

Article

Understanding the Drivers and Barriers to Preventing the Spread of Kauri Dieback: An Audience Segmentation Approach [†]

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Abstract

Kauri dieback, caused by *Phytophthora agathidicida* Weir, Beever, Pennycook & Bellgard, poses a major threat to the ecological and cultural significance of Aotearoa New Zealand's kauri forests. Visitor behaviour, particularly boot-cleaning and adherence to track-use guidelines, is a key transmission pathway. Using the COM-B framework and audience segmentation, we surveyed 451 visitors to the Waitākere and Hunua Ranges to identify behavioural drivers, barriers, and segment-specific intervention needs. Stepwise regressions accounted for 52% of the variance in self-reported boot-cleaning compliance and 56% in track-use compliance within this sample (adjusted R^2). Boot-cleaning compliance was enhanced by habit strength, worry about spreading the pathogen, awareness of correct procedures, and reliance on functional cleaning stations, while inconvenience and chemical aversion reduced compliance. Track-use compliance was lowered by perceived low likelihood of spread, doubts about mitigation effectiveness, time-cost concerns, and strong forest-use identity, whereas protection motivation and habitual rule-following increased compliance. Latent profile analyses produced three segments per behaviour: boot-cleaning—Conflicted, Receptive, Engaged; and track-use—Identity-Driven Forest Users, Uncommitted, Engaged—which differed systematically in knowledge, concern, and compliance. We outline potential intervention implications informed by these findings and prior literature.

Keywords: COM-B; behaviour change wheel; audience segmentation; biosecurity; recreation management; kauri dieback; *Phytophthora*; New Zealand



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1. Introduction

The iconic New Zealand kauri tree (*Agathis australis*, (D.Don) Lindl. ex Loudon) is under increasing threat from the soil-borne pathogen *Phytophthora agathidicida* Weir, Beever, Pennycook & Bellgard, the causative agent of kauri dieback [1,2]. As a dominant and ecologically foundational species, kauri shape forest structure, nutrient cycling, and habitat availability, supporting a diverse assemblage of dependent flora and fauna. Their influence extends beyond individual trees to broader ecosystem processes, meaning that widespread infection has the potential to destabilise entire forest systems [3]. Kauri trees provide essential food and habitat for native birds and insects, and their towering canopies host

unique plant communities [4]. Their leaf litter creates highly tannic Podzol soils, which inhibit invasive species [5]. Consequently, the loss of kauri could trigger the collapse of an entire ecosystem, including flora and fauna that have co-evolved with these trees.

Kauri dieback was first identified on Great Barrier Island in the 1970s and later detected in the Waitākere Ranges in 2006 [1]. The disease spreads primarily through the movement of contaminated soil and water between affected and unaffected areas and is fatal for the kauri [6,7]. Human activity within forest environments is widely recognised as a major contributor, particularly when soil adheres to footwear or equipment [1,8]. Given the high visitation rates to kauri forest areas such as the Waitākere and Hunua Ranges near Auckland, even small lapses in biosecurity practices can create numerous opportunities for disease transmission.

In response, national biosecurity policies (e.g., National Pest Management Plan (2022), or Tiakina Kauri) have implemented a range of preventative measures aimed at reducing soil transfer. These include restrictions on track access, adherence to marked pathways, and mandatory boot-cleaning protocols that remove all visible soil and apply a 5% SteriGENE® solution to eliminate spores [9–12]. Despite the presence of these measures, compliance is inconsistent, and the ongoing spread of the pathogen suggests that existing interventions have not fully addressed underlying behavioural challenges [8,9,13].

1.1. Behaviour Change Interventions

Early approaches to influence behaviour often relied on the assumption that increasing knowledge would lead to behavioural change, known as the knowledge-deficit model [14,15]. However, research has consistently shown that awareness alone is insufficient; behaviour is shaped by a complex interplay of cognitive, social, and situational factors [16–18]. Although informational signage and educational materials remain central to current kauri dieback mitigation strategies, these approaches may overlook important motivational and contextual influences on visitor behaviour [16–18].

Contemporary approaches to behaviour change emphasise the importance of systematically identifying the factors that enable or constrain target behaviours [19]. The Capability, Opportunity, and Motivation–Behavioural (COM-B) model provides a comprehensive framework for the analysis of the key drivers and barriers influencing the chosen behaviours [20]. This model underpins the integrated behaviour change framework, the Behaviour Change Wheel (BCW) [16,20]. The COM-B model categorises influences into three main components—people’s capability, opportunity, and motivation to perform a particular behaviour. These categories are further divided into six subcomponents: Physical and Psychological Capability, Physical and Social Opportunity, and Reflective and Automatic Motivation, which capture both practical and psychological factors shaping behaviour. For example, Physical Capability may involve the skills needed to clean boots correctly, while Psychological Capability relates to awareness of infected tracks. Physical Opportunity includes environmental constraints such as the availability of alternatives when tracks are closed, and Social Opportunity reflects peer norms and social influence. Motivation encompasses deliberate decision-making (Reflective Motivation), such as weighing up the pros and cons of using a closed track, as well as emotional or habitual processes (Automatic Motivation), for example witnessing the demise of a much-loved kauri tree and not wishing to engage in any action that may spread further damage. Understanding these dynamics enables the design of interventions that go beyond information provision, integrating structural, social, and motivational levers to support sustained behaviour change.

The use of COM-B to determine drivers of and barriers to pro-environmental behaviours has previously been successful. Studies have applied the model across a wide range of environmental challenges, including sustainable land management [21] and biodi-

versity loss [22]. Other researchers have employed COM-B to promote household water conservation [23], energy efficiency [24], litter reduction [25], and sustainable consumerism [26]. These applications demonstrate the versatility of COM-B in diagnosing behavioural determinants and guiding targeted interventions across diverse pro-environmental contexts.

Audience segmentation offers a complementary strategy by recognising that populations are not behaviourally homogeneous. Instead, individuals can be grouped according to shared patterns of beliefs, motivations, and constraints. By identifying clusters of users with similar behavioural profiles, such as those derived from the COM-B model, interventions can be tailored to address the specific factors influencing each group, thereby increasing both effectiveness and efficiency [27,28]. Audience segmentation has been successfully applied to various environmental challenges, including climate change mitigation behaviours [28] and citizen reporting [29].

To date, segmentation has not been applied to kauri dieback prevention. Given the high volume of local and national visitors to kauri forests, achieving universal compliance is unlikely. However, even small improvements in behaviour across the visitor population can significantly reduce disease transmission and improve forest health outcomes. Incremental gains may also buy valuable time for scientific solutions or infrastructure upgrades. Targeting interventions toward segments most likely to spread kauri dieback is therefore critical to safeguarding this iconic New Zealand species.

