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Eco-anxiety and environmental identity in Older adults from New Zealand

An exploration of data from the New Zealand Health, Work and
Retirement Study

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Abstract

Biodiversity and the natural environment are two key determinants of human health. Among other things, they are essential to supporting food security and freshwater availability, and limiting the spread of zoonotic diseases. These determinants face the substantial anthropogenic threats of biodiversity loss, pollution and climate change, which together comprise the triple planetary crisis. Widespread adoption of pro-environmental behaviours (PEBs) is one element of the response required to mitigate these threats. Eco-anxiety and environmental identity are two concepts that relate to people's commitment to PEBs. These concepts have been included in the New Zealand Health, Work and Retirement (NZHWR) Study for the first time in the 2024/25 survey, through the inclusion of the Hogg Eco-Anxiety Scale (HEAS) and the Revised Environmental Identity Scale (R-EID).

This thesis includes both a scoping review and a quantitative analysis. The scoping review explores the existing scales used to quantify eco-anxiety and environmental identity in adults (aged 18 and over); the average scores and demographic trends of these scales; and evidence of a relationship between the two concepts. The quantitative analysis explores HEAS and R-EID data from the 2024/25 NZHWR Study, the participants of which are older adults (aged 55 and over) living in New Zealand. This research is the first to quantify eco-anxiety and environmental identity among older adults in New Zealand. Ultimately, this research may help to inform population-level strategies to encourage the adoption of PEBs and, therefore, support biodiversity and the natural environment as important determinants of health.

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Abbreviations

AI	Artificial intelligence
ANOVA	Analysis of variance
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CSDH	Commission on Social Determinants of Health
EAQ	Eco-Anxiety Questionnaire
EHINZ	Environmental Health Intelligence NZ
EID	Environmental Identity Scale
EMEA	Eco-Anxiety Measurement Scale
GAD-7	General Anxiety Disorder-7 Scale
HART	Health and Ageing Research Team
HEAS	Hogg Eco-Anxiety Scale
IFHV	Institute for International Law of Peace and Armed Conflict
IPCC	Intergovernmental Panel on Climate Change
IQR	Interquartile range
JB	Joanna Briggs Institute
NA	Not applicable
NCEA	National Certificate of Educational Achievement
NZ	New Zealand
NZHWR Study	New Zealand Health, Work and Retirement Study
OECD	Organisation for Economic Co-operation and Development
PEB	Pro-environmental behaviour
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
R-EID	Revised Environmental Identity Scale
SD	Standard deviation
UNFCCC	United Nations Framework Convention on Climate Change
US	United States of America

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1 Introduction

1.1 Biodiversity and the natural environment

*“How come the most intellectual creature to ever walk Earth is
destroying its only home?”*

Jane Goodall, 2018 (Goodall, 2018)

1.1.1 The importance of biodiversity and the natural environment for human health

Human health is closely related to the health of our environments (Intergovernmental Panel on Climate Change (IPCC), 2023b). It is widely recognised that the conditions in which we live, grow, work and age impact our health outcomes through the wider determinants of health (Commission on Social Determinants of Health (CSDH), 2008). The health of the natural environment and global ecosystem are two such determinants (World Health Organization, 2025b) (Figure 1).

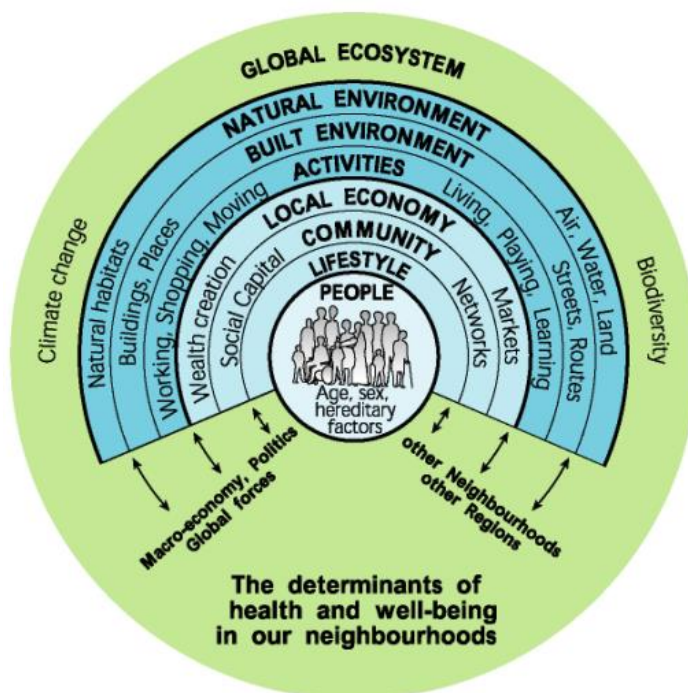


Figure 1: Determinants of health and well-being (Barton & Grant, 2006; extended from Dahlgren & Whitehead, 1991).

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The natural environment encompasses both living (for example, plants, animals and microorganisms) and non-living (for example, air and water) elements. The living aspects of the environment are embodied by the term ‘biodiversity’ (Pereira et al., 2012). The preservation and protection of biodiversity is essential for supporting food security, freshwater availability and air quality, limiting the spread of zoonotic diseases and maintaining the availability of natural medicines (World Health Organization, 2025a, 2025b). The natural environment is associated with enhanced human well-being, including improved mental health and reduced cardiovascular, respiratory, cancer and all-cause mortality (Aerts et al., 2018). Finally, part of the global economy depends on nature – in particular, the construction, agriculture and food and beverages sectors – and is therefore at risk from nature loss (World Economic Forum & PwC, 2020). A 2020 report by the World Economic Forum estimated that US\$44 trillion of economic value generation is either moderately or highly dependent on nature or natural services, representing over half of the global gross domestic product at the time (World Economic Forum & PwC, 2020). These examples summarise some of the considerable health and economic arguments for protecting the natural environment.

1.1.2 Threats to biodiversity, the natural environment and human health

The natural environment faces a number of anthropogenic threats (Bowler et al., 2020; Intergovernmental Panel on Climate Change (IPCC), 2023b). The three main threats are biodiversity loss, pollution and climate change, which together represent the ‘triple planetary crisis’ (United Nations Climate Change, 2022). These issues are all interlinked. For example, pollution and climate change are major drivers of biodiversity change, along with other pressures such as land-use change toward human-dominated habitats, overexploitation, and the introduction of exotic species (Pereira et al., 2012). However, both pollution and climate change are major issues in their own right (United Nations Climate Change, 2022). In particular, combatting climate change has been recognised as “humanity’s most urgent task” (Wiseman, 2022).

Climate change is defined by the Intergovernmental Panel on Climate Change (IPCC) as a prolonged shift in average weather patterns and the climate system, due either to

natural events and processes or anthropogenic activities (Intergovernmental Panel on Climate Change (IPCC), 2023a). The United Nations Framework Convention on Climate Change (UNFCCC) limits their definition to anthropogenic climate change; that is, shifts attributable to human activity (United Nations Framework Convention on Climate Change (UNFCCC), 1992). Climate change is recognised as a significant threat to public health (Climate and Health Alliance, 2021; World Federation of Public Health Associations, 2023; World Health Organization, 2018) and its effects are capable of undermining decades of health improvement work (World Health Organization, 2023).

The adverse effects of the triple planetary crisis on human health are many and varied. Physical health effects may be realised through direct experience of extreme weather events or exposure to pollution, or indirectly through alterations to other social determinants of health (Romanello et al., 2024). For example, direct experience of climate events may lead to injuries such as heat stress during heat-waves, burns or smoke exposure during wildfires, particulate matter inhalation during sand and dust storms leading to a heightened risk of asthma, cardiovascular disease and premature mortality, and drowning-related injuries during floods (Lwin et al., 2023; Paterson et al., 2018; Romanello et al., 2024; Tobias et al., 2019; Zhang et al., 2016). Considering heat-related mortality alone, there has been a 106% increase among adults aged 65 years and over between 1990-99 and 2014-23 (Romanello et al., 2024). Additionally, rising overnight temperatures impact sleep, with a 6% increase in the number of hours of sleep lost between 1986 to 2005 and 2023 (Romanello et al., 2024).

In terms of mental health, exposure to environmental crises may prompt normal psychological reactions which need not be pathologised (Berry et al., 2010; Horwitz & Wakefield, 2007). For example, short-term adjustment difficulties may be a normal response to extreme stress (Jacob, 2013). However, it is important to recognise the adverse mental health effects beyond the usual response to adversity that may result from direct experience of these events (Berry et al., 2010). Anxiety, depression, acute and post-traumatic stress reactions, sleep disruption, suicide and suicidal ideation are all documented consequences of short-term extreme weather events (Basu et al., 2017; Bryant et al., 2014; Galea et al., 2007; Orengo-Aguayo et al., 2019; Palinkas &

Wong, 2020). It is estimated that 25 to 50% of people exposed to such events will experience adverse mental health outcomes (Bryant et al., 2014; Galea et al., 2007; Schwartz et al., 2017; Trombley et al., 2017b). In the medium- to long-term, higher temperatures are associated with aggression, higher suicide rates, reduced cognitive functioning, exacerbation of pre-existing mental illness and functional hypothyroidism (Gao et al., 2019; Norloei et al., 2017; Obradovich et al., 2018; Palinkas & Wong, 2020; Piil et al., 2018; Schmeltz & Gamble, 2017; Stevens et al., 2019; Thompson et al., 2018; Vida et al., 2012; Younan et al., 2018). Similarly, prolonged droughts have been associated with anxiety, depression and higher rates of suicide, with older adults particularly affected by these outcomes (Berry et al., 2010; Bourque & Cunsolo Willox, 2014; Hanigan et al., 2012; O'Brien et al., 2014; Trombley et al., 2017a). Finally, the existential threat of climate change itself also impacts mental well-being (Asugeni et al., 2015; Bourque & Cunsolo Willox, 2014; Palinkas & Wong, 2020). This is particularly problematic as it may feed a perception of pro-environmental behaviours (PEBs) as “intangible or insignificant” and may contribute to eco-anxiety (anxiety related to ecological crises)(Albrecht, 2011; Hayes et al., 2018).

Mental health may also be indirectly influenced by climate change events (Berry et al., 2010; Doherty & Clayton, 2011). Indirect influences include the economic impacts of property damage, the displacement of communities, social conflict and threats to physical health through weather events, altered spread of communicable diseases and heat stress (Palinkas & Wong, 2020). Berry et al.’s framework suggests two pathways through which the indirect mental health impacts of climate change are realised: effects on physical health and effects on community well-being (Berry et al., 2010). The physical health pathway acknowledges that mental health is reciprocally related to physical health, and therefore may be affected by the physical health risks of climate change (Berry et al., 2010; Ohrnberger et al., 2017). The community well-being pathway encompasses the adverse effects of climate change on social environments and the subsequent mental health impacts (Berry et al., 2010). For example, higher temperatures may impact the viability of certain employment opportunities, leading to reduced productivity, reduced income and socioeconomic hardship, with subsequent impacts on mental health (Berry et al., 2010). Evidently, the potential mental health

adversity resulting directly or indirectly from climate change is substantial. The development of both preventive and supportive strategies is essential.

