., Johansson-Stenman, O., & Kurz, V. (2021). The use of green nudges as an environmental policy instrument. *Review of Environmental Economics and Policy*, *15*(2), 216–237. https://doi.org/10.1086/715524

Clary, E. G., & Snyder, M. (1999). The motivations to volunteer: Theoretical and practical considerations. *Current Directions in Psychological Science*, *8*(5), 156–159. https://doi.org/10.1111/1467-8721.00037

Ding, C., & Schuett, M. A. (2020). Predicting the commitment of volunteers' environmental stewardship: Does generativity play a role? *Sustainability*, *12*(17), 6802. https://doi.org/10.3390/su12176802

Dudgeon, D., Arthington, A. H., Gessner, M. O., Kawabata, Z.-I., Knowler, D. J., Lévêque, C., Naiman, R. J., Prieur-Richard, A.-H., Soto, D., Stiassny, M. L. J., & Sullivan, C. A. (2006). Freshwater biodiversity: Importance, threats, status and conservation challenges. *Biological Reviews*, *81*(2), 163–182. https://doi.org/10.1017/S1464793105006950

Einolf, C. J., & Yung, C. (2018). Super-volunteers: Who are they and how do we get one? *Nonprofit and Voluntary Sector Quarterly*, *47*(4), 789–812. https://doi.org/10.1177/0899764018760400

Finkelstien, M. A. (2009). Intrinsic vs. extrinsic motivational orientations and the volunteer process. *Personality and Individual Differences*, *46*(5–6), 653–658. https://doi.org/10.1016/j.paid.2009.01.010

Foster, A. (2018). Volunteer environmental stewardship and affective labour in Philadelphia. *Conservation and Society*, *16*(1), 52–63. https://doi.org/10.4103/cs.cs_16_49

Fraisl, D., Hager, G., Bedessem, B., Gold, M., Hsing, P.-Y., Danielsen, F., Hitchcock, C. B., Hulbert, J. M., Piera, J., Spiers, H., Thiel, M., & Haklay, M. (2022). Citizen science in environmental and ecological sciences. *Nature Reviews Methods Primers*, *2*(1), 64. https://doi.org/10.1038/s43586-022-00144-4

Gago, T., Trowsdale, S., Sibley, C. G., & Milfont, T. L. (2023). Satisfaction with the condition of local waterways in Aotearoa New Zealand. Preprint. https://doi.org/10.31234/osf.io/rwx3j

Ganzevoort, W., & van den Born, R. J. G. (2020). Understanding citizens' action for nature: The profile, motivations and experiences of Dutch nature volunteers. *Journal for Nature Conservation*, *55*, 125824. https://doi.org/10.1016/j.jnc.2020.125824

Guiney, M. S., & Oberhauser, K. S. (2009). Conservation Volunteers' connection to nature. *Ecopsychology*, *1*(4), 187–197. https://doi.org/10.1089/eco.2009.0030

Harrison, G. W., & List, J. A. (2004). Field experiments. *Journal of Economic Literature*, *42*(4), 1009–1055.

Heimann, A., & Medvecky, F. (2022). Attitudes and motivations of New Zealand conservation volunteers. *New Zealand Journal of Ecology*, *46*(1), 1–13. https://doi.org/10.20417/nzjecol.46.18

Higgins, S. L., Thomas, F., Goldsmith, B., Brooks, S. J., Hassall, C., Harlow, J., Stone, D., Völker, S., & White, P. (2019). Urban freshwaters, biodiversity, and human health and well-being: Setting an interdisciplinary research agenda. *WIREs Water*, *6*(2), e1339. https://doi.org/10.1002/wat2.1339

Hine, D. W., Driver, A. B., & McLeod, L. J. (2018). Developing behaviourally effective policies to manage household water use. In R. Bartel, L. Noble, J. Williams, & S. Harris (Eds.), *Water policy, imagination and innovation* (pp. 193–210). Routledge.

Hine, D. W., Phillips, W. J., Driver, A. B., & Morrison, M. (2017). Audience segmentation and climate change communication. In *Oxford handbook of climate change communication*. Oxford University Press.