1.2. *This Study*

This study aims to identify the primary drivers of and barriers to forest users' compliance with boot-cleaning and track-use guidelines in the Waitākere and Hunua Ranges. Specifically, we predict that:

- Higher perceived drivers and lower perceived barriers will be associated with greater compliance with boot-cleaning and track-use guidelines.
- Distinct profiles of drivers and barriers will emerge among respondents, with some audience segments exhibiting deficits related to capability, opportunity, and motivation.
- Audience segments with unique driver/barrier profiles will differ significantly in their level of compliance with boot-cleaning and track-use guidelines.
- This study examines associations between perceived capability, opportunity, and motivation factors and self-reported compliance behaviours. Given the cross-sectional design and reliance on self-report measures, we interpret findings as indicative of relationships within this sample rather than causal determinants of behaviour.

2. Materials and Methods

2.1. *Participants*

Data were collected from individuals in Aotearoa, New Zealand, who had visited the Waitākere and/or Hunua Ranges within the previous four years. Participants were recruited through a combination of an online research panel (Qualtrics, Provo, UT, USA; <https://www.qualtrics.com>) and supplementary community-based outreach, including local flyer distribution and targeted social media advertisements within the Titirangi region. This approach yielded a total sample of 451 respondents.

The resulting sample differed somewhat from national population benchmarks, with an overrepresentation of New Zealand European respondents and individuals with higher levels of tertiary education (56.5% having attained a bachelor's degree or higher compared with 27.1%), as well as a greater proportion of female participants (61% compared to 50%). Detailed demographic comparisons are provided in Table S1 in the Supplementary Materials.

2.2. Online Survey

Data were collected using an online questionnaire administered via Qualtrics. Eligibility was determined through an initial screening item asking whether respondents had visited the relevant forest areas within the specified timeframe. Only those meeting this criterion proceeded to the main survey. Several measures were implemented to ensure data quality, including bot-detection tools (RelevantID and reCAPTCHA), randomisation of item order within sections, and an embedded attention-check question to identify inattentive responses. The survey also employed a forced-response format, resulting in minimal missing item-level data. Twenty-one otherwise eligible participants were excluded from the final dataset because they either failed the attention-check question or exited the survey prior to completion.

2.3. Measures

The questionnaire initially captured demographic information (gender, age, highest educational achievement, and ethnicity), reasons for forest use (recreation, convenience or work-related), and sources of kauri dieback information (traditional broadcast media such as TV or radio, traditional print media such as newspaper or journal articles, social media, organisational websites, community sources such as community groups, newsletters or word of mouth, and family or close friends).

Knowledge of kauri dieback was assessed with five multiple-choice questions about kauri trees (what they look like and their origins), kauri dieback (what causes it and how it spreads) and correct boot-cleaning practice (Refer to the Supplementary Table S2 for more detail). Knowledge scores were calculated as the total number of correct responses.

Concern about kauri dieback was measured using three items: 'I am not overly worried about kauri dieback' (reverse coded), 'The more I hear and read about kauri dieback, the more concerned I become', 'Considering any potential effects which kauri dieback may have on me personally, I am not particularly concerned' (reverse coded). Responses were coded on a 5-point Likert scale, which recorded the responses from 1 (Strongly disagree) to 5 (Strongly agree). Reliability analysis showed adequate internal consistency for the three items (Cronbach's $\alpha = 0.72$), so the three items were averaged for an overall concern score for analysis.

General environmental worldview was assessed using a 6-item short version of the New Ecological Paradigm (NEP) [30,31]. Items captured both 'eco-centric' ('The earth is like a spaceship with very limited room and resources', 'Plants and animals do not exist primarily to be used by humans', 'The balance of nature is very delicate and easily upset by human activities') and anthropocentric perspectives ('Mankind is created to rule over the rest of nature' (reverse coded), 'Modifying the environment for human use seldom causes serious problems' (reverse coded), 'There are no limits to growth for nations' (reverse coded)). Responses were recorded on a 5-point Likert scale from 1 (Strongly disagree) to 5 (Strongly agree). Responses were combined to produce an overall score reflecting environmental orientation, with higher NEP values indicating higher ecocentrism. This NEP scale demonstrated marginal internal reliability (Cronbach's $\alpha = 0.68$), indicating moderate consistency among items. However, comparable reliability estimates have been reported in previous New Zealand research using shortened NEP measures [32]. In addition, the NEP variable was included primarily as an auxiliary descriptive measure rather than a core predictor or segmentation variable. Given its theoretical relevance and acceptable construct performance within the present analyses, NEP scores were retained while recognising the limitation associated with the moderate reliability estimate.

Two key behavioural outcomes were examined: compliance with boot-cleaning protocols and adherence to track-use guidelines. Boot-cleaning guideline compliance was

assessed by four items capturing frequency of cleaning before and after entry, removal of soil, and use of disinfectant solution. Responses were coded on a 5-point Likert scale, which recorded the responses from 1 (Never) to 5 (Always). Reliability analysis indicated very good internal consistency (Cronbach's $\alpha = 0.87$), so the four items were averaged for an overall boot-cleaning compliance score for analysis.

Track-use guideline compliance was measured through three items assessing avoidance of closed tracks, staying on designated paths, and limiting off-track movement by accompanying individuals or animals. Responses were coded on a 5-point Likert scale ranging from 1 (Never) to 5 (Always). Reliability analysis showed adequate internal consistency for the three items (Cronbach's $\alpha = 0.74$), so the three items were averaged for an overall track-use compliance score for analysis.

Behavioural drivers and barriers were assessed using items adapted from a previous study using the COM framework [33]. Participants indicated their level of agreement with statements using a 5-point Likert scale of Strongly Disagree (1) to Strongly Agree (5), reflecting both facilitating factors (drivers) and inhibiting factors (barriers). Full item wording is provided in Table 1.

Table 1. Capability–Opportunity–Motivation driver (D) and barrier (B) variables and associated questions for the two behaviours—boot-cleaning (BC) and track-use (TU).

COM Category	Variable Name	Question
Boot-cleaning		
Capability—Physical	Chemical aversion	I will not spray SteriGENE® on my footwear or outdoor equipment because I don't want to touch chemicals (B).
Capability—Psychological	Awareness of correct BC	I am aware of the correct way to clean my boots at a cleaning station (D).
	Lack of knowledge of BC	I do not know the best method for cleaning my footwear or outdoor equipment (B).
Opportunity—Physical	Committed to BC	I avoid accessing forest tracks when boot-cleaning stations are out of cleaning liquid (D).
	Time Consuming	Cleaning my boots before and after hiking is too time-consuming (B).
	Inconvenient	I usually only clean my boots when it is convenient to do so (B).
Opportunity—Social	Positive Relationships	My family and close friends would be supportive if I asked them to clean their boots before accessing tracks in kauri forests (D).
	Limited Personal Responsibility	I am resistant to cleaning my boots because it's the government's responsibility to fix this problem, not mine (B).
Motivation—Reflective	Worry Invoked BC	I am careful about cleaning my boots because I am worried about spreading kauri dieback (D).
	Lack of Personal Agency	I am not confident that my boot-cleaning behaviour can make a difference to kauri dieback (B).
Motivation—Automatic	Habitual BC	Cleaning my boots frequently has just become second nature; I don't think about it anymore (D).
	Allow Natural Course	I am reluctant to clean my boots because I feel it is time we stop trying to prevent natural occurrences such as kauri dieback (B).
Track-use		
Capability—Physical	Knowledge of Risk Mitigation	I am reluctant to stop using the closed tracks in the Waitākere and Hunua Ranges because I know how to do so without causing damage (B).
Capability—Psychological	Knowledge of Infected Areas	When visiting the forests in the Waitākere and/or Hunua Ranges, I know which tracks are affected by Kauri dieback (D).
	Difficulty in Following Closures	I find it hard to keep track of which tracks are open or closed when visiting forests in the Waitākere and Hunua Ranges (B).
Opportunity—Physical	Time Consuming	I use the closed tracks in the Waitākere and Hunua Ranges because I don't have time to take the long way round (B).
	Pest Trapping	I will sometimes access a closed track to manage pest traps and weeds (B).