A final consideration is the influence of the triple planetary crisis on health equity. The effects of the crisis are not evenly distributed across populations and will exacerbate existing health and social inequities (American Public Health Association, 2025; Bukari & Aluko, 2023; EHINZ, 2024). Additionally, it is the populations who are most socially vulnerable who will be disproportionately affected (EHINZ, 2024). In New Zealand, high-priority population groups – groups who experienced multiple or substantial vulnerabilities – include the oldest and youngest age groups, people with chronic health conditions, people living in rural areas and areas with higher deprivation and ethnic minorities (EHINZ, 2024). Integration of health equity measures in climate policy is an essential step in avoiding worsening health inequities (Bolte et al., 2023).

The triple planetary crisis is, by definition, a global phenomenon. New Zealand has been ranked as “very high risk” in the WorldRiskIndex, a composite measure of exposure and vulnerability (Bündnis Entwicklung Hilft / IFHV, 2025). New Zealand sits at 102nd of 174 countries in terms of the human and economic effects of climate-related extreme weather events, an increase from 142nd over the preceding 30 years (Adil et al., 2025). Local research is essential to inform an evidence-based threat mitigation and resilient response plan to combat these risks.

1.1.3 What needs to be done?

It is appropriate that the triple planetary crisis has been described as “the defining public health challenge of the twenty-first century,” given its wide-reaching adverse effects on health and health equity (Li, 2022). Action to combat this threat is required at multiple levels. At a governance and policy level, mitigation and adaptation options include support of renewable energy supplies (such as solar and wind power) and development of resilient power systems, ecosystem protection and restoration, support of efficient buildings and fuel-efficient vehicles (Intergovernmental Panel on Climate Change (IPCC), 2023b). Economic strategies such as carbon pricing

instruments (for example, emissions trading or carbon taxes) are one tool that may be used to support a shift towards sustainability (Intergovernmental Panel on Climate Change (IPCC), 2023b). Another approach is to adopt circular economy models in favour of linear growth models (Andersen, 2024). These circular models would encourage and reward reuse, repairability and recyclability in favour of the linear “take, make and waste” approach that has driven the triple planetary crises to date (Andersen, 2024). International cooperation – for example, providing financial and technological support – is central to achieving substantial climate change mitigation and adaptation (Intergovernmental Panel on Climate Change (IPCC), 2023b).

Widespread individual behaviour change is also required. The adoption of PEBs enables individuals to reduce carbon emissions and pollution and protect biodiversity (Intergovernmental Panel on Climate Change (IPCC), 2023b). Examples of PEBs are wide-ranging. They include supporting renewable energy sources, conserving energy and water, reusing and recycling products, composting household food waste, eating less meat, dairy products or eggs, buying secondhand clothes in preference to new clothes, belonging to environmental groups, boycotting products produced by non-environmentally sustainable brands and using active transport (such as walking or cycling) or public transport rather than fossil fuel-powered cars (Ágoston, Balázs, et al., 2024; Intergovernmental Panel on Climate Change (IPCC), 2023b).

The scale of the triple planetary crises necessitates extensive uptake of PEBs globally. As such, a substantial body of research has explored what motivates people to undertake PEBs and how we can increase their uptake. This research has found that social labelling (a persuasion technique that uses statements about an individual to promote the desired behaviour, for example, “you are an environmentalist”), environmental appeals and identity-based prompts increase people’s likelihood of performing PEBs, but guilt-eliciting prompts and monetary incentives do not (Jin & Oh, 2025; Truelove & Nugent, 2020; Truelove et al., 2025; Wang et al., 2022; Whitmarsh & O'Neill, 2010). Additionally, a qualitative study from Australia found that societal and cultural factors may pose barriers to uptake. Barriers included the requirement of a car for transport, or the perception of collective PEBs (such as political environmental

activism) as either ineffective or detrimental to one's reputation (Uren, 2019). Another motivational challenge is that, for many people, many of the threatening consequences of climate change are in the future. Consequently, a temporal orientation towards the future (as opposed to the present) has been found to be associated with intention to perform PEBs (Pittaway et al., 2024). Available literature clearly demonstrates that there are many moderating factors influencing people's uptake of PEBs.

The effectiveness of educational messaging strategies to influence public opinion and uptake of PEBs has been called into question (Brulle, 2010). It is argued that these approaches result in a leadership minority determining and marketing the public's best interest rather than promoting public discussion, thus hindering development of community discourse and action (Brulle, 2010). Indeed, increased climate messaging may counter-productively lead to an increase in climate scepticism (Kapeller & Jäger, 2020). This highlights an opportunity for the exploration of alternative motivators – such as environmental identity - as an encouragement for communities to take up PEBs. Fostering a sense of environmental identity within communities (for example, through increasing opportunities for people to experience nature) may encourage natural uptake of PEBs (Clayton & Czellar, 2023). Conversely, alternative means of encouraging PEBs among communities with a low sense of environmental identity could be developed to appeal to alternative motivators, such as commercial or social incentives.

Developing an understanding of how people relate to the environment, respond to environmental crises and commit to PEBs is crucial. Such an understanding will help to inform mental wellbeing strategies, to anticipate patterns of illness, and to develop population-level strategies that encourage PEBs and protect groups who are most at risk of adverse mental health effects from environmental challenges (Hayes et al., 2018). This research project focusses on two concepts that can be used to develop this understanding: eco-anxiety and environmental identity. These concepts have been included in the New Zealand Health, Work and Retirement (NZHWR) Study for the first time in the 2024/25 survey. The NZHWR Study includes people aged 55 years and older who live in New Zealand (Massey University). Full details of the study and dataset are discussed in Chapter 3: Methods. The eco-anxiety and environmental identity

responses to the 2024/25 NZHWR Study are the focus of this research. These terms are further defined and outlined below:

1.2 Eco-anxiety

“Greta Thunberg’s activism, borne out of her depression and urge to make a difference, is an example of the positive outcomes climate anxiety can have.”

L van Susteren in Borter, 2019 (Borter, 2019)

1.2.1 Eco-anxiety and related concepts

‘Psychoterratic’ illness (psyche = mental wellbeing, terratic = earth-related) is a term that describes earth-related mental illness: that is, where links between a person and their home are disrupted and mental wellbeing is affected (Albrecht et al., 2007). This concept was introduced at the Royal Australian and New Zealand College of Psychiatry Congress in Cairns, 2006 (Albrecht et al., 2007). The concept spans a variety of terms, including ‘eco-paralysis’ (the feeling of being unable to take actions that substantially mitigate the risks of climate change)(Hayes et al., 2018), ‘solastalgia’ (distress from the loss of solace or comfort from one’s home environment)(Albrecht et al., 2007) and ‘eco-anxiety’ (Hayes et al., 2018; Hogg et al., 2021). Eco-anxiety is defined as a chronic, non-specific worry about environmental doom (Ágoston et al., 2022; Pihkala, 2020a). Hogg et al. (2021) recognise eco-anxiety as a multidimensional experience that may include anxiety-like affective symptoms (for example, emotions like worry or fear), rumination (repetitive thinking about environmental issues which, in turn, fuels further eco-anxiety and rumination), behavioural symptoms (such as difficulty sleeping or working) and anxiety about one’s personal, negative effect on the environment.

Research into eco-anxiety has faced conceptual challenges due to the potential breadth of the concept (Clayton & Karazsia, 2020; Coffey et al., 2021; Kurth & Pihkala, 2022). One such challenge is the range of possible affective responses to environmental crises. Some studies have included multiple responses including sadness, shame and guilt (Clayton & Karazsia, 2020; Verplanken et al., 2020). This creates a difficulty in untangling the role of different emotions in affecting wellbeing or influencing behaviour (Kurth & Pihkala, 2022). Other challenges include definition of the scope of environmental concerns (for example, climate change or broader environmental issues) and scale focus (for example, different patterns of response)(Clayton & Karazsia, 2020). Consequently, there are a number of related, but distinct, concepts that describe negative emotional responses to environmental concerns. Examples include ecological stress (Helm et al., 2018), climate change anxiety (Clayton & Karazsia, 2020), climate change distress (Reser et al., 2012) and pre-traumatic stress disorder (Van Susteren, 2017). Eco-anxiety, the focus of this research, includes those terms that refer to anxiety but employs a larger scope, encompassing those in response to any ecological threat. Due to a paucity of evidence that uses this specific definition of eco-anxiety, other literature that is conceptually similar is referred to in this section, despite terminological differences.

1.2.2 An adaptive response, not a pathology

Importantly, eco-anxiety is recognised as an adaptive response to the wide-ranging threats to the natural environment (Sims et al., 2020; Verplanken & Roy, 2013). That is, eco-anxiety is recognised as a reasonable reaction to these threats and the adverse effects they pose to human health (Clayton & Karazsia, 2020; Grose, 2020; Hogg et al., 2021; Lawton, 2019). Therefore, while recognition of eco-anxiety is an important facilitator towards providing support – and, in severe cases, intervention – over-pathologisation of the experience should be avoided (Hogg et al., 2021).

1.2.3 Eco-anxiety as a motivator for action

Research has begun to recognise that eco-anxiety can be beneficial, depending on the context and extent of the experience (Kurth & Pihkala, 2022; Lewis et al., 2020). While eco-anxiety may lead to an avoidant ‘flight’ response, it may also stimulate purposeful engagement with the perceived threat (Grose, 2020; Hoggett & Randall, 2018; Kapeller & Jäger, 2020; Kurth & Pihkala, 2022; Pihkala, 2020b). In the context of eco-anxiety, this active engagement may take the form of information gathering or PEBs (Hoggett & Randall, 2018; Innocenti et al., 2023; Pihkala, 2020a; Verplanken & Roy, 2013). For example, Verplanken and Roy (2013) found that ‘habitual ecological worrying’ was positively correlated with PEBs (Verplanken & Roy, 2013). Kapeller and Jäger (2020) explored this further and highlighted that a population’s degree of climate scepticism and environmental self-identity (the extent to which a person sees themselves as a person who takes environmentally-friendly actions) are two key factors that influence this relationship (Kapeller & Jäger, 2020; Van der Werff et al., 2013). Additionally, it has been argued that fear appeals (messages that use fear to attempt to persuade people to a particular course of action) may be an effective strategy to prompt climate action, if they are able to make the effects of climate change – often temporally and geographically distant – a chief concern for their receivers and suggest effective action (Brulle, 2010; McQueen, 2021). Evidently, eco-anxiety may be a beneficial phenomenon that plays a role in the encouragement of PEBs. As Sims et al summarised: “Not enough people are experiencing this eco-anxiety” (Sims et al., 2020).