Hine, D. W., Reser, J. P., Morrison, M., Phillips, W. J., Nunn, P., & Cooksey, R. (2014). Audience segmentation and climate change communication: Conceptual and methodological considerations. *Wiley Interdisciplinary Reviews: Climate Change*, *5*(4), 441–459. https://doi.org/10.1002/wcc.279

Hodge, D. R. (2003). The intrinsic spirituality scale: A new six-item instrument for assessing the salience of spirituality as a motivational construct. *Journal of Social Service Research*, *30*, 41–61. https://doi.org/10.1300/J079v30n01_03

Ibrahim, A., Rundle-Thiele, S., & Knox, K. (2019). Working within resource constraints: A qualitative segmentation study. *Journal of Strategic Marketing*, *29*(3), 247–263. https://doi.org/10.1080/0965254x.2019.1676294

Jones, C., & Kirk, N. (2018). Shared visions: Can community conservation projects' outcomes inform on their likely contributions to national biodiversity goals? *New Zealand Journal of Ecology*, *42*(2), 116–124. https://doi.org/10.20417/nzjecol.42.14

Kolodko, J., Schmidtke, K. A., Read, D., & Vlaev, I. (2021). #LetsUnlitterUK: A demonstration and evaluation of the Behaviour Change Wheel methodology. *PLoS One*, *16*(11), e0259747. https://doi.org/10.1371/journal.pone.0259747

Larned, S. T., Snelder, T., Unwin, M. J., & McBride, G. B. (2016). Water quality in New Zealand rivers: Current state and trends. *New Zealand Journal of Marine and Freshwater Research*, *50*(3), 389–417. https://doi.org/10.1080/00288330.2016.1150309

Lawson, D. M., Hall, K. R., Yung, L., & Enquist, C. A. (2017). Building translational ecology communities of practice: Insights from the field. *Frontiers in Ecology and the Environment*, *15*(10), 569–577. https://doi.org/10.1002/fee.1736

Lo, Y., Mendell, N. R., & Rubin, D. B. (2001). Testing the number of components in a normal mixture. *Biometrika*, *88*(3), 767–778.

Lyver, P. O., Ruru, J., Scott, N., Tylianakis, J. M., Arnold, J., Malinen, S. K., Bataille, C. Y., Herse, M. R., Jones, C. J., Gormley, A. M., Peltzer, D. A., Taura, Y., Timoti, P., Stone, C., Wilcox, M., & Moller, H. (2018). Building biocultural approaches into Aotearoa—New Zealand's conservation future. *Journal of the Royal Society of New Zealand*, *49*(3), 1–18. https://doi.org/10.1080/03036758.2018.1539405

Ma, G. C., & McLeod, L. J. (2023). Understanding the factors influencing cat containment: Identifying opportunities for behaviour change. *Animals*, *13*(10), 1630. https://doi.org/10.3390/ani13101630

Maris, R., Dorner, Z., & Carlsson, F. (2024). *Nudges and monetary incentives: A Green partnership?* (Working Paper in Economics 842). University of Gothenburg.

Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, *24*(4), 503–515. https://doi.org/10.1016/j.jenvp.2004.10.001

McAllum, K. (2012). *Organisational volunteering: Meanings of volunteering, professionalism, volunteer communities of practice and wellbeing* (Doctoral thesis), University of Waikato.

McDougle, L. M., Greenspan, I., & Handy, F. (2011). Generation green: Understanding the motivations and mechanisms influencing young adults' environmental volunteering. *International Journal of Nonprofit and Voluntary Sector Marketing*, *16*(4), 325–341. https://doi.org/10.1002/nvsm.431

McFarlane, K., Wallace, K., Shanahan, D., & Clapcott, J. (2024). Working together to scale ecosystem restoration: Collective approaches to community action in Aotearoa New Zealand. *Ecology and Society*, *29*(2), 17. https://doi.org/10.5751/ES-15152-290217

McLeod, L. J., Hine, D. W., Milfont, T. L., Dorner, Z., Tassell-Matamua, N. A., Maris, R. D. C., Kitson, J. C., & Stahlmann-Brown, P. (2024). Protecting and restoring freshwater biodiversity across urban areas in Aotearoa New Zealand: Citizens' reporting of pollution in stormwater drains and waterways. *Journal of Environmental Management*, *351*, 120019. https://doi.org/10.1016/j.jenvman.2024.120019

Measham, T. G., & Barnett, G. B. (2008). Environmental volunteering: Motivations, modes and outcomes. *Australian Geographer*, *39*(4), 537–552. https://doi.org/10.1080/00049180802419237

Meier, S., & Stutzer, A. (2007). Is volunteering rewarding in itself? *Economica*, *75*(297), 39–59. https://doi.org/10.1111/j.1468-0335.2007.00597.x

Mertens, S., Herberz, M., Hahnel, U. J. J., & Brosch, T. (2022). The effectiveness of nudging: A meta-analysis of choice architecture interventions across behavioural domains. *Proceedings of the National Academy of Sciences of the United States of America*, *119*(1), e2107346118. https://doi.org/10.1073/pnas.2107346118

Michie, S., Atkins, L., & West, R. (2014). *The behaviour change wheel. A guide to designing interventions*. Silverback Publishing.