Table 1. *Cont.*

COM Category	Variable Name	Question
Opportunity—Social	Positive Relationships	My family and close friends would be supportive if I refused to use the closed tracks in the Waitākere and Hunua Ranges (D).
	TU Guideline Enforcement	When I see people using closed tracks, I find it difficult to tell them to stop (B).
	Non-compliant Social Norms	Most of the visitors to the Waitākere and Hunua Ranges do not appear to care about the rules around track closures, so why should I? (B).
	Limited Personal Responsibility	I will keep using the closed tracks in the Waitākere and Hunua Ranges because it is the government's responsibility to fix the problem, not mine (B).
Motivation-Reflective	Protection of Kauri	I avoid using closed tracks in the Waitākere and Hunua Ranges to protect the kauri forests (D).
	Lack of Personal Agency	I am not confident that my avoiding closed tracks in the Waitākere and Hunua Ranges will ultimately make a difference to kauri dieback (B).
	Unlikelihood of Spread	I sometimes use the closed tracks in the Waitākere and Hunua Ranges because I think it is unlikely that I will spread kauri dieback (B).
	Low Punishment Likely	I am reluctant to stop using the tracks in the Waitākere and Hunua Ranges when it is very unlikely I will be caught (B).
	Unsuccessful Mitigation Efforts	I will continue using the closed tracks in the Waitākere and Hunua Ranges as I don't believe the current efforts can stop the spread of kauri dieback (B).
Motivation-Automatic	Habitual Rule Follower	When a new request is made by the Iwi of the Waitākere region, Te Kawerau ā Maki or the Auckland City Council, such as a rāhui or track closure, I usually obey without thinking about it (D).
	TU as an Identity	The forest and walking in it are part of my identity, so I will continue accessing closed tracks in the Waitākere and Hunua Ranges (B).
	Selfishness	I am unwilling to sacrifice my own pleasure and well-being to protect kauri forests (B).
	Limit Care for Kauri	Limiting access to kauri forests will limit my ability to understand and care for them (B).

2.4. Data Analysis

Statistical analyses were conducted using IBM SPSS Statistics for Windows Version 28.0 (IBM Corp., Armonk, NY, USA), with latent profile models estimated in Mplus Version 8.6 (Muthén & Muthén, Los Angeles, CA, USA). Stepwise multiple regression was used to identify the subset of COM-B variables that uniquely predicted each behavioural outcome. Given the conceptual overlap between capability, opportunity, and motivation constructs, some degree of multicollinearity is expected. As such, regression coefficients are interpreted with caution, particularly with respect to their unique contributions.

Latent Profile Analysis (LPA) was employed to identify distinct respondent subgroups based on their pattern of COM-B responses for both behaviours. Model selection was guided by multiple criteria including the Bayesian Information Criteria (BIC) [34,35], relative entropy [36,37] and the Lo–Mendell–Rubin likelihood ratio test (LMR) [38]. Each group was named based on its distinctive COM profile characteristics.

Associations between identified profiles and additional variables were examined using MANOVA, followed by Tukey HSD post hoc tests and chi-square analyses, supplemented by bootstrapping procedures to account for violations of statistical assumptions. Effect sizes were interpreted using conventional thresholds (small $\eta^2 = 0.01$, medium = 0.06, large = 0.14), with emphasis placed on practical and theoretical significance in addition to statistical magnitude.

3. Results

3.1. Descriptive Statistics and Correlations

As predicted, all barrier items were negatively correlated with both boot-cleaning compliance and track-use compliance. All driver items were positively correlated with boot-cleaning compliance; however, not all the driver items were positively correlated with track-use compliance. The exception was the Capability-Psychological variable Knowledge of Infected Areas, which was not significantly correlated with reported track-use compliance, and tended to be positively correlated with many of the barrier items (see Supplementary Tables S3 and S4 for further details).

3.2. COM Variables Predicting Boot-Cleaning and Track-Use Compliance

Two stepwise multiple regressions were conducted to identify the subset of COM items that were associated with variance in both self-reported boot-cleaning compliance and track-use compliance within this sample. Four drivers and two barriers were found to be significant predictors for boot-cleaning compliance. The four drivers showed that forest users reported higher compliance with boot-cleaning guidelines if they were more habitual in their boot-cleaning; more worried about the impact of spreading kauri dieback; more aware of the correct boot-cleaning practices; and more committed to only using tracks with a functional boot-cleaning station. The two barriers showed that forest users reported less compliance with boot-cleaning guidelines, as they felt boot-cleaning was more inconvenient and as their aversion to the boot-cleaning chemicals increased. Overall, the set of significant predictors ($F(6, 444) = 81.80, p < 0.001$) accounted for 52% of the variance in self-reported boot-cleaning compliance (adjusted R^2). The amount of unique variance explained ranged from 7% for habitual cleaning to 1% for commitment to cleaning. A full breakdown of the regression findings is presented in Table 2.

Table 2. Stepwise regression of Capability Opportunity Motivation variables against compliance to boot-cleaning and track-use guidelines (N = 451).

Predictors	B	SE B	95% CI for B		β	sr^2
			LB	UB		
Boot-cleaning						
Habitual BC	0.23 ***	0.03	0.18	0.29	0.30	0.07
Worry Invoked BC	0.20 ***	0.03	0.14	0.27	0.24	0.04
Awareness Correct BC	0.14 ***	0.04	0.08	0.21	0.15	0.02
Inconvenient	−0.12 ***	0.03	−0.17	−0.06	−0.17	0.02
Chemical Aversion	−0.11 ***	0.03	−0.17	−0.06	−0.16	0.02
Committed to BC	0.06 *	0.03	0.01	0.11	0.09	0.01
Track-use						
Unlikelihood of Spread	−0.16 ***	0.04	−0.23	−0.09	−0.25	0.02
Protection of Kauri	0.14 ***	0.03	0.08	0.19	0.19	0.03
Time Consuming	−0.10 **	0.03	−0.16	−0.04	−0.15	0.01
Track-use as an Identity	−0.05 *	0.03	−0.13	−0.01	−0.12	0.01
Habitual Rule Follower	0.06 **	0.02	0.01	0.10	0.09	0.01
Unsuccessful mitigation efforts	−0.09 **	0.03	−0.17	−0.03	−0.16	0.01

Notes: B = Unstandardised beta coefficient, SE = Standard error, CI = Confidence interval, LB = Lower bound, UB = Upper bound, β = Standardised beta coefficient, sr^2 = Squared semi-partial Pearson correlation. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Four barriers and two drivers were found to be significant predictors for track-use compliance. The barrier results demonstrated that forest users were less likely to report compliance with track-use guidelines if they felt they were less likely to spread kauri dieback; had higher doubts that mitigation efforts would be successful; felt taking alternative routes would be too time-consuming; and felt that forest use was a larger part of their identity. Two drivers showed that forest users were more likely to report compliance

with track-use guidelines if they had a greater desire to protect kauri and if rule following was more habitual. Overall, the set of significant predictors ($F(6, 444) = 95.64, p < 0.001$) accounted for 56% of the variance in self-reported track-use compliance (adjusted R^2). The amount of unique variance explained ranged from 3% for wanting to protect kauri to 1% for holding more of an identity based on forest use. A full breakdown of the regression findings is presented in Table 2.