Eco-anxiety is still an emerging area of research, and clinical norms of eco-anxiety in the general New Zealand population have not yet been established (Hogg et al., 2021). Understanding population norms is useful for identifying target populations for primary prevention efforts, as well as recognising those who are experiencing more severe eco-anxiety than might be expected (Hogg et al., 2021). This study will support the development of these norms.

1.3 Environmental identity

“Never before have we had such an awareness of what we are doing to the planet, and never before have we had the power to do something about that.”

David Attenborough (Attenborough, 2020)

1.3.1 Environmental identity and related concepts

Environmental identity reflects “a belief that the environment is important to us and an important part of who we are” (Clayton, 2003, p. 46). This self-defined perspective describes how a person sees themselves in relation to the environment (Clayton et al., 2021). Environmental identity is a multidimensional concept, including cognitive, emotional and behavioural elements that describe how a person relates to the natural world (Clayton, 2003). It is correlated with environmental concern and with PEBs (Brügger et al., 2011; Clayton & Czellar, 2023; Clayton et al., 2021; Stets & Biga, 2003). To date, environmental identity has most commonly been quantified using full-length or shortened versions of Clayton’s original Environmental Identity Scale (EID, 2003)(Clayton, 2003; Pagano et al., 2025).

As with eco-anxiety, a number of distinct, yet related, constructs have been developed to explore the relationship between people and nature (Adrian Brügger, 2011; Balundé et al., 2019; Pagano et al., 2025). One particular conceptual challenge is the distinction between the subtly different constructs of environmental identity and environmental self-identity (Balundé et al., 2019). Clayton et al. (2021, p. 1) holds that self-identity is a “socially-motivated attributional tendency” that provides a way for people to describe their position within different social groups. For example, a person with strong environmental self-identity would see themselves as someone who acts in an environmentally-friendly way (Van der Werff et al., 2013). Environmental self-identity is

a key characteristic that influences a population's response to threatening climate change messaging, along with climate change scepticism (Kapeller & Jäger, 2020).

This differs from the concept of environmental identity, which, rather than reflecting one's relation to a social group or movement, indicates one's relation to a non-social entity – the natural environment (Clayton et al., 2021). Environmental identity explores the extent to which a person feels connected to the natural environment and which, in turn, may influence a person's perceptions and behaviours (Clayton et al., 2021; Van der Werff et al., 2013). Environmental identity and environmental self-identity may occur concurrently but are not mutually inclusive (Balundé et al., 2019). For example, a strong environmental identity may mean a person is more likely to undertake PEBs and demonstrate environmental self-identity (Nisbet et al., 2009). Conversely, a person demonstrating strong environmental self-identity by performing PEBs may not necessarily be doing so out of a sense of connection with the natural environment (Olivos & Clayton, 2017). The term “ecological identity” combines both of these differing perspectives, acknowledging that both influence engagement in PEBs (Clayton et al., 2021; Walton & Jones, 2018).

The range of human-nature relationship constructs is testament to the complexity of the relationship and the various theoretical approaches possible (Balundé et al., 2019). To maintain conceptual clarity, this project focusses on environmental identity as defined by Clayton (2003) and excludes related but distinct concepts such as environmental self-identity and ecological identity.

1.3.2 Environmental identity and Te Ao Māori

While Indigenous Peoples are not a homogeneous group, a sense of connection with the natural environment is understood to be a commonly-held value (Apiti et al., 2023; Ford et al., 2020; Romanello et al., 2024). In New Zealand, previous research has found that Māori cultural identity is related to environmental identity (Apiti et al., 2023; Lockhart et al., 2019). This aligns with recognition of the importance of kaitiakitanga (active guardianship of the environment) in mātauranga Māori (Māori

worldview)(Harmsworth & Awatere, 2013). Potential differences in environmental identity between New Zealanders of Māori descent, compared with those who are not of Māori descent, represents a gap in the literature that will be explored in this project.

1.4 The relationship between eco-anxiety and environmental identity

Given that environmental identity reflects one's sense of relation to the natural environment, and eco-anxiety reflects worry about environmental doom, it follows that the two concepts are likely to be correlated. Previous research has indeed reflected a relationship between these concepts, and acknowledged that this relationship is multifaceted (Maral et al., 2025; Showmiya & Sajeeth Kumar, 2024). One aspect of the relationship is that a strong sense of environmental identity may amplify concerns about the environment – and, consequently, eco-anxiety – due to a strong emotional connection with the natural world (Showmiya & Sajeeth Kumar, 2024). Alternatively, another aspect is that individuals with a strong environmental identity who are experiencing eco-anxiety may be able to use their connection with the environment as a coping mechanism and find solace in the natural environment (for example, through spending time in green spaces) (Bruehlman-Senecal et al., 2016). In line with this theoretical basis, previous research has identified a strong positive correlation between the two measures (Showmiya & Sajeeth Kumar, 2024).

1.5 Research aims

The relationship between human health and environmental health is bidirectional: each impacts the other. Consequently, actions to protect and strengthen the environment can – and should – be aligned with health outcomes (COP28 United Arab Emirates, 2023; World Health Organization, 2025b). Effectively planning these actions requires an understanding of the relationship. Eco-anxiety and environmental identity are two concepts that support an understanding of some of the mental health effects of environmental crises and some of the motivators that encourage individuals to undertake PEBs. Quantifying these elements in a population of older adults in New Zealand will inform related public health strategies.

This research will explore the eco-anxiety and environmental identity data collected in the 2024/25 NZHWR Study. These concepts were measured using the Hogg Eco-Anxiety Scale (HEAS) and the Revised Environmental Identity Scale (R-EID), respectively (Clayton et al., 2021; Hogg et al., 2021) . Further detail about these scales is provided in Sections 3.2.1 and 3.2.2. The aims of this research are:

1. To explore NZHWR Study participants' responses to the HEAS.
2. To explore NZHWR Study participants' responses to the R-EID.
3. To explore the possibility of a relationship between participants' responses to the HEAS and the R-EID.

These aims informed the specific questions guiding this research project:

1. What is the average score of eco-anxiety (measured by the Hogg Eco-Anxiety Scale, HEAS) among older adults in New Zealand?
 - a. How do these scores differ by demographic groups (for example, age, gender, Māori descent, socioeconomic status, country of birth, educational attainment and employment status)?
2. What is the average score of environmental identity (measured by the revised environmental identity scale, R-EID) among older adults in New Zealand?
 - a. How do these scores differ by demographic groups (for example, age, gender, Māori descent, socioeconomic status, country of birth, educational attainment and employment status)?
3. Is there a correlation between older adults' HEAS and R-EID scores?

2 Literature review

2.1 Methods

A scoping review was conducted to identify relevant literature. Initial exploratory searches found a limited number of studies that employed the specific scales used in the 2024/25 NZHWR Study (the HEAS and the R-EID). Additionally, preliminary searches of the Cochrane Database of Systematic Reviews and JBI Evidence Synthesis on the 6th July 2025 did not identify any existing reviews on the topics of eco-anxiety or environmental identity in adults (aged 18 years and over). This paucity of evidence was attributed to the novelty of eco-anxiety and environmental identity concepts in research. Therefore, this scoping review maintained a broad view and aimed to identify any validated instruments that had been used to measure these concepts in adults, in order to develop a more nuanced understanding of existing data.

The research questions informing the scoping review were:

1. What scales are used to quantify eco-anxiety among adults? What are the average scores of these scales?
 - a. How do these scores differ by demographic groups (e.g. age, gender, ethnicity, socioeconomic status, rural/urban residence)?
2. What scales are used to quantify environmental identity among adults? What are the average scores of these scales?
 - a. How do these scores differ by demographic groups (e.g. age, gender, ethnicity, socioeconomic status, rural/urban residence)?
3. Is there a correlation between adults' eco-anxiety scores and environmental identity scores?

This review followed the PRISMA Extension for Scoping Reviews guidance (Tricco et al., 2018). Eligibility criteria are shown in Table 1. These criteria were used to develop the search string and to screen search results to determine eligibility for inclusion.

Participant age was the first eligibility criteria. Participants in the NZHWR Study are

aged 55 years and older (Massey University; Phillips, 2023). Therefore, studies required adult participants to be eligible for inclusion. This was defined as participants aged 18 years or older to avoid excessively narrowing the number of eligible records by searching only for research with older adults, as research with this age group is limited.

One search string was developed to encompass all three research questions (Appendix A: Scoping review search string (Scopus)). Therefore, three concepts were included in the search string to reflect each of the three research questions. Preliminary search work identified related but distinct terms for both eco-anxiety (for example, “climate anxiety”) and EID. EID in particular has a number of related terms, including:

- Environmental self-identity – how much one sees one’s behaviours as supporting the environment (Van der Werff et al., 2014).
- Politicised environmental identity – how much one sees oneself as part of a political struggle to support the environment (Mackay et al., 2021).
- Organisational environmental identity – how an organisation perceives their environmental values and duties (Liu & Qi, 2023).
- Connection with nature – a measure of one’s level of emotional connection to the natural world (Mayer & Frantz, 2004).
- Nature relatedness – a construct describing one’s level of connectedness with the natural world and understanding that all aspects of nature are important (Nisbet et al., 2009).

These related terms were classed as ineligible for both concepts after exploration of their definitions and internal discussion with the supervisory team. The purpose of this decision was to ensure consistency of definitions included in the review. Additionally, studies were required to have used a validated instrument to quantify concepts (Cosh et al., 2024): for example, subjectively asking participants a single question to gauge their level of eco-anxiety or EID was deemed ineligible. This requirement aimed to ensure that the studies included in the review had assessed the concepts of eco-anxiety and environmental identity in a robust way.

Eligibility was not limited by geographic location, due to a paucity of research on these concepts among this age group. Studies needed to provide quantitative results to be eligible, and must have been published as a full text. Books and book chapters were excluded to keep the review within a manageable scope, and dissertations were excluded due to their lack of peer review. Case studies of a single person were not eligible, so that the review included eco-anxiety and EID assessment of groups of people, rather than individuals without community context.

Table 1: Eligibility criteria

Field	Inclusion criteria	Exclusion criteria
Participants	Adults (aged 18+ years).	Participants aged less than 18 years old, or data not able to be distinguished from younger age groups.
Concept	- Any eco-anxiety scale - Any environmental identity scale - Relationship between eco-anxiety and environmental identity	- Climate anxiety - Environmental self-identity - As above
Context	Global (but highlight whether any NZ-specific evidence is identified).	Not applicable (NA).
Study design	Quantitative research.	Qualitative research.
Limits	Studies published as a full text in peer-reviewed journals.	Non-English language studies, books and book chapters, conference abstracts, editorials, letters, case studies/clinical vignettes, dissertations and pre-prints.

To increase the likelihood of identifying relevant research, the search was run in four databases (Tricco et al., 2018): Scopus, PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL) Complete and PsychINFO. The search was run on the 20th July 2025. Search results were imported into Covidence and independently reviewed for eligibility by two researchers (MG and LM)(Covidence, 2025). Conflicting judgements were resolved by discussion. Quality assessment of full texts used the JBI (Joanna Briggs Institute) Critical Appraisal Checklist for Analytical Cross-Sectional Studies (JBI, 2020). Data charting was done by a single researcher (MG), using a custom template in Covidence (Covidence, 2025). The results of the search and screening process are shown in Figure 2.