Milfont, T. L., Duckitt, J., & Cameron, L. D. (2006). A cross-cultural study of environmental motive concerns and their implications for proenvironmental behavior. *Environment and Behavior*, *38*(6), 745–767. https://doi.org/10.1177/0013916505285933

Milfont, T. L., Osborne, D., Yogeeswaran, K., & Sibley, C. G. (2020). The role of national identity in collective pro-environmental action. *Journal of Environmental Psychology*, *72*, 101522. https://doi.org/10.1016/j.jenvp.2020.101522

Ministry for the Environment. (2022). *Understanding New Zealanders' attitudes to the environment*. Retrieved from https://environment.govt.nz/facts-and-science/science-and-data/understanding-new-zealanders-attitudes-to-the-environment/

Murnane, R. J., & Willett, J. B. (2010). *Methods matter: Improving causal inference in educational and social science research*. Oxford University Press.

Muthén, L. K., & Muthén, B. O. (2017). *Mplus: Statistical analysis with latent variables: User's guide (version 8)*. Muthen & Muthen.

Nielsen, K. S., Marteau, T. M., Bauer, J. M., Bradbury, R. B., Broad, S., Burgess, G., Burgman, M., Byerly, H., Clayton, S., Espelosin, D., Ferraro, P. J., Fisher, B., Garnett, E. E., Jones, J. P. G., Otieno, M., Polasky, S., Ricketts, T. H., Trevelyan, R., van der Linden, S., … Balmford, A. (2021). Biodiversity conservation as a promising frontier for behavioural science. *Nature Human Behaviour*, *5*(5), 550–556. https://doi.org/10.1038/s41562-021-01109-5

Nisa, C. F., Bélanger, J. J., Schumpe, B. M., & Faller, D. G. (2019). Meta-analysis of randomised controlled trials testing behavioural interventions to promote household action on climate change. *Nature Communications*, *10*(1), 4545. https://doi.org/10.1038/s41467-019-12457-2

Peters, M. A., Hamilton, D., & Eames, C. (2015). 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), 179–189.

Peterson, N. A., Speer, P. W., & McMillan, D. W. (2008). Validation of a brief sense of community scale: Confirmation of the principal theory of sense of community. *Journal of Community Psychology*, *36*(1), 61–73. https://doi.org/10.1002/jcop.20217

Pillemer, K., Wells, N. M., Meador, R. H., Schultz, L., Henderson, C. R., & Cope, M. T. (2017). Engaging older adults in environmental volunteerism: The retirees in service to the environment program. *Gerontologist*, *57*(2), 367–375. https://doi.org/10.1093/geront/gnv693

Prysby, M. (2020). Recruitment and building the team. In C. A. Lepczyk, O. D. Boyle, & T. L. V. Vargo (Eds.), *Handbook of citizen science in ecology and conservation* (1st ed., pp. 73–86). University of California Press. https://doi.org/10.2307/j.ctvz0h8fz

Ramaswamy, V., Desarbo, W. S., Reistein, D. J., & Robinson, W. T. (1993). An empirical pooling approach for estimating marketing mix elasticities with PIMS data. *Marketing Science*, *12*(1), 103–124.

Randle, M., & Dolnicar, S. (2009). Not just any volunteers: Segmenting the market to attract the high contributors. *Journal of Nonprofit & Public Sector Marketing*, *21*(3), 271–282. https://doi.org/10.1080/10495140802644513

Randle, M., & Dolnicar, S. (2012). Attracting volunteers in highly multicultural societies: A marketing challenge. *Journal of Nonprofit & Public Sector Marketing*, *24*(4), 351–369. https://doi.org/10.1080/10495142.2012.733668

Randle, M., & Dolnicar, S. (2015). The characteristics of potential environmental volunteers: Implications for marketing communications. *Australasian Journal of Environmental Management*, *22*(3), 329–339. https://doi.org/10.1080/14486563.2014.976848

Richardson, K., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S. E., Donges, J. F., Drüke, M., Fetzer, I., Bala, G., von Bloh, W., Feulner, G., Fiedler, S., Gerten, D., Gleeson, T., Hofmann, M., Huiskamp, W., Kummu, M., Mohan, C., Nogués-Bravo, D., … Rockström, J. (2023). Earth beyond six of nine planetary boundaries. *Science Advances*, *9*(37), eadh2458. https://doi.org/10.1126/sciadv.adh2458

Rundle-Thiele, S., Dietrich, T., & Kubacki, K. (2017). Why we need segmentation when designing social marketing programs. In T. Dietrich, S. Rundle-Thiele, & K. Kubacki (Eds.), *Segmentation in social marketing: Process, methods and application* (pp. 197–214). Springer.