Given moderate intercorrelations among COM variables, these results should be interpreted as exploratory and sample-dependent rather than definitive rankings of predictor importance. The relatively small unique variance contributions ($sr^2 = 1\%–7\%$) indicate that much of the explained variance is shared among predictors. These findings should be interpreted in conjunction with the potential for shared variance among predictors, given conceptual overlap between COM-B constructs.

3.3. Segmentation of Participants by COM Variables

Latent Profile Analysis (LPA) was conducted using MPLUS (version 8.6) to determine latent profile groups based on boot-cleaning COM variable scores, and a second LPA to determine latent profile groups based on track-use COM variable scores. The identified profiles represent data-derived groupings within the present sample rather than naturally occurring or fixed audience types. Because profile membership was defined using COM variables, differences between segments on these same variables are expected and should not be interpreted as independent explanatory findings.

For both behaviours, one to six profile solutions were tested and the fit indices for each profile solution are presented in Table 3. For both behaviours, the Lo–Mendel–Rubin (LMR) test indicated that the 3-profile solutions fit the data significantly better than the 2-profile solutions, while subsequent profile solutions failed to significantly improve fit. Furthermore, models with additional profiles yielded comparatively small classes and reduced interpretability, suggesting possible over-extraction of profiles. Thus, for both behaviours, the 3-profile solutions were retained for interpretation and subsequent analyses. The identified segments were labelled following established naming conventions in audience segmentation research, ensuring labels reflected each segment's dominant drivers and barriers. For boot-cleaning, these were Conflicted ($n = 43$), Receptive ($n = 97$) and Engaged ($n = 299$), and for track-use, Identity-Driven Forest Users ($n = 49$), Uncommitted ($n = 97$) and Engaged ($n = 305$).

Table 3. LPA model fit indices for boot-cleaning and track-use Capability Opportunity Motivation profile solutions.

Profile Solutions	BIC	Entropy	LMR	<i>p</i>
Boot-cleaning				
1	16,906.23	-	-	-
2	15,673.06	0.93	1296.30	<0.01
3	15,197.89	0.94	547.73	<0.01
4	15,065.68	0.95	206.02	0.20
5	14,915.87	0.95	253.16	0.06
6	14,851.31	0.95	142.22	0.86
Track-use				
1	26,366.01	-	-	-
2	23,608.74	0.98	2848.86	<0.001
3	22,997.65	0.97	721.00	0.02
4	22,774.57	0.97	336.30	0.29
5	22,616.46	0.97	271.89	0.07
6	22,551.15	0.98	179.88	0.39

Notes: BIC = Bayesian Information Criteria, LMR = Lo-Mendel-Rubin likelihood ratio test.

3.3.1. Boot-Cleaning Segments

The three-segment solution for boot-cleaning is presented in Figure 1, and the comparison statistics for boot-cleaning guideline compliance, demographic, and other personal variables are presented in Table 4 (Detailed statistical information for barriers and driver variables is available in Table S5). A comparison of the three segments across all tested variables is presented in Table 5, and a short descriptive summary is given below.

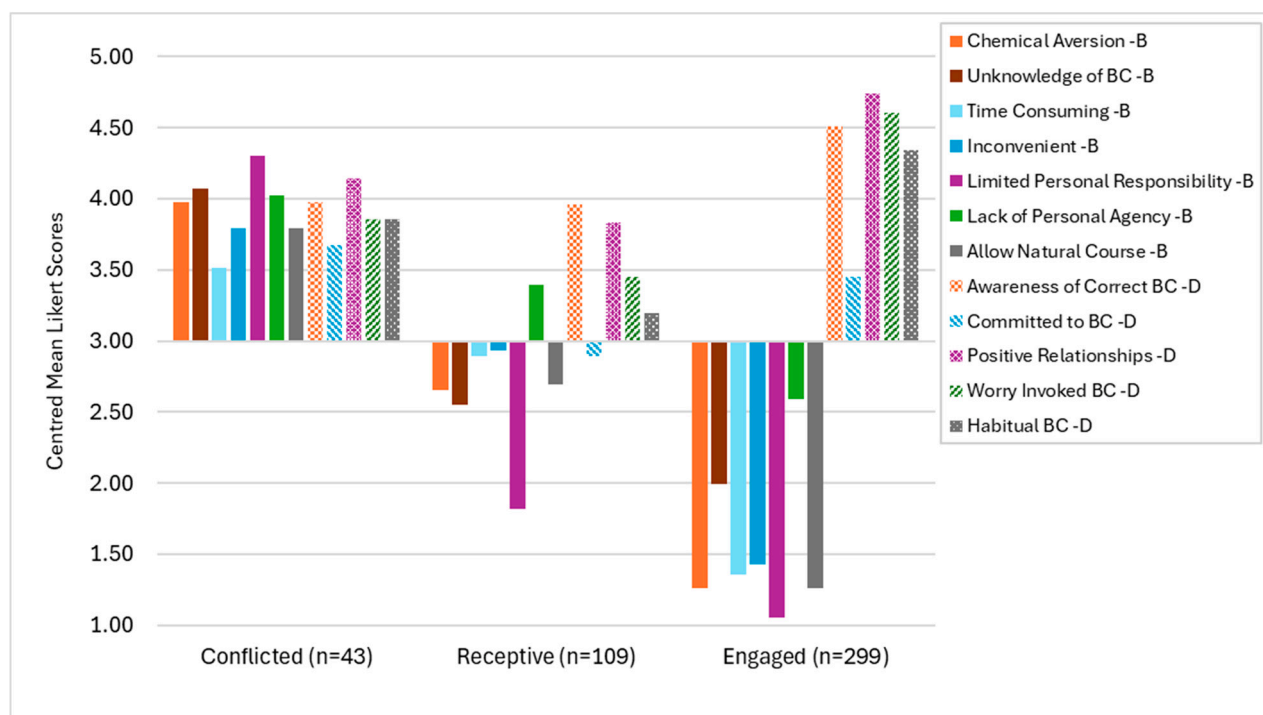


Figure 1. Means of Capability, Opportunity, and Motivation factors across the three identified boot-cleaning (BC) profiles (B = barriers, D = drivers).

Table 4. Comparison of guideline compliance, demographic, and other personal variables across the three identified segments for boot-cleaning.