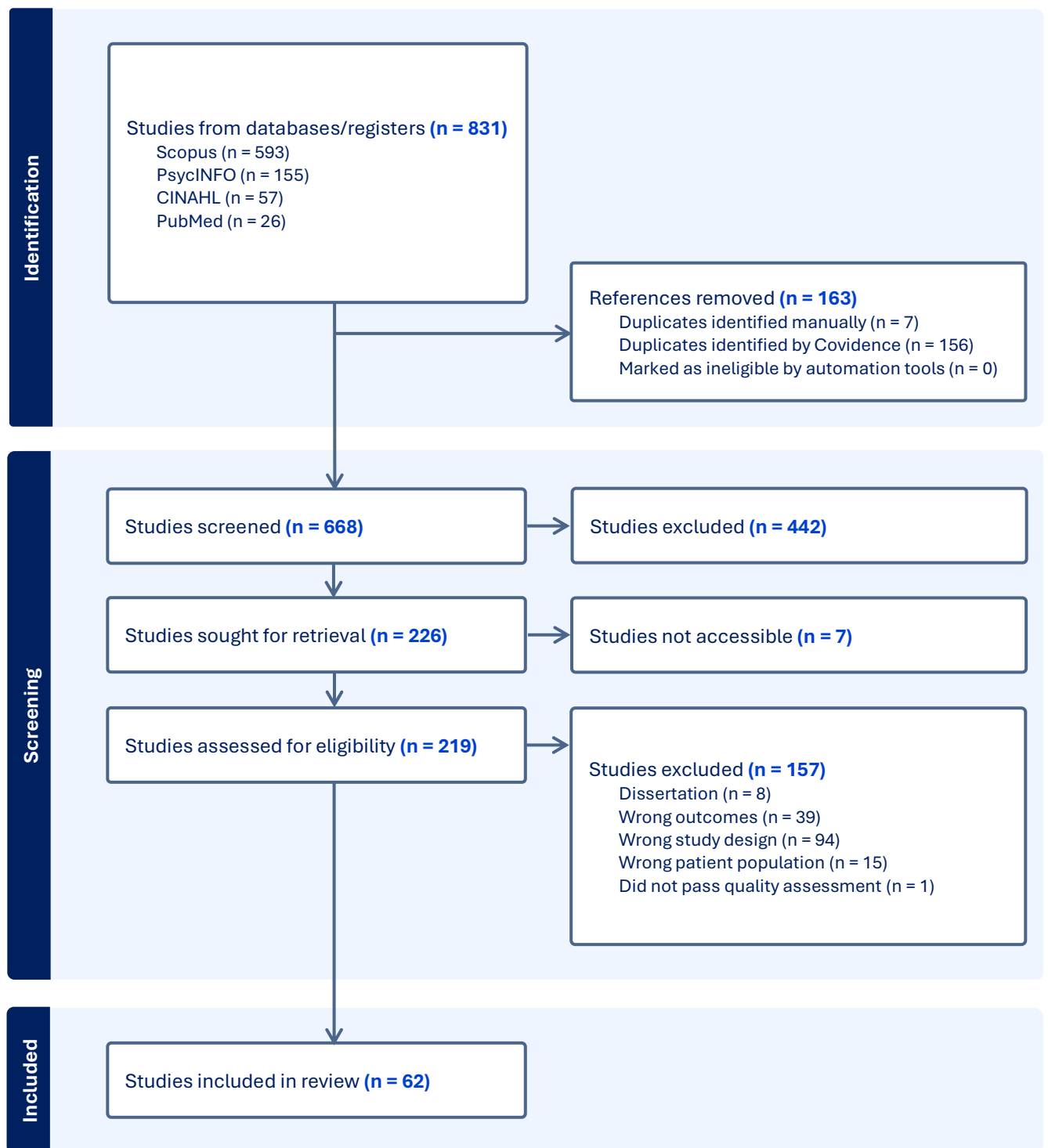


Figure 2: PRISMA flow diagram

Of the 62 included studies, 38 explored eco-anxiety and 25 explored environmental identity. One study explored both concepts and is included in both of these counts (Mathé et al., 2025).

2.2 Results: Eco-anxiety

2.2.1 Overview

38 eligible studies explored eco-anxiety. The earliest study was published in 2021, with 94.7% of studies (n=36) published since 2023 (Figure 3).

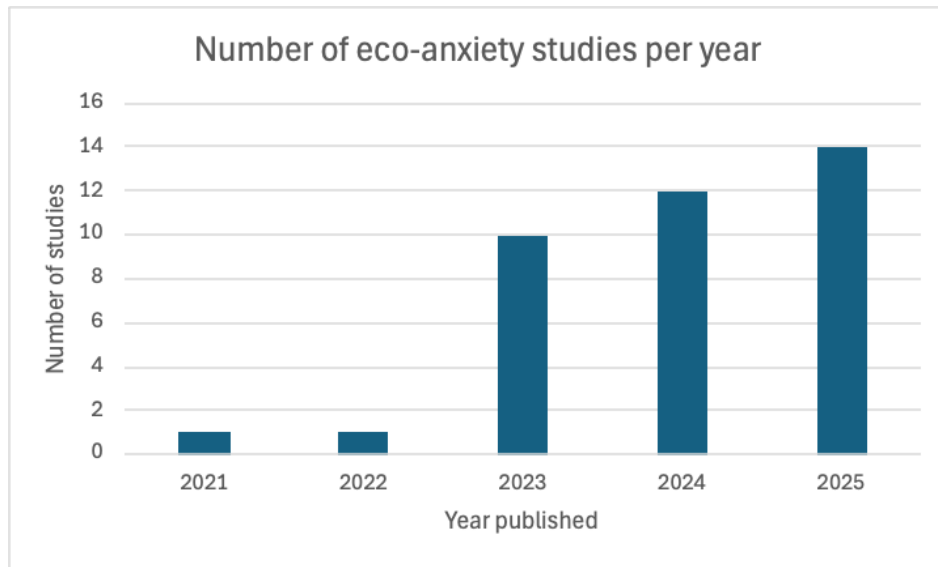


Figure 3: Number of eligible eco-anxiety studies published, by year.

Most studies were published in Turkey (n=9, 23.7%), Italy (n=6, 15.8%) and France (n=5, 13.2%). One study included participants from New Zealand (Hogg et al., 2021). Most studies used a cross-sectional design (n=31, 81.6%). An additional 4 studies were cross-sectional, but included longitudinal follow-up for a subgroup of participants (10.5%). The remaining 3 studies were quasi-experimental (Çolak et al., 2025), two-wave longitudinal (Pavani et al., 2023) and two-part prospective, although only the cross-sectional baseline assessment met inclusion criteria for this review (Mathers-Jones & Todd, 2023).

Eco-anxiety was used as a research variable in most studies (n=22, 57.9%). 13 studies (34.2%) focussed on adaptation or validation of an eco-anxiety scale and 3 studies (7.9%) described development of an eco-anxiety scale (Ágoston et al., 2022; Hogg et al., 2021; Jalin et al., 2025).

2.2.2 Scales and versions

Three eco-anxiety scales were used by the eligible studies. These were the:

1. Hogg Eco-Anxiety Scale (HEAS)(Hogg et al., 2021), used by 31 studies (81.6%).
2. Eco-Anxiety Questionnaire (EAQ)(Ágoston et al., 2022), used by 5 studies (13.2%).
3. Eco-Anxiety Measurement Scale (EMEA)(Jalin et al., 2025), used by 2 studies (5.3%).

The versions and translations of these scales are summarised in Table 2. The HEAS has been the most widely adapted and translated, into languages including French, German, Italian, Icelandic, Polish, Portuguese, Serbian, Turkish and Ukranian. Interestingly, three different Italian (Innocenti et al., 2023; Rocchi et al., 2023; Spano et al., 2025) and Turkish (Çimşir et al., 2024; Türkarlan et al., 2023; Uzun et al., 2022) versions of the scale have been developed and used in different studies. Studies that used the HEAS most commonly reported the same four dimensions of the scale as identified in the original paper: affective symptoms, rumination, behavioural symptoms and anxiety about one's personal impact on the planet (Hogg et al., 2021). However, two studies reported that a single factor was a better fit for their data (Innocenti et al., 2023; Pavani et al., 2023). These studies were based in Italy and France, respectively.

The EAQ has been adapted into French, German and short versions, as well as being used in Italy and Hungary. All studies consistently reported the same two dimensions: habitual ecological worry and negative consequences of eco-anxiety. The EMEA has only been used in French research to date. Both studies that used this scale reported three dimensions: anxiety-depressive manifestations, relational disturbances and ecological obsessions.

These results indicate that eco-anxiety research is of international interest and that the concept is generally considered to be multi-dimensional.

Table 2: Summary of eco-anxiety scale versions and translations

Scale	Version	Number of items	Language	Dimensions
Hogg Eco-Anxiety Scale (HEAS)(Hogg et al., 2021)	Original	13 (Hogg et al., 2021; Hogg et al., 2023; Hogg et al., 2024; Höller et al., 2025; Mathers-Jones & Todd, 2023; Pavani et al., 2023)	English (Hogg et al., 2021; Hogg et al., 2023; Hogg et al., 2024; Mathers-Jones & Todd, 2023). French (Pavani et al., 2023). Icelandic (Höller et al., 2025).	Most studies reported the same four factors: 1. Affective symptoms (4 items) 2. Rumination (3 items) 3. Behavioural symptoms (3 items) 4. Anxiety about one's impact on the planet (3 items) (Hogg et al., 2021; Hogg et al., 2023; Hogg et al., 2024; Höller et al., 2025). One study reported the scale as a single factor (Pavani et al., 2023). One study did not report factors (Mathers-Jones & Todd, 2023).
	French version (Mathé et al., 2025)	13 (Mathé et al., 2025)	French (Mathé et al., 2025).	1. Affective symptoms (4 items) 2. Rumination (3 items) 3. Behavioural symptoms (3 items) 4. Anxiety about one's impact on the planet (3 items).
	German version (Heinzel et al., 2023)	13 (Heinzel et al., 2023; Henschel et al., 2025)	German (Heinzel et al., 2023; Henschel et al., 2025).	1. Affective symptoms 2. Rumination 3. Behavioural symptoms 4. Anxiety about one's personal impact on the planet The number of items in each factor was not reported.
	Italian versions: 1. (Innocenti et al., 2023) 2. (Rocchi et al., 2023), also used by (Baroni et al., 2025) 3. (Spano et al., 2025)	13 (Baroni et al., 2025; Innocenti et al., 2023; Rocchi et al., 2023; Spano et al., 2025)	Italian (Baroni et al., 2025; Innocenti et al., 2023; Rocchi et al., 2023; Spano et al., 2025).	Three studies reported the same four factors as the original study: 1. Affective symptoms (4 items) 2. Rumination (3 items) 3. Behavioural symptoms (3 items)