Schuett, M. A., Kyle, G. T., Leitz, J., Kurzawski, K., & Lee, K. (2014). Anglers' motivations for volunteering with fishing or conservation organizations. *Fisheries*, *39*(7), 305–311. https://doi.org/10.1080/03632415.2014.924407

Schultz, P. W. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology*, *21*, 327–339. https://doi.org/10.1006/jevp.2001.0227

Schwartz, G. (1978). Estimating the dimension of a model. *The Annals of Statistics*, *6*(2), 461–464.

Sextus, C. P., Hytten, K. F., & Perry, P. (2024). Volunteer commitment and longevity in community-based conservation in Aotearoa New Zealand. Kōtuitui: New Zealand. *Journal of Social Sciences Online*, 1–21. https://doi.org/10.1080/1177083X.2024.2335995

Sinner, J., Tadaki, M., McCarthy, A., Challies, E., & Thomson-Laing, J. (2022). *Catchment and community environment groups in Aotearoa New Zealand: Goals, activities and needs* (Report No. 3733) (p. 68). Cawthron Institute.

Slater, M. D., Kelly, K. J., & Thackeray, R. (2006). Segmentation on a shoestring: Health audience segmentation in limited-budget and local social marketing interventions. *Health Promotion Practice*, *7*(2), 170–173. https://doi.org/10.1177/1524839906286616

Sloane, G. M.-T., & Pröbstl-Haider, U. (2019). Motivation for environmental volunteering—a comparison between Austria and Great Britain. *Journal of Outdoor Recreation and Tourism*, *25*, 158–168. https://doi.org/10.1016/j.jort.2019.01.002

Smith, L. T. (2012). *Decolonizing methodologies: Research and indigenous peoples* (2nd ed.). Zed Books.

Stats, N. Z. (2021). *Māori population estimates: At 30 June 2021*. Retrieved from https://www.stats.govt.nz/information-releases/maori-population-estimates-at-30-june-2021

Sundaraja, C. S., Hine, D. W., & Lykins, A. D. (2021). Palm oil: Understanding barriers to sustainable consumption. *PLoS One*, *16*(8), e0254897. https://doi.org/10.1371/journal.pone.0254897

Takase, Y., Hadi, A. A., & Furuya, K. (2019). The relationship between volunteer motivations and variation in frequency of participation in conservation activities. *Environmental Management*, *63*(1), 32–45. https://doi.org/10.1007/s00267-018-1106-6

Te Aho, L. (2018). Te Mana o te Wai: An indigenous perspective on rivers and river management. *River Research and Applications*, *35*(10), 1615–1621. https://doi.org/10.1002/rra.3365

Thode, H. C. (2002). *Testing for normality*. CRC Press.

Tipa, G. (2009). Exploring indigenous understandings of river dynamics and river flows: A case from New Zealand. *Environmental Communication*, *3*(1), 95–120. https://doi.org/10.1080/17524030802707818

Van Bavel, J. J., Cichocka, A., Capraro, V., Sjåstad, H., Nezlek, J. B., Pavlović, T., Alfano, M., Gelfand, M. J., Azevedo, F., Birtel, M. D., Cislak, A., Lockwood, P. L., Ross, R. M., Abts, K., Agadullina, E., Aruta, J. J. B., Besharati, S. N., Bor, A., Choma, B. L., & Boggio, P. S. (2022). National identity predicts public health support during a global pandemic. *Nature Communications*, *13*(1), 517. https://doi.org/10.1038/s41467-021-27668-9

van der Werff, E., Steg, L., & Keizer, K. (2013). The value of environmental self-identity: The relationship between biospheric values, environmental self-identity and environmental preferences, intentions and behaviour. *Journal of Environmental Psychology*, *34*, 55–63. https://doi.org/10.1016/j.jenvp.2012.12.006

van Valkengoed, A. M., Abrahamse, W., & Steg, L. (2022). To select effective interventions for pro-environmental behaviour change, we need to consider determinants of behaviour. *Nature Human Behaviour*, *6*(11), 1482–1492. https://doi.org/10.1038/s41562-022-01473-w

Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., Glidden, S., Bunn, S. E., Sullivan, C. A., Liermann, C. R., & Davies, P. M. (2010). Global threats to human water security and river biodiversity. *Nature*, *467*(7315), 555–561. https://doi.org/10.1038/nature09440

Walker, E., Wehi, P., Nelson, N., Beggs, J., & Whaanga, H. (2019). Kaitiakitanga, place and the urban restoration agenda. *New Zealand Journal of Ecology*, *43*(3), 1–8. https://doi.org/10.20417/nzjecol.43.34

West, S., & Pateman, R. (2016). Recruiting and retaining participants in citizen science: What can be learned from the volunteering literature? *Citizen Science: Theory and Practice*, *1*(2), 15. https://doi.org/10.5334/cstp.8

SUPPORTING INFORMATION

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

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