Variable				Conflicted (n = 43)	Receptive (n = 109)	Engaged (n = 299)
	F	p	η^2	Mean	Mean	Mean
Guideline compliance	91.30	<0.001	0.29	3.80 ^a	3.70 ^a	4.80 ^b
Kauri dieback concern	28.55	<0.001	0.11	3.10 ^a	3.20 ^a	3.85 ^b
Kauri dieback knowledge	12.28	<0.001	0.05	2.91 ^a	3.34 ^b	3.68 ^b
Age (years)	6.12	0.002	0.03	32.47 ^a	40.79 ^b	41.51 ^b
NEP	43.03	<0.001	0.16	3.18 ^a	3.57 ^b	4.05 ^c
	χ^2	p	r	n (Z _{Resid})	n (Z _{Resid})	n (Z _{Resid})
Gender						
Male	14.27	0.006	0.16	24 (2.51)	50 (1.91)	98 (−3.29)
Female				18 (−2.51)	59 (−1.91)	198 (3.29)
Education						
Secondary				4 (−1.61)	20 (0.03)	59 (1.01)
Trade Cert.	13.40	0.04	0.03	20 (3.42)	26 (−0.32)	67 (−1.82)
Undergrad				11 (0.04)	28 (0.14)	76 (−0.13)
Postgrad+				8 (−1.89)	35 (0.32)	97 (0.89)

Table 4. Cont.

Variable				Conflicted (<i>n</i> = 43)	Receptive (<i>n</i> = 109)	Engaged (<i>n</i> = 299)
Forest use						
Recreation	72.43	<0.001	0.12	24 (−6.34)	94 (0.67)	260 (2.62)
Convenience				13 (8.44)	4 (−0.62)	4 (−4.71)
Work related				6 (0.61)	11 (−0.54)	34 (0.13)
Information sources						
Traditional broadcast	0.52	0.77	0.02	19 (0.0)	51 (0.7)	128 (−0.7)
Traditional print	0.28	0.87	0.02	19 (0.0)	46 (−0.5)	135 (0.5)
Social media	1.09	0.58	0.04	21 (0.1)	57 (1.0)	139 (−1.0)
Websites	0.21	0.90	0.02	17 (−0.5)	47 (0.1)	129 (0.2)
Community sources	6.58	0.04	0.10	21 (−0.72)	48 (−2.33)	173 (2.46)
Family and friends	8.71	0.01	0.13	24 (2.89)	40 (0.24)	98 (−2.02)

Means with different superscripts (in rows) differ significantly at $p < 0.05$ Tukey HSD; NEP = New Ecological Paradigm; η^2 = partial eta squared; $\eta^2 \geq 0.14$ indicates strong effect size, $\eta^2 = 0.06$ indicates medium effect size, $\eta^2 = 0.01$ indicates small effect size; r = Pearson's correlation coefficient; $r \geq 0.50$ indicates strong effect size, $r = 0.30$ indicates medium effect size, $r = 0.10$ indicates small effect size; Z_{Resid} = Adjusted standardised residual, where $|Z_{\text{Resid}}| > 1.2$ is significant at $p < 0.05$; a positive significant Z_{Resid} value means that particular group is more likely to be over represented, a negative value is more likely to be under represented.

Table 5. Comparison of all measured variables across all identified segments for boot-cleaning and trac-use.

Boot-Cleaning	Conflicted (<i>n</i> = 43)	Receptive (<i>n</i> = 109)	Engaged (<i>n</i> = 299)
COM-B characteristics			
Barrier agreement	strong	moderate	weaker
Driver agreement	moderate	moderate	strong
Guideline compliance	lower	lower	highest
Knowledge amd attitudes			
Concern	lower	lower	highest
Knowledge	lowest	moderate	highest
Ecocentrism (NEP)	lowest	moderate	highest
Demographics			
Gender	more likely male	no difference	more likely female
Average age	youngest	older	older
Education	more likely trade	no difference	no difference
Forest use	more likely convenience	no difference	more likely recreation
Information sources			
Community sources	no difference	less likely	more likely
Family and friends	more likely	no difference	less likely
Track-use	Identity-Driven Forest Users (<i>n</i> = 49)	Uncommitted (<i>n</i> = 97)	Engaged (<i>n</i> = 305)
COM-B Characteristics			
Barrier agreement	moderate	moderate	weak
Driver agreement	moderate	moderate	strong
Guideline compliance	lowest	moderate	highest
Knowledge and attitudes			
Concern	lower	lower	highest
Knowledge	lowest	moderate	highest
Ecocentrism (NEP)	lowest	moderate	highest
Demographics			
Gender	more likely male	no difference	more likely female
Average age	youngest	older	oldest
Education	no difference	no difference	no difference
Forest use	more likely convenience	no difference	more likely recreation

Table 5. *Cont.*

Boot-Cleaning	Conflicted (<i>n</i> = 43)	Receptive (<i>n</i> = 109)	Engaged (<i>n</i> = 299)
Information sources			
Community sources	no difference	no difference	no difference
Family and friends	more likely	no difference	less likely

The Engaged segment represents participants who exhibit consistently strong drivers and very low barriers toward both boot-cleaning and track-use compliance. Members of this group have high awareness, strong personal responsibility, and well-established habits that make pro-environmental behaviours almost automatic. They are motivated by concern for kauri, supported by their social networks, and confident that their actions make a difference. Their high capability, opportunity, and motivation translate into the highest compliance levels across all segments.

The Receptive segment is characterised by moderate drivers and low-to-moderate barriers. Members generally accept the importance of kauri dieback prevention and show willingness to comply, but their behaviours are less strongly habit-driven than those of the Engaged segment. While this group holds personal responsibility for protecting kauri and possesses some knowledge of correct practices, several psychological and contextual factors remain only partially developed. As a result, their compliance is moderate rather than high, but they represent a group with strong potential for targeted behaviour change interventions.

The Conflicted segment exhibits low compliance due to the combination of moderate drivers and relatively high barriers. These visitors tend to feel uncertain about correct boot-cleaning methods, doubt the impact of their individual actions, and show some aversion to aspects of the required behaviours, such as using disinfectant or taking extra time to clean footwear. They also lean more toward viewing responsibility for kauri dieback management as lying with authorities rather than individuals. Although they have some supportive social context and basic awareness, their elevated barriers outweigh their drivers, resulting in inconsistent and often low levels of compliance.

3.3.2. Track-Use Segments

The three-segment solution for track-use is presented in Figure 2, and the comparison statistics for track-use guideline compliance, demographic, and other personal variables are presented in Table 6 (Detailed statistical information for barriers and driver variables is available in Table S6). A comparison of the three segments across all tested variables is presented in Table 5, and a short descriptive summary is given below.

The Engaged segment consists of participants who show consistently high capability, opportunity, and motivation to follow both boot-cleaning and track-use guidelines. They exhibit very strong drivers, such as a desire to protect kauri, habitual rule-following, and supportive social networks, and extremely low levels of perceived barriers. Their behaviours are well-established, confident, and highly consistent, resulting in the highest compliance levels across all groups.