				4. Anxiety about personal impact (3 items) (Baroni et al., 2025; Rocchi et al., 2023; Spano et al., 2025). One study found that a single-factor model was a better fit for the data (Innocenti et al., 2023).
	Polish version (Larionow et al., 2024)	13 (Larionow et al., 2024)	Polish (Larionow et al., 2024).	1. Affective symptoms (4 items) 2. Rumination (3 items) 3. Behavioural symptoms (3 items) 4. Anxiety about personal impact (3 items).
	Portuguese version (Sampaio et al., 2023)	13 (Sampaio et al., 2023)	Portuguese (Sampaio et al., 2023).	1. Affective symptoms (4 items) 2. Rumination (3 items) 3. Behavioural symptoms (3 items) 4. Anxiety about personal impact (3 items).
	Serbian-language version (Trifunović & Rajčević, 2024)	13 (Trifunović & Rajčević, 2024)	Serbian (Trifunović & Rajčević, 2024).	1. Affective symptoms (4 items) 2. Rumination (3 items) 3. Behavioural symptoms (3 items) 4. Anxiety about personal impact (3 items).
	Turkish versions: 1. (Uzun et al., 2022), used by (Baykara Mat & Yilmaz, 2024; Cebeci et al., 2025; Çolak et al., 2025; Er et al., 2024; Kabasakal-Cetin, 2023; Özkan et al., 2025) 2. (Türkarlan et al., 2023), also used by	13 (Türkarlan et al., 2023) (Baykara Mat & Yilmaz, 2024; Cebeci et al., 2025; Çimşir et al., 2024; Çolak et al., 2025; Er et al., 2024; Kabasakal-Cetin, 2023; Özkan et al., 2025; Yesildere Saglam & Mizrak Sahin, 2025)	Turkish (Baykara Mat & Yilmaz, 2024; Cebeci et al., 2025; Çimşir et al., 2024; Çolak et al., 2025; Er et al., 2024; Kabasakal-Cetin, 2023; Özkan et al., 2025; Türkarlan et al., 2023; Yesildere Saglam & Mizrak Sahin, 2025).	All studies reported the same four factors as the original study: 1. Affective symptoms (4 items) 2. Rumination (3 items) 3. Behavioural symptoms (3 items) 4. Anxiety about personal impact (3 items) (Baykara Mat & Yilmaz, 2024; Cebeci et al., 2025; Çimşir et al., 2024; Çolak et al., 2025; Er et al., 2024; Kabasakal-Cetin, 2023; Özkan et al., 2025;

	(Yesildere Saglam & Mizrak Sahin, 2025) 3. (Çimşir et al., 2024)			Türkarşlan et al., 2023; Yesildere Saglam & Mizrak Sahin, 2025).
	Ukrainian version (Kryazh & Baranov, 2025)	13 (Kryazh & Baranov, 2025)	Ukrainian (Kryazh & Baranov, 2025).	1. Affective symptoms (4 items) 2. Rumination (3 items) 3. Behavioural symptoms (3 items) 4. Anxiety about personal impact (3 items).
	Version not specified.	13 (Hervé & Marsat, 2023; López-García et al., 2025; Orrù et al., 2024; Vecina et al., 2025) Not reported (Vecina et al., 2024)	Language not specified, but studies conducted in Spain (López-García et al., 2025; Vecina et al., 2025; Vecina et al., 2024), France (Hervé & Marsat, 2023) and Italy (Orrù et al., 2024).	Two studies did not report factors (Hervé & Marsat, 2023; López-García et al., 2025). Four factors were reported in three studies: 1. Affective symptoms (4 items) 2. Behavioural symptoms (3 items) 3. Negative emotionality (3 items) 4. Rumination (3 items) (Vecina et al., 2025; Vecina et al., 2024) and: 1. Cognitive 2. Behavioural 3. Emotional 4. Personal accountability (Orrù et al., 2024).
Eco-Anxiety Questionnaire (EAQ)(Ágoston et al., 2022)	Original	22 (Ágoston et al., 2022; Devecchi et al., 2025)	English (Ágoston et al., 2022). Language not specified, but study conducted in Italy (Devecchi et al., 2025).	All versions reported the same two factors: 1. Habitual ecological worry (13 items) 2. Negative consequences of eco-anxiety (9 items).
	French version (Micoulaud-Franchi et al., 2024)	22 (Micoulaud-Franchi et al., 2024)	French (Micoulaud-Franchi et al., 2024).	
	German version (Zeier & Wessa, 2024)	22 (Zeier & Wessa, 2024)	German (Zeier & Wessa, 2024).	

	Short version (Ágoston, Buvár, et al., 2024)	8 (Ágoston, Buvár, et al., 2024)	Language not specified, but study conducted in Hungary (Ágoston, Buvár, et al., 2024).	1. Habitual ecological worry (4 items) 2. Negative consequences of eco-anxiety (4 items).
Eco-Anxiety Measurement Scale (EMEA)(Jalin et al., 2025)	Original	22 (Jalin et al., 2025; Jalin et al., 2024)	French (Jalin et al., 2025; Jalin et al., 2024).	Both studies reported three factors: 1. Anxiety-depressive manifestations (9 items) 2. Relational disturbances (7 items) 3. Ecological obsessions (6 items).

2.2.3 Average scores

2.2.3.1 *Hogg Eco-Anxiety Scale*

Two methods for score categorisation were reported. The first was a binary categorisation describing the presence or absence of clinically-significant eco-anxiety, defined as a score of 3 or more on the first two items of the HEAS (Larionow et al., 2024). This method was developed by Larionow et al and was also used by Baroni et al (Baroni et al., 2025; Larionow et al., 2024). Using this method, Larionow et al found that 12.62% of the 634 Polish-speaking adults in their study had clinically-significant eco-anxiety (12.79% of female participants and 11.82% of male participants)(Larionow et al., 2024). The second method grouped scores into mild, moderate and severe levels of eco-anxiety by evenly dividing their 5-point response scale (Vecina et al., 2025). This method was used in a study of 1911 people, representative (in terms of age, gender and place of residence) of the Spanish population. Just over half (51.8%) of people were classed as having mild eco-anxiety, 42.1% as having moderate eco-anxiety and 6.1% as having severe eco-anxiety (Vecina et al., 2025).

Most (90.3%, n=28) of the 31 studies that used the HEAS used a 4-point scale. Two studies used a 5-point scale (López-García et al., 2025; Vecina et al., 2025) and one did not report the scoring scale (Yesildere Saglam & Mizrak Sahin, 2025). Of those that used a 4-point scale, 78.6% (n=22) used values of 0 to 3 (0=Not at all, 3=Nearly every day), consistent with the original scale (Hogg et al., 2021). This section focusses on these studies and excludes those that used different scoring values (or did not report scoring values), to facilitate comparison. All reported Cronbach's alpha values exceeded 0.7, indicating sufficient internal consistency of the scale and dimensions (Mackridge, 2018).

The maximum possible score for the total scale was 39, calculated by multiplying the 13 items by the highest response option. Forty-one percent (n=9) of the studies reported average scores for either the total scale (n=6) or as an average score per item (n=3). Average total scores (presented as mean (standard deviation, SD)) ranged from 8.3 (6.9) in a study of 343 Italian adults (Orrù et al., 2024) to 27.1 (7.0) in a study of 491

Turkish women (Özkan et al., 2025). Where reported, average total scores were divided by 13, the number of items in the scale, to facilitate comparison with studies that reported average scores per item. The resultant average-per-item scores ranged from a minimum 0.43 (0.48) in a study of 96 young adult Australian residents (age range 18 to 31 years)(Mathers-Jones & Todd, 2023) to 2.08 (Özkan et al., 2025).

Average per-item scores for the four dimensions of the scale were reported in 54.5% (n=12) of the studies. In the affective symptoms dimension, scores ranged from 0.47 (0.58) in a study of 634 Polish-speaking adults (Larionow et al., 2024) to 0.98 (0.77) in a study of 335 Italian adults (Rocchi et al., 2023). Average scores in the rumination dimension ranged from 0.33 (0.59) in a sample of 365 New Zealand undergraduate students (Hogg et al., 2021) to 1.10 (0.69) in a study of Turkish university students and school teachers (Çimşir et al., 2024). In the behavioural symptoms dimension, average scores ranged from 0.33 (0.54) in a study of German-speaking adults from Germany, Austria and Switzerland (Henschel et al., 2025) and 0.33 (0.50) in a study of 485 German university students and staff (Heinzel et al., 2023), to 0.81 (0.86) in a study of 370 New Zealand undergraduate students (Hogg et al., 2021). In the anxiety about personal impact dimension, average scores ranged from 0.47 (0.58) (Larionow et al., 2024) to 1.42 (0.87) (Rocchi et al., 2023).

In most studies (66.7%, n=8), anxiety about personal impact was the highest-scoring dimension (Çimşir et al., 2024; Heinzel et al., 2023; Henschel et al., 2025; Hogg et al., 2023; Hogg et al., 2024; Mathé et al., 2025; Rocchi et al., 2023; Türkarslan et al., 2023). These studies also all identified behavioural symptoms as the lowest-scoring dimension, in addition to one further study (Larionow et al., 2024).

2.2.3.2 Eco-Anxiety Questionnaire

All five studies that used the EAQ used a 4-point scale (1=Strongly disagree, 4=strongly agree)(Ágoston, Buvár, et al., 2024; Ágoston et al., 2022; Devecchi et al., 2025; Micoulaud-Franchi et al., 2024; Zeier & Wessa, 2024). Where reported, Cronbach's alphas for the overall scale (Micoulaud-Franchi et al., 2024) and the two dimensions of

the scale (Ágoston, Buvár, et al., 2024; Ágoston et al., 2022; Zeier & Wessa, 2024) all exceeded 0.7, indicating satisfactory internal consistency (Mackridge, 2018). No methods of score categorisation were reported.

The maximum possible score for the four studies that used the full-length scale was 88, calculated by multiplying the 22 items by the highest response option. Average scores for the total, full-length scale were reported in two studies and both exceeded the mid-point of the scale (Devecchi et al., 2025; Micoulaud-Franchi et al., 2024). Of these, a study of 880 Italian women reported the higher average (M(SD): 63.9 (10.7))(Devecchi et al., 2025) and a study of 1004 French people (54.1% female) reported the lower average (M(SD): 49.5 (12.8))(Micoulaud-Franchi et al., 2024). These results are not suitable to inform inter-country comparisons due to their different gender distributions.