The Uncommitted segment is characterised by generally moderate responses across both drivers and barriers. Members tend to hold some pro-kauri motivations, but these are not strongly ingrained or habitual, and their perceived barriers are mostly low to moderate. Their behavioural patterns sit near the midpoint of most measures, indicating a group that is willing but not strongly driven. As a result, they demonstrate moderate to high compliance, with substantial room for improvement through targeted behaviour change strategies.

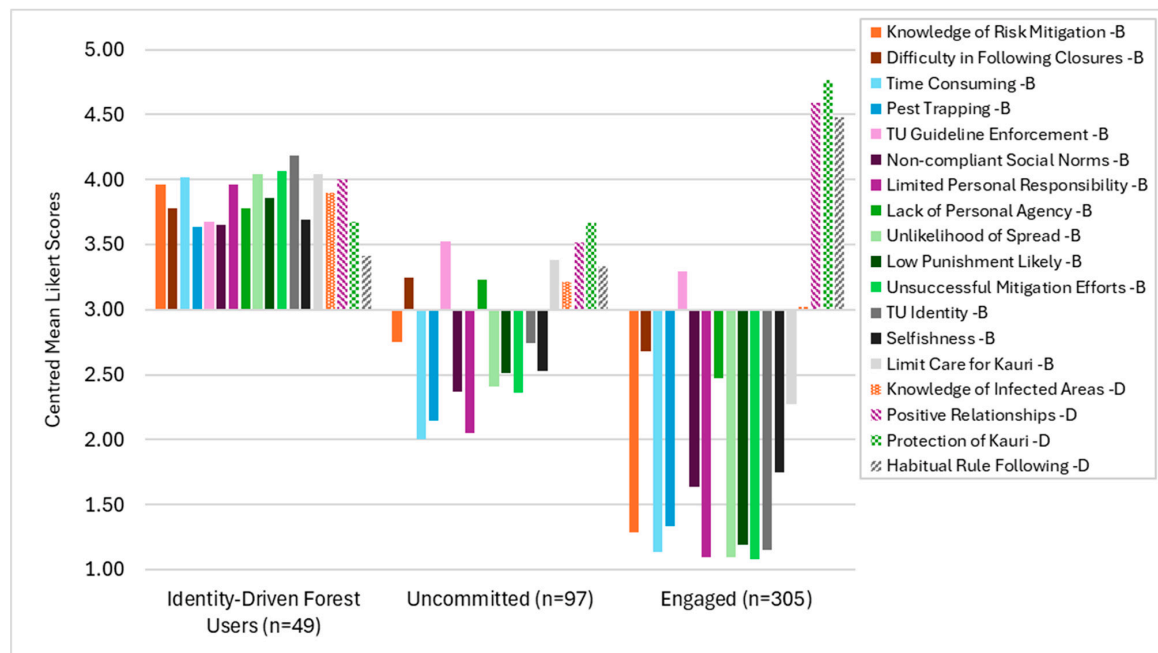


Figure 2. Means of Capability, Opportunity, and Motivation factors across the three identified track-use (TU) profiles (B = barriers, D = drivers).

Table 6. Comparison of demographic and other personal variables across the three identified segments for track-use.

Variable	Identity-Driven Forest Users (n = 49)			Uncommitted (n = 97)		Engaged (n = 305)	
	F	p	η^2	Mean	Mean	Mean	
Guideline compliance	201.27	<0.001	0.47	3.30 ^a	4.20 ^b	4.80 ^c	
Kauri dieback concern	35.47	<0.001	0.14	2.95 ^a	3.20 ^a	3.86 ^b	
Kauri dieback knowledge	14.12	<0.001	0.06	2.90 ^a	3.33 ^b	3.69 ^b	
Age (years)	10.12	<0.001	0.04	32.18 ^a	38.36 ^b	42.47 ^b	
NEP	42.15	<0.001	0.16	3.20 ^a	3.58 ^b	4.04 ^c	
	χ^2	p	r	n (Z _{Resid})	n (Z _{Resid})	n (Z _{Resid})	
Gender							
Male	26.31	<0.001	0.20	34 (4.81)	38 (0.23)	100 (−3.42)	
Female				14 (−4.81)	59 (−0.23)	202 (3.42)	
Education							
Secondary				7 (−0.8)	20 (0.6)	56 (0.0)	
Trade Cert.	11.10	0.09	0.07	21 (3.0)	26 (0.4)	66 (−2.4)	
Undergrad				9 (−1.2)	24 (−0.2)	82 (1.0)	
Postgrad+				12 (−1.1)	27 (−0.8)	101 (1.4)	
Forest use							
Recreation	86.90	<0.001	0.15	26 (−6.32)	85 (1.12)	267 (3.21)	
Convenience				15 (9.13)	2 (−1.40)	4 (−4.88)	
Work related				8 (1.18)	10 (−0.42)	33 (−0.51)	
Information sources							
Traditional broadcast	2.13	0.34	0.07	25 (1.1)	46 (0.8)	127 (−1.4)	
Traditional print	0.61	0.74	0.04	24 (0.7)	44 (0.2)	132 (−0.7)	
Social media	3.86	0.14	0.09	27 (1.0)	53 (1.5)	137 (−2.0)	
Websites	0.88	0.65	0.04	22 (0.3)	45 (0.8)	126 (−0.9)	
Community sources	1.19	0.55	0.05	24 (−0.7)	49 (−0.7)	169 (1.1)	
Family and friends	21.37	<0.001	0.22	30 (3.91)	42 (1.74)	90 (−4.12)	

Means with different superscripts (in rows) differ significantly at $p < 0.05$ Tukey HSD; NEP = New Ecological Paradigm; η^2 = partial eta squared; $\eta^2 \geq 0.14$ indicates strong effect size, $\eta^2 = 0.06$ indicates medium effect size, $\eta^2 = 0.01$ indicates small effect size; r = Pearson's correlation coefficient; $r \geq 0.50$ indicates strong effect size, $r = 0.30$ indicates medium effect size, $r = 0.10$ indicates small effect size; Z_{Resid} = Adjusted standardised residual, where $Z_{\text{Resid}} > |2|$ is significant at $p < 0.05$; a positive significant Z_{Resid} value means that particular group is more likely to be overrepresented, a negative value is more likely to be underrepresented.

The Identity-Driven Forest User segment is defined by a strong sense of identity attached to forest use, which shapes their perceptions of track-use guidelines. Members hold several motivational barriers, such as believing they are unlikely to spread disease, perceiving mitigation as ineffective, and feeling that alternative routes are too time-consuming, alongside concerns that restricted access limits their connection to, and care for, kauri. Despite some positive drivers, these barriers dominate, resulting in the lowest track-use compliance of the three groups.

We note that for both behaviours, some between-group differences are characterised by medium effect sizes ($\eta^2 \approx 0.06$); these magnitudes are consistent with expectations in applied behavioural research involving heterogeneous populations. Importantly, the identified segments exhibited coherent and systematic differences across multiple COM-B drivers and barriers, rather than relying on single-variable contrasts. This pattern suggests the practical and theoretical validity of the segmentation despite moderate effect sizes.

4. Discussion

This study explored the psychological and contextual factors shaping forest users' compliance with two key behaviours designed to limit the spread of kauri dieback: boot-cleaning and adherence to track-use guidelines. As predicted, we found perceived drivers to be positively associated with compliance behaviours, and perceived barriers to be negatively associated. Latent Profile Analyses revealed three distinct audience segments for both boot-cleaning and track-use compliance, based on participant driver/barrier responses. These segments represent data-derived groupings within this sample and should be interpreted as heuristic rather than fixed audience types, and show that compliance is not uniform across the user population; instead, different groups display different profiles of drivers and barriers, highlighting the value of targeted rather than one-size-fits-all interventions [32,33]. In our following discussion of intervention suggestions, it should be noted that they are informed by our findings in combination with prior behavioural research and theoretical frameworks, and should be viewed as hypothesis-generating directions requiring empirical validation.

4.1. Compliance and Intervention Implications with Boot-Cleaning Guidelines

We identified three boot-cleaning segments based on behavioural drivers and barriers: Conflicted, Receptive, and Engaged. The Conflicted segment showed low compliance, driven primarily by elevated barriers that outweighed their moderate drivers. In contrast, the Receptive segment demonstrated similarly low compliance, but for different reasons, namely, weaker drivers that were not strong enough to overcome generally neutral or negative barriers. Despite comparable compliance levels, these two segments represent distinct pathways to non-compliance, which need to be considered when designing interventions. As expected, the Engaged segment reported high boot-cleaning compliance, underpinned by consistently low barriers and strong behavioural drivers.

Boot-cleaning compliance is strongly influenced by a range of capability, opportunity and motivational factors, particularly worry about spreading kauri dieback, the development of habitual cleaning practices, and clear awareness of correct procedures. These findings align with evidence that motivational drivers such as concern, perceived responsibility, and habit strength often outperform purely informational approaches in promoting pro-environmental behaviour [17,18]. Interventions could therefore prioritise strengthening these drivers.

However, reducing barriers is equally important, particularly perceptions of inconvenience and aversion to chemical disinfectant. Previous evaluations of cleaning-station design have shown that ease of use substantially increases compliance [39,40], suggesting

that infrastructure improvements may yield significant gains. Clear visual standards for what “clean” footwear looks like, benches and handheld scrubbers for heavily soiled boots, and signage highlighting the safety of SteriGENE® could further reduce physical and psychological barriers. Providing mechanisms for reporting broken or empty stations may also increase users’ perceived agency [29]. Overall, improving boot-cleaning compliance may benefit from a combination of environmental restructuring, motivational messaging, and habit-formation supports [41].

Specifically, for the Conflicted segment, interventions could prioritise barrier reduction and simple, confidence-building supports. Upgrading older, cumbersome stations to high-efficiency models may help address perceptions of inconvenience, while installing a short “prep zone” before the main unit (a bench with handheld scrubbers and picks) prevents queues and allows heavily soiled footwear to be dealt with quickly. Previous field evaluations of redesigned kauri dieback cleaning stations have demonstrated measurable improvements in visitor compliance following infrastructure simplification and usability enhancements [39,40].

To reduce chemical aversion, stations could display concise safety reassurance (e.g., 5% solution, safe for people/dogs/gear when used as directed). Cognitive load can be lightened through clear visual standards (“unclean/adequately clean” photo boards) and a compact step heuristic (e.g., dry scrub → inspect → spray), supported by floor arrows and footprints that make the correct sequence intuitive. Finally, brief social prompts (“Your group is counting on you—please clean before and after”) reinforce supportive norms without moralising and help convert hesitancy into action.

The Receptive segment would respond well to habit-building supports and motivational cues. Consistency across stations (layout, iconography, instructions) enables cue-driven repetition and helps the behaviour become automatic. Short, positively framed feedback at the point of action (“Thanks—your clean boots protect this kauri forest”) consolidates completion and supports habit formation. To keep motivation proximal, signage can link cleaning to tangible, place-based outcomes (e.g., named trees and the locations of kauri trees known to be showing signs of infection of kauri dieback), reminding visitors that what happens at this station matters here. Light-touch public commitments (e.g., a small “I cleaned today” tick on a trailhead board or a QR check-in) can further stabilise intentions without adding friction. Together, these elements turn generally favourable attitudes into reliable, low-effort routines.

For the Engaged segment, the emphasis is on maintenance and channelling enthusiasm rather than behaviour change. Reliable infrastructure and uniform user experience could be preserved so that strong habits remain effortless. Rotating brief affirmative messages can avoid “banner blindness,” while inviting these visitors to model correct cleaning at busy times, report faults, or participate in small co-design tweaks (e.g., improving instruction clarity) aligns their identity with stewardship. Because their barriers are already minimal, the main risk is erosion of trust, so swift restocking, visible maintenance, and consistent station performance are key to sustaining exemplary compliance [42].

4.2. Audience Segments and Compliance with Track-Use Guidelines

We identified three track-use segments based on behavioural drivers and barriers: Identity-Driven Forest Users, Uncommitted, and Engaged. The Identity-Driven Forest User segment reported low track-use compliance, driven by motivational and contextual barriers that outweighed their moderate drivers. The Uncommitted segment reported moderate compliance, reflecting generally low-to-moderate barriers and relatively weak, but still positive drivers. Although both groups fall short of full compliance, they do so for different reasons, which will

need to be considered when designing intervention strategies. In contrast, the Engaged segment exhibited consistently high compliance, supported by strong drivers and minimal barriers.

Track-use compliance is influenced by a different set of barriers to those for boot-cleaning, many tied to motivation and personal identity. Forest use identity was negatively associated with self-reported compliance; however, the direction of this relationship cannot be determined from cross-sectional data, and reverse causation is possible. It is plausible that lower compliance behaviours may reinforce identity expression (e.g., viewing oneself as someone who accesses restricted areas), rather than identity necessarily driving non-compliance. These findings should therefore be interpreted as associative rather than causal. Visitors who strongly identify with forest use may therefore differ in how they interpret or prioritise track-use guidelines. Similar patterns have been observed in studies of place attachment and rule adherence in conservation settings [9,26].

Interventions that directly challenge the belief that individuals pose minimal risk, such as messages linking specific cases of infection to human movement, may help shift perceptions, as demonstrated in analogous wildlife-reporting contexts [29]. Highlighting successful mitigation and track-upgrade efforts may also counter beliefs that management actions are ineffective. For those who rely on tracks for transport or local movement, structural improvements such as safer footpaths, expanded parking, or alternative track upgrades may be necessary to reduce contextual barriers. Consistent with findings in behavioural science, reducing effort and increasing access to acceptable alternatives may be more effective than solely motivational messaging [16].

Specifically, for Identity-Driven Forest Users, interventions should respect and harness identity rather than oppose it. Where possible, co-design open loops that recreate valued experiences (e.g., canopy immersion, quieter stretches, scenic pauses) so that compliance does not feel like identity loss. Communication could make personal risk concrete without assigning blame by using brief, local narratives that link human soil transfer to specific infection events, paired with examples where staying on open tracks protected adjacent forests. These messages may help recalibrate risk while preserving dignity. Transparent updates on the rationale and sequencing of track priorities (what gets reopened, when, and why) and opportunities to contribute to advisory forums can convert identity-as-access into identity-as-guardianship [9]. Similar stewardship and citizen-participation approaches have previously been used in conservation and restoration contexts to strengthen environmental engagement and collective efficacy [29].