Average scores for the two dimensions of the scale were reported by three studies, all of which used full-length versions of the scale (Devecchi et al., 2025; Micoulaud-Franchi et al., 2024; Zeier & Wessa, 2024). The maximum possible scores of the dimensions were 52 for habitual ecological worry (13 items on a 4-point scale) and 36 for negative consequences of eco-anxiety (9 items on a 4-point scale)(Table 2). The average dimension scores reported in each study were divided by the number of items in each dimension (13 and 9, respectively) to facilitate comparison between the dimensions. The highest-scoring dimension in all three studies was habitual ecological worry, with scores ranging from M(SD) 33.7 (9.0)(Micoulaud-Franchi et al., 2024), to M(SD) 46.1 (5.8)(Devecchi et al., 2025), equating to averages of 2.60 and 3.55 across 13 items, respectively. The scores in the negative consequences of eco-anxiety dimension ranged from M(SD) 13.3 (4.2)(Zeier & Wessa, 2024) to M(SD) 17.8 (6.1)(Devecchi et al., 2025), equating to averages of 1.48 to 1.98 across 9 items, respectively. These results indicate that participants tend to experience habitual ecological worry more strongly than negative consequences of eco-anxiety. This aligns with the results of literature using the HEAS, where the 'behavioural symptoms' dimension is most frequently the lowest-scoring dimension (Section 2.2.3.1).

2.2.3.3 *Eco-Anxiety Measurement Scale*

Both studies that used the EMEA used a 4-point Likert scale (1=No, 4=Yes)(Jalin et al., 2025; Jalin et al., 2024). Cronbach's alphas for the overall scale (Jalin et al., 2024) and the three dimensions of the scale (Jalin et al., 2025; Jalin et al., 2024) all exceeded 0.7, indicating satisfactory internal consistency (Mackridge, 2018). No methods of score categorisation were reported.

The maximum possible score was 88, calculated by multiplying the 22 items by the highest response option. Both studies reported a wide range of total scores (18 to 84 in 2024, indicating that some questions were not able to be scored, and 23 to 85 in 2025). Average scores for the total scale were slightly above the midpoint in both studies; M(SD): 46.0 (12.5)(Jalin et al., 2024) and 49.2 (12.4)(Jalin et al., 2025). It is interesting that a lower average score was seen in the 2024 study population (522 French-speaking adults who attended climate awareness workshops) compared to the 2025 study population (429 French-speaking adults, recruited through online advertisement), given the different recruitment pools. Both study populations had a similar age range (18 to 76 years in 2024 vs 18 to 82 years in 2025), although the mean age of participants was higher in the 2025 study (45.7 years (SD: 15.3) in 2025, vs 28.5 years (12.8) in 2024).

Scores for the three dimensions of the EMEA were only reported in the 2025 study (Jalin et al., 2025). In each dimension, scores ranged from the minimum possible score to the maximum possible score (anxiety-depressive manifestations: 9 to 36; relational disturbances: 7 to 28; ecological obsessions: 6 to 24). Average dimension scores were divided by the number of items in each dimension (9, 7, and 6, respectively; Table 2) to facilitate comparison between the dimensions. The highest-scoring dimension was relational disturbances (M(SD): 16.92 (4.46), an average of 2.41 across 7 items), followed by ecological obsessions (M(SD): 14.39 (3.86), an average of 2.40 across 6 items). Anxiety-depressive manifestations was the lowest-scoring dimension (M(SD): 17.89 (5.87), an average of 1.99 across 9 items).

2.2.4 Demographic trends

2.2.4.1 Gender

14 of the studies that used the HEAS explored differences between genders. Of the five studies that analysed gender differences for the total scale, two studies found that women had a significantly higher score than men (Cebeci et al., 2025; Kabasakal-Cetin, 2023). The remaining studies either found no significant difference between genders (Er et al., 2024; Henschel et al., 2025) or did not report significance (Innocenti et al., 2023).

Trends were clearer among the affective symptoms and anxiety about personal impact dimensions of the scale. Considering affective symptoms, 7 of 12 studies found that women had significantly higher scores than men (Çimşir et al., 2024; Hogg et al., 2023; Hogg et al., 2024; Kabasakal-Cetin, 2023; Mathé et al., 2025; Rocchi et al., 2023; Türkarslan et al., 2023) and a further 4 studies found that women had higher scores than men, though the difference was not statistically significant (Henschel et al., 2025; Larionow et al., 2024; Sampaio et al., 2023) or significance was not reported (Trifunović & Rajčević, 2024). One study found no significant difference (Er et al., 2024).

Similar results were evident in the anxiety about personal impact dimension. Seven of 12 studies found that women had significantly higher scores than men (Çimşir et al., 2024; Henschel et al., 2025; Hogg et al., 2023; Hogg et al., 2024; Kabasakal-Cetin, 2023; Larionow et al., 2024; Türkarslan et al., 2023) and a further 2 studies found that women had higher scores than men, although significance was not reported (Rocchi et al., 2023; Trifunović & Rajčević, 2024). Three studies found no significant difference (Er et al., 2024; Mathé et al., 2025; Sampaio et al., 2023).

Results were more divided in the rumination dimension. Most studies found no significant difference between men and women (Er et al., 2024; Henschel et al., 2025; Hogg et al., 2023; Hogg et al., 2024; Larionow et al., 2024; Mathé et al., 2025; Sampaio et al., 2023). However, three studies found that women had significantly higher scores than men (Kabasakal-Cetin, 2023; Rocchi et al., 2023; Türkarslan et al., 2023) and one found that men had significantly higher scores than women (Çimşir et al., 2024).

Only one study reported a significant difference between genders in the behavioural symptoms dimension; Er et al found that men had significantly higher scores than women (Er et al., 2024). Two further studies found men had higher scores than women in this dimension, although the significance of these results was not reported (Rocchi et al., 2023; Trifunović & Rajčević, 2024). The remaining nine studies found no significant differences between genders in this dimension (Çimşir et al., 2024; Henschel et al., 2025; Hogg et al., 2023; Hogg et al., 2024; Kabasakal-Cetin, 2023; Larionow et al., 2024; Mathé et al., 2025; Sampaio et al., 2023; Türkarslan et al., 2023).

Overall, the majority of studies did not report a significant difference between men and women's total HEAS, behavioural symptoms or rumination scores. However, most studies found that women had significantly higher scores in the affective symptoms and anxiety about personal impact dimensions.

Three of the studies that used the EAQ explored differences by gender and all three found differences in eco-anxiety between men and women. One study reported results by gender for the total scale, and found that women had significantly higher eco-anxiety than men (M(SD): 50.5 (12.4) vs 48.4 (13.2), $p=0.008$) (Micoulaud-Franchi et al., 2024). All three studies found that women had significantly higher scores than men in the habitual ecological worry dimension (Ágoston et al., 2022; Micoulaud-Franchi et al., 2024; Zeier & Wessa, 2024). The studies also found that women had higher scores than men in the negative consequences of eco-anxiety dimension, but this result was only significant in two of the studies (Ágoston et al., 2022; Zeier & Wessa, 2024). Ágoston et al noted that the effect size of the difference between genders was small for both dimensions (Ágoston et al., 2022).

The two studies that used the EMEA both found some differences in eco-anxiety between men and women. Considering the total scale, women had higher mean eco-anxiety scores than men in both studies, although this was only significant in Jalin et al's 2024 study (2024: 48.7 vs 42.9, $p=0.017$; 2025: 50.0 vs 47.8, $p=0.073$) (Jalin et al., 2025; Jalin et al., 2024). Women also had significantly higher scores than men in the

anxiety-depressive manifestations and relational disturbances dimensions in both studies. There was no significant difference in the ecological obsessions dimension in either study.

The results of all three eco-anxiety scales demonstrate that women tend to have higher levels of eco-anxiety than men, although the difference is not always statistically significant.

2.2.4.2 Age

Of the 31 studies that used the HEAS, 12 explored the relationship between results and participant age. Three studies reported results for the total scale, and all three found that there was no significant relationship between age and eco-anxiety (Cebeci et al., 2025; Er et al., 2024; Henschel et al., 2025). One study explored the prevalence of clinically-significant eco-anxiety among generational age groups (defined as a score of 3 or more on the first two items of the scale)(Baroni et al., 2025). This study found no significant difference between Millennial (aged 27 to 42 years), Generation X (aged 43 to 58 years) and Baby Boomer (59 to 77 years) participants, with prevalence values of 83.1%, 86% and 81.3%, respectively.

While the studies reporting the relationship between age and the total scale did not find significant differences, some studies did report significant differences when the dimensions of the scale were explored separately. This was most evident in the “anxiety about personal impact” dimension. Three out of 10 (33.3%) studies found that younger participants had significantly higher anxiety about personal impact than older participants (Hogg et al., 2024; Larionow et al., 2024; Rocchi et al., 2023). Two out of 10 (20%) studies identified the same trend, but results either did not reach statistical significance (Mathé et al., 2025) or significance was not reported (Hogg et al., 2023). Ten percent of studies (1/10) found the opposite, reporting that participants in the oldest age group had the highest scores, although significance was not reported (Trifunović & Rajčević, 2024). One German study of 322 people aged 18 to 79 years (1/10, 10%), found that while there was a significant negative correlation between age

and personal impact anxiety ($r=-0.11$, $p<0.05$), indicating higher personal impact anxiety among younger participants, there was no significant difference between age groups (split into participants aged 32 or younger versus participants older than 32)(Henschel et al., 2025). Four out of ten (40%) studies, including Henschel et al, found no significant difference in personal impact anxiety scores between age groups (Er et al., 2024; Henschel et al., 2025; Sampaio et al., 2023; Türkarslan et al., 2023).

Most studies found no significant differences by age in the other three dimensions of the scale. In the affective symptoms dimension, 7/10 (70%) studies found no significant differences by age (Er et al., 2024; Henschel et al., 2025; Hogg et al., 2023; Hogg et al., 2024; Mathé et al., 2025; Sampaio et al., 2023; Türkarslan et al., 2023). However, 2/10 (20%) studies found that younger participants had significantly higher affective symptoms than older participants (Larionow et al., 2024; Rocchi et al., 2023), and one study found the same trend but did not report statistical significance (Larionow et al., 2024). The behavioural symptoms dimension had similar results, with 8/10 (80%) studies reporting no significant difference by age (Er et al., 2024; Henschel et al., 2025; Hogg et al., 2023; Hogg et al., 2024; Mathé et al., 2025; Rocchi et al., 2023; Sampaio et al., 2023; Türkarslan et al., 2023). The remaining two studies found contrasting results. One study found significantly higher behavioural symptoms among younger participants (Larionow et al., 2024) and the other found that the oldest age group (participants aged 50 years and older) had the highest score in this dimension, but did not report statistical significance (Trifunović & Rajčević, 2024).

A range of trends were reported for the rumination dimension. Again, most studies found no significant difference by age (6/10, 60%)(Er et al., 2024; Henschel et al., 2025; Mathé et al., 2025; Rocchi et al., 2023; Sampaio et al., 2023; Türkarslan et al., 2023). 2/10 (20%) found that older participants had higher rumination scores than younger participants (Hogg et al., 2023; Hogg et al., 2024). 1/10 (10%) studies found the opposite, reporting that younger participants had significantly higher rumination scores than older people (Larionow et al., 2024). Finally, 1/10 (10%) studies found that the middle of three age groups (participants aged 30 to 50 years) had the highest

rumination score (Trifunović & Rajčević, 2024). The statistical significance of this result was not reported.

Overall, most studies found no significant differences by age in scores for the total HEAS or the affective symptoms, rumination and behavioural symptoms dimensions. 6/10 (60%) studies found that younger people had higher scores in the anxiety about personal impact dimension, although this difference was not always statistically significant.

Four of the EAQ studies explored variation in results by age. Two studies reported results for the total scale, and both found significantly higher eco-anxiety among younger participants (Devecchi et al., 2025; Micoulaud-Franchi et al., 2024). Similarly, the negative consequences of eco-anxiety dimension was found to be significantly higher among younger participants in all four studies (Ágoston et al., 2022; Devecchi et al., 2025; Micoulaud-Franchi et al., 2024; Zeier & Wessa, 2024). The largest reported correlation coefficient was $r=-0.15$, $p<0.001$, in a study of 880 Italian women aged between 18 to 64 years (Devecchi et al., 2025). Three of the four studies found that younger participants had significantly higher scores in the habitual ecological worry dimension (Ágoston et al., 2022; Devecchi et al., 2025; Zeier & Wessa, 2024). The largest reported correlation coefficient for this dimension was $r=-0.12$, $p<0.01$, in a study of 4608 adults in the United States, with a mean age of 43.3 years (Ágoston et al., 2022). The fourth study found no significant difference in habitual ecological worry between participants aged less than 35 years and those aged 35 years and older (Micoulaud-Franchi et al., 2024).

One of the EMEA studies explored trends in eco-anxiety by age (Jalin et al., 2025). This study found that eco-anxiety was higher among younger participants for the total scale, the anxiety-depressive manifestations dimension and the relational disturbances dimension (correlations: $r=-0.21$, $r=-0.21$ and $r=0.28$, respectively, and p -values all <0.001). There was no significant difference in the ecological obsessions dimension. Participants' ages ranged from 18 to 82 years.

Overall, studies that used the EAQ or EMEA tended to report higher levels of eco-anxiety among younger participants for the total scales and most scale dimensions. Only one study that used the EMEA explored score variation by participant age, so the generalisability of this finding for this scale is limited (Jalin et al., 2025). Conversely, most studies that used the HEAS found that there was no significant relationship between participant age and scores for the total scale or the affective symptoms, rumination or behavioural symptoms dimensions. The anxiety about personal impact dimension is the exception: most studies found that younger participants tended to have higher scores in this dimension, although statistical significance was not reached or reported in every study. This aligns with the trends seen in the EAQ and EMEA.

2.2.4.3 Employment status

Three studies that used the HEAS explored the relationship between eco-anxiety and employment status. Two out of three (66.7%) studies found that participants who were not employed had significantly higher scores for the total scale than participants who were employed (Cebeci et al., 2025; Henschel et al., 2025). Cebeci et al also found that students had significantly higher total scores than employed participants (Cebeci et al., 2025). Conversely, the third study reported no significant difference between participants who were employed and those who weren't (Özkan et al., 2025). This was a study including 491 women which investigated the effect of eco-anxiety on fertility preferences; the all-female participant group could be a reason why this study did not find the same trend in eco-anxiety by employment status as the other two studies. Only one study explored the relationship between eco-anxiety and employment status for the separate dimensions of the scale (Henschel et al., 2025). Henschel et al found significantly higher scores in the affective symptoms dimension for people who were not employed, compared to people who were (Henschel et al., 2025). There was no significant relationship in the other three dimensions of the scale.

Two studies that used the EAQ explored variation in results by employment status. The first stratified participants into 'higher', 'lower' and 'inactive' "socio-professional categories" (term not further described)(Micoulaud-Franchi et al., 2024). This study

found no significant differences between socio-professional groups in the total scale and habitual ecological anxiety dimension. In the distress related to eco-anxiety dimension, the study found that scores were significantly different between groups, with the 'lower' socio-professional group reporting significantly greater distress than the other two groups (M(SD) lower: 16.45 ± 6.14 ; higher: 15.46 ± 5.65 ; inactive: 15.21 ± 5.57 ; $p=0.028$). The second study stratified participants into 'employed' and 'not employed' groups (Ágoston et al., 2022). This study found that scores in both dimensions were higher among participants who were not employed, although noted that the effect size was small in both cases.

No studies that used the EMEA explored variation in results by employment status.

Overall, some studies using the HEAS or EAQ found that participants who were not employed had significantly higher levels of eco-anxiety than participants who were employed. However, this trend was not evident in all studies. This conclusion is limited by the small number of studies that explored this relationship.

2.2.4.4 Rural vs urban residence

Two studies that used the HEAS explored the relationship between participants' area of residence and eco-anxiety. Both studies found that there was no significant relationship between area of residence and dimension scores for any of the four dimensions of the scale (Larionow et al., 2024; Sampaio et al., 2023). These studies represented 634 people from Poland (Larionow et al., 2024) and 623 Portuguese undergraduate students (Sampaio et al., 2023). One further study of 40 geography teachers in Bosnia and Herzegovina explored whether teachers' eco-anxiety varied by the location of the school they were teaching at (Trifunović & Rajčević, 2024). This has been considered a proxy measure of participant residence in this review. 32 teachers (80%) taught at an urban school and 8 (20%) at a rural school. The study found that participants working in rural schools had higher average scores than their urban counterparts in all four dimensions of the HEAS. However, the significance and effect size of the differences were not reported (Trifunović & Rajčević, 2024).

Three studies that used the EAQ explored variation in results by area of residence. Two out of three (66.7%) studies found no significant difference between participants living in different areas (Ágoston et al., 2022; Micoulaud-Franchi et al., 2024). The first of these studies included 1004 people in France and found no significant difference in the total scores or dimension scores between people living in the countryside, smaller cities or larger cities (Micoulaud-Franchi et al., 2024). The second included 4608 people in Hungary and found no significant difference in the dimension scores between people living in the capital city, in other cities or in villages (Ágoston et al., 2022). Ágoston et al subsequently conducted a different study with a representative sample (in terms of sex, age, region and settlement size) of the Hungarian population (Ágoston, Buvár, et al., 2024). Interestingly, this study found differences in dimension scores by area of residence. Participants living in other cities and villages had higher habitual ecological worry scores than participants living in capital cities, and participants living in areas other than the capital city (including other cities, villages and country seats) had higher negative consequences of anxiety than those living in the capital city. The effect size of the differences was small in both dimensions (0.01 and 0.03, respectively)(Ágoston, Buvár, et al., 2024).

No studies that used the EMEA explored variation in results by area of residence.

Overall, 4/6 (66.7%) studies found no significant relationship between participants' area of residence and their level of eco-anxiety. 2/6 (33.3%) studies found a trend towards higher eco-anxiety among people living outside a capital city (Ágoston, Buvár, et al., 2024) or working in a rural area (Trifunović & Rajčević, 2024). While this relationship has not yet been investigated in many studies, most studies to-date have not found a significant relationship between area of residence and eco-anxiety.

2.2.4.5 Education level

Five studies that used the HEAS explored the relationship between participants' educational attainment and eco-anxiety. Three out of five (60%) studies found no

significant relationship between participants' level of education and HEAS total and/or dimension scores (Cebeci et al., 2025; López-García et al., 2025; Sampaio et al., 2023). Two out of five (40%) studies found a significant relationship, although, interestingly, reported opposing trends. One study of 322 adults from Germany, Austria and Switzerland found that participants with a higher level of education had significantly higher eco-anxiety in the affective symptoms and behavioural symptoms dimensions only (Henschel et al., 2025). Conversely, a study of 634 adults in Poland found a significant negative correlation between level of education and eco-anxiety score in all dimensions except the behavioural symptoms dimension, indicating that more education was associated with less eco-anxiety (Larionow et al., 2024).

Two studies that used the EAQ explored variation in results by educational attainment. Both studies were set in Hungary and both found that participants with primary school-level education had higher scores in the negative consequences of eco-anxiety dimension than participants with high school, college or university education, though these differences were not all significant and effect sizes were small (0.005 and 0.01 in the 2022 and 2024 studies, respectively)(Ágoston, Buvár, et al., 2024; Ágoston et al., 2022).

The two studies found opposing results in the habitual ecological worry dimension of the EAQ. In the earlier study of 4608 people, those with an elementary or less/vocational education had lower scores than those with a high school, college or higher education (Ágoston et al., 2022). In the later study of 1000 people, which was representative of the Hungarian population in terms of sex, age, residence region and settlement size, participants with a primary school education had higher scores than those with a high school, college or university education (Ágoston, Buvár, et al., 2024). The effect size of the differences were small in both studies (0.003 and 0.01, respectively)(Ágoston, Buvár, et al., 2024; Ágoston et al., 2022).

One study that used the EMEA explored the relationship between participants' educational attainment and eco-anxiety (Jalin et al., 2024). This study of 522 French-speaking adults who attended climate workshops found that a higher level of education

was significantly associated with a higher level of eco-anxiety, including the total scale and two of the three dimensions (climate-related emotional manifestations and involvement with ecology)(regression coefficient for total EMEA: $b=0.09$; $p=0.002$).

There was no significant correlation between educational attainment and the 'relational difficulties' dimension of the EMEA.

Overall, the eight studies that explored the relationship between education level and eco-anxiety reported different trends. Three out of eight (37.5%) studies, all using the HEAS, found no significant relationship. A further 3/8 (37.5%), one using the HEAS and two using the EAQ, found that more education tended to be associated with less eco-anxiety. The remaining 2/8 (25%) studies, one using the HEAS and one using the EMEA, found that more education tended to be associated with more eco-anxiety. Further exploration of this relationship is required to reach a definitive conclusion.

2.2.4.6 Socioeconomic status

Three studies that used the HEAS explored the relationship between socioeconomic status and eco-anxiety. Two studies recorded income level and the third recorded participants' income relative to their expenses: these have been considered as proxy measures of socioeconomic status for the purpose of this review. Two out of three (66.7%) studies found that higher socioeconomic status was significantly associated with higher levels of eco-anxiety (Henschel et al., 2025; López-García et al., 2025). Conversely, Özkan et al found that participants whose income was less than their expenses had significantly greater eco-anxiety than those whose income equalled their expenses (Özkan et al., 2025).

One study that used the EAQ explored the relationship between socioeconomic status and eco-anxiety. This study measured subjective socioeconomic status on a 7-point scale and found a weak positive correlation between this measurement and both dimensions of eco-anxiety, indicating slightly higher levels of eco-anxiety among people with higher socioeconomic status (correlations: 0.047 for habitual ecological worry and

0.060 for negative consequences of eco-anxiety; p values not stated but described as <0.01 for both dimensions)(Ágoston et al., 2022).

No studies that used the EMEA explored variation in results by socioeconomic status.

Overall, 3/4 (75%) studies found that a higher socioeconomic status was associated with higher eco-anxiety scores.

2.2.4.7 Ethnicity

None of the included studies explored differences in eco-anxiety by ethnicity.

2.2.5 Summary

Eco-anxiety is an emerging concept in research; the earliest eligible study in this review was published in 2021 (Hogg et al., 2021). Despite its novelty, three different scales have been developed: the HEAS, the EAQ and the EMEA. These scales have been widely translated and adapted to different contexts (Table 2). Only one study, which used the HEAS, included participants from New Zealand (Hogg et al., 2021). In this scale, anxiety about personal impact tends to be the highest-scoring dimension, and behavioural symptoms the lowest-scoring. Two methods of score categorisation have been suggested, both for the HEAS. The first of these is a binary categorisation into clinically-significant and non-clinically significant eco-anxiety, defined by score of 3 or more on the first two items of the scale (Larionow et al., 2024). The second method is a categorisation into mild, moderate and severe eco-anxiety based on even division of the response scale (Vecina et al., 2025). Score categorisation was not commonly used and was only employed in three studies (Baroni et al., 2025; Larionow et al., 2024; Vecina et al., 2025).

Various trends were reported regarding the relationship between demographic characteristics and eco-anxiety. Of the few studies that examined these relationships, most found that women, people with higher socioeconomic status and people who weren't employed tended to have higher eco-anxiety than men, people with lower

socioeconomic status and people who were employed. Most studies found no significant relationship between participants' area of residence and eco-anxiety. The relationships that eco-anxiety displayed with age and education level were more varied. In the EMEA; EAQ; and anxiety about personal impact dimension of the HEAS; younger participants tended to have higher eco-anxiety, although this was not always significant. However, most studies that used the HEAS found no significant relationship between age and the total scale or the other dimensions. Similarly, most of the studies that used the HEAS found no significant relationship between participants' levels of education and eco-anxiety. However, three other studies reported that a higher level of education was associated with more eco-anxiety and two studies reported the opposite. This disparity between different studies highlights that further research is needed to better understand the relationship between eco-anxiety and demographic characteristics.

2.3 Results: Environmental identity

2.3.1 Overview

Twenty-five eligible studies explored environmental identity. The earliest of these was published in 2010 (Kiesling & Manning, 2010). However, most studies have been published in the past five years (Figure 4).

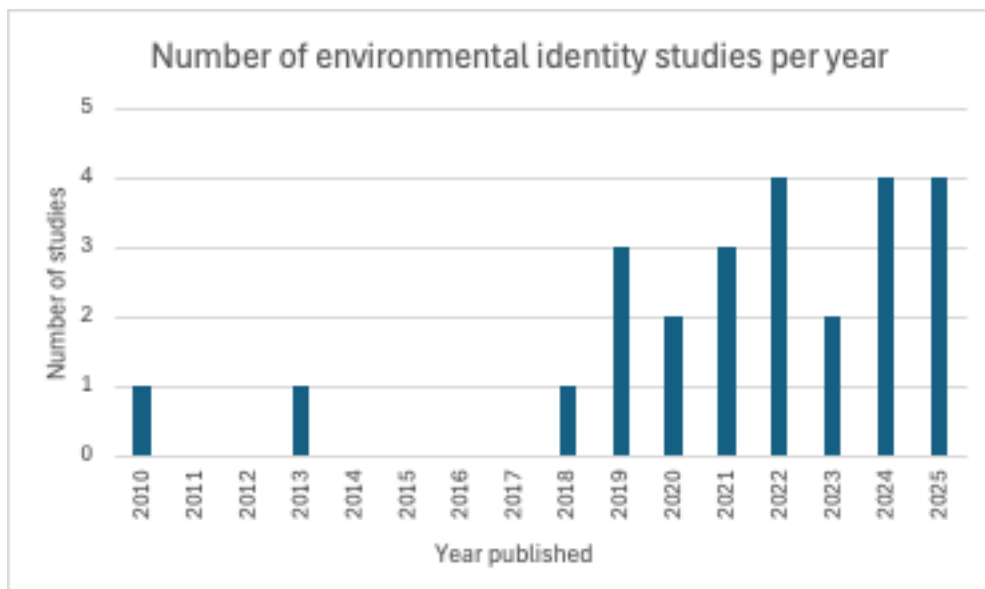


Figure 4: Number of eligible environmental identity studies published, by year.

Most studies were conducted in the United States and Turkey ($n=7$ in each location, representing 56% of eligible studies). No eligible environmental identity studies were conducted in New Zealand. The nearest geographical setting was one study conducted across Australia and Tonga (Clark et al., 2019).

84% of studies were cross-sectional in design ($n=21$). Other study types included a non-randomised experimental survey (Ayaz et al., 2021), an exploratory study with a daily survey over 60 days (Contreras et al., 2024), a longitudinal study (Mah et al., 2020) and a survey with three-month follow-up (Patrasc-Lungu & Iliescu, 2022b).

Most studies used an environmental identity scale as a research variable (n=22, 88%). Two studies (8%) adapted an environmental identity scale to Portuguese (Ferreira et al., 2024) and Greek (Gkargavouzi et al., 2018) settings, respectively. One study represented the update of Clayton's original environmental identity scale into the revised version (Clayton et al., 2021).

2.3.2 Scales and versions

Two environmental identity scales were used by the eligible studies, albeit in different translations and versions. The two underlying scales were the:

1. Environmental Identity Scale (EID)(Clayton, 2003), used by 17 studies (68%).
2. Revised Environmental Identity Scale (R-EID)(Clayton et al., 2021), used by 8 studies (32%).

The various translations and versions of these scales are summarised in Table 3. Clayton's 2003 EID has been adapted into French (Prévot et al., 2018), Spanish (Olivos & Aragonés, 2011) and Turkish versions (Clayton & Kiliç, 2013), while the R-EID has been adapted into a Portuguese version (Ferreira et al., 2024). Both scales have also been translated into other languages as required and employed in both original-length and shortened formats (Table 3).

Both scales were found to be sufficiently explained by a single factor in their original study (Clayton, 2003; Clayton et al., 2021). However, some subsequent studies identified different dimensions of the scales. These are summarised in Table 3.

Table 3: Summary of environmental identity scale versions and translations

Scale	Version	Number of items	Language	Dimensions
Environmental identity scale (EID)(Clayton, 2003)	Original	24 (Clark et al., 2019; Gkargkavouzi et al., 2018; Irkhin, 2020; Kiesling & Manning, 2010; Mah et al., 2020; Nartova-Bochaver et al., 2022)	English (Clark et al., 2019; Kiesling & Manning, 2010). Greek (Gkargkavouzi et al., 2018). Translated as required for Armenia, China, Cuba, Estonia, India, Poland, Russia, Turkey and Ukraine (Nartova-Bochaver et al., 2022). Language not specified, but studies set in Russia (Irkhin, 2020), Tonga (Clark et al., 2019) and Canada (Mah et al., 2020).	Gkargkavouzi et al reported six factors: 1. Appreciation of natural environment (5 items) 2. Ideological commitment to the environment (6 items) 3. Belonging to the natural world (4 items) 4. Attitudes to nature (3 items) 5. Contact with nature (3 items) 6. Environmental identity (3 items) (Gkargkavouzi et al., 2018). Clark et al reported four factors: 1. Environmental identity (5 items) 2. Enjoying nature (6 items) 3. Appreciate nature (5 items) 4. Environmentalism (7 items)(Clark et al., 2019). Nartova-Bochaver et al reported a unidimensional scale (Nartova-Bochaver et al., 2022). Mah et al describe that the scale: "includes statements measuring four dimensions including interaction with and perceived importance of interaction with nature; and positive emotions associated with interactions of self and nature" (Mah et al., 2020). No other studies reported factors.
	French version (Prévot et al., 2018)	11 (Mathé et al., 2025; Monroe et al., 2021)	French (Mathé et al., 2025). Not reported, but study set in the US (Monroe et al., 2021).	Not reported.
	Spanish version (Olivos & Aragonés, 2011)	24 (Sierra-Barón et al., 2023) 22 (Patrasc-Lungu & Iliescu, 2022a, 2022b).	Spanish (Sierra-Barón et al., 2023). Not reported, but study set in the US (Patrasc-Lungu & Iliescu, 2022a, 2022b).	Original study (Olivos & Aragonés, 2011) and Sierra-Barón et al (Sierra-Barón et al., 2023) described four dimensions: 1. Environmental identity 2. Enjoying nature 3. Appreciation of nature

				4. Environmentalism
	Turkish version (Clayton & Kiliç, 2013)	24 (Ayaz et al., 2021; Clayton & Kiliç, 2013; Kızılay & Önal, 2019; Uçar & Canpolat, 2019) 14 (Atik et al., 2023)	Turkish (Atik et al., 2023; Ayaz et al., 2021; Clayton & Kiliç, 2013; Kızılay & Önal, 2019; Uçar & Canpolat, 2019).	Ayaz et al reported four factors: 1. Environmental identity (5 items) 2. Desire to be near to nature (6 items) 3. Resembling nature (6 items) 4. Environmentalist behaviours (7 items)(Ayaz et al., 2021). Atik et al also reported four factors in the shorter version: 1. Environmental identity (4 items) 2. Closeness to nature (3 items) 3. Connectedness to nature (4 items) 4. Eco-friendly behaviours (3 items)(Atik et al., 2023). No other studies reported factors.
	Short version (Clayton, 2003)	12 (Curtin & Jia, 2022)	English (Curtin & Jia, 2022).	Not reported.
Revised environmental identity scale (R-EID)(Clayton et al., 2021)	Original	14 (Afacan, 2024; Clayton et al., 2021; Pinho, 2025a, 2025b)	English, Russian, Mandarin Chinese (Clayton et al., 2021). Turkish (Afacan, 2024). Not specified, but study set in Portugal (Pinho, 2025a, 2025b).	Not reported.
	Portuguese version (Ferreira et al., 2024)	14 (Ferreira et al., 2024)	Portuguese (Ferreira et al., 2024).	Ferreira et al reported two factors: 1. Connectedness with nature (10 items) 2. Protection of nature (4 items) (Ferreira et al., 2024).
	Short version	11 (Contreras et al., 2024; Huang et al., 2024; Smith & Wolfe, 2025)	Not specified, but studies set in Taiwan (Huang et al., 2024), US and Canada (Smith & Wolfe, 2025) and Belgium (Contreras et al., 2024).	None reported by included studies.

2.3.3 Average scores

The results of environmental identity scales tended to be presented either as an average score per item or as an average total score. No studies suggested a system to categorise environmental identity scores (for example into low, medium and high scores). As such, the mid-point of the various scoring scales used has been employed as a descriptive marker.

2.3.3.1 *Environmental Identity Scale*

Of the 17 studies that used the EID, 8 (47.1%) used a 7-point Likert-type scale, 7 (41.2%) used a 5-point scale, one (5.9%) used a 4-point scale (Irkhin, 2020) and one (5.9%) did not report the scale range (Gkargkavouzi et al., 2018). Where reported, Cronbach's alpha values in all studies except one exceeded 0.7, indicating