The Uncommitted segment benefits from small reductions in effort cost, clear alternatives, and subtle norm reinforcement. Wayfinding could make the compliant choice the easy choice: consistent closure treatments, legible maps at decision points, and signage that highlights time-equivalent open routes help neutralise the “too time-consuming” perception. Messaging that combines descriptive norms and protection (“Most visitors stay on open tracks to protect kauri—thanks for being part of the majority”) acknowledges existing intentions while nudging follow-through. Intermittent, visible ranger presence and predictable closure barriers strengthen the salience of rules, while highlighting scenic features along alternative routes preserves experiential value. These low-friction elements, delivered consistently, convert moderate goodwill into dependable compliance. As non-compliance in this group could stem from perceived personal benefits or rewards [43], like increased seclusion on closed tracks, strategies that remove these rewards by improving the quality and experience of alternate routes may be more effective than escalating the rarely applied punitive deterrents.

For the Engaged segment, the objective is to safeguard high standards and channel pro-social energy. Maintaining the integrity of closures (that is, ensuring closures are physically configured so visitors cannot easily bypass them via informal side paths or

gaps in the barrier) prevents confusion, and periodic public recognition of community compliance sustains collective efficacy. Invitations to mentor family/friends, assist with wayfinding at busy nodes, or report breached closures allow these visitors to extend their pro-social impact. As with boot-cleaning, rapid maintenance responses and consistent signage protect trust, the currency that underpins already strong motivational drivers [42].

4.3. Limitations and Future Research

This study relied on self-reported data, which may inflate compliance estimates due to social desirability or recall bias. This limitation may also influence the strength and pattern of relationships observed between perceived drivers/barriers and compliance behaviour. While both compliance measures showed acceptable reliability, the track-use measure could be strengthened with items capturing behaviours beyond formal tracks, such as informal route use [9]. Additionally, one track-use compliance item combined behaviours relating to children and dogs leaving designated tracks. These represent distinct behavioural agents with potentially different motivations and constraints, and combining them may reduce measurement precision and obscure differences in compliance patterns across behavioural contexts. Future research should separate these behaviours to allow more accurate assessment of compliance dynamics. The cross-sectional design limits causal inference; observed associations between COM-B variables and behaviour should be interpreted as correlational.

The sample was also not fully representative of the New Zealand population, with over-representation of New Zealand European and tertiary-educated participants. This sampling imbalance may also limit the extent to which the identified audience segments and behavioural drivers/barriers generalise across culturally diverse forest user groups in Aotearoa New Zealand. In particular, Māori relationships with kauri forests may involve distinct cultural, spiritual, and Kaitiakitanga (guardianship)-based dimensions that are not fully captured within the present sample or segmentation model. Consequently, some motivational and contextual influences on compliance behaviour may differ from those identified here. Future research would benefit from more representative sampling approaches and the use of culturally grounded co-design or kaupapa Māori research frameworks developed in partnership with iwi and local communities. Such approaches may identify additional pathways for encouraging compliance and stewardship behaviours that extend beyond those captured by the current COM-B framework.

Not all components of the COM-B model were fully captured. In particular, physical capability (e.g., mobility or physical ability to use cleaning stations) was not assessed, and social opportunity was limited primarily to close social networks rather than broader observational or normative influences. In addition, track-use compliance was measured using a limited number of items and may not capture behaviours such as informal path use. These limitations may reduce explanatory completeness.

Future studies should prioritise observational or technological measures of compliance to validate self-report patterns. Developing more comprehensive measures of track-use behaviour will help capture the full spectrum of compliance and non-compliance. Longitudinal research could illuminate how behaviour changes over time, and how shifts in infrastructure, public messaging, or social norms shape compliance. Co-design approaches involving iwi, community groups, and frequent forest users would also provide valuable insight into acceptable and culturally grounded interventions. Given the rapid spread of kauri dieback, research that evaluates targeted and scalable interventions, particularly those addressing motivational and identity-based barriers, remains an urgent priority.

5. Conclusions

This paper aimed to understand forest visitor behaviour related to kauri dieback hygiene practices, with the goal of identifying how targeted behavioural segmentation can strengthen the effectiveness of track-use and boot-cleaning interventions. By combining behavioural science principles with robust segmentation analysis, the study demonstrates that compliance is not uniform across visitors but is driven by distinct configurations of motivation, opportunity, and capability. Engaged visitors exhibit strong intrinsic motivation and well-established habits, indicating that maintaining a consistent, trustworthy, and low-friction environment is key to sustaining their positive behaviour. In contrast, other visitors display more conditional or convenience-driven behaviour, shaped by perceived personal benefits, competing motives, or limited habit formation. For this group, interventions need to focus on their unique mix of motivational, capability-related, and contextual barriers and drivers to effectively lift compliance.

Collectively, this research adds to the existing knowledge base by providing a nuanced, behaviourally informed segmentation framework that supports more precise, evidence-based intervention design. Rather than treating visitors as a homogeneous population, the segmentation approach shows how interventions can be aligned with the specific psychological drivers and contextual realities of different groups. These findings provide a behaviourally informed basis for understanding variation in self-reported compliance with kauri dieback prevention measures. While the segmentation framework highlights meaningful differences across groups, the results are exploratory and sample-specific. Future research should validate these patterns using behavioural measures and more representative samples, including culturally grounded approaches. Nevertheless, the study demonstrates the value of combining behavioural diagnostics with segmentation to inform more targeted and potentially effective biosecurity interventions.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/f17070745/s1>. Table S1: Comparison of participant demographic information and 2023 New Zealand census data; Table S2: Knowledge questions (Correct answers in bold); Table S3: Correlation matrix (Pearsons r correlations) and descriptive statistics for compliance to boot-cleaning (BC) guidelines and Capability, Opportunity, Motivation driver and barrier variables (N = 451); Table S4: Correlation matrix (Pearsons r correlations) and descriptive statistics for compliance to track-use (TU) guidelines and Capability, Opportunity, Motivation driver and barrier variables (N = 451); Table S5: Comparison of driver and barrier variables across the three identified segments for boot-cleaning (BC); Table S6: Comparison of driver and barrier variables across the three identified segments for track-use (TU).

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the University of Canterbury Human Ethics Committee (protocol code HREC 2022/12/LR, date of approval: 4 July 2022).

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Data Availability Statement: Data cannot be shared publicly because of restrictions imposed by the Human Research Ethics Committee at the University of Canterbury. These restrictions are imposed due to a discrepancy between two information sheets provided to the participants of the study. The UC Human Research Ethics Committee has decided upon the more conservative interpretation and restricted online publishing. Despite this, data requests can be made to the Human Research Ethics Committee at human-ethics@canterbury.ac.nz, and should be made prior to 2032, at which time the dataset will be permanently unavailable.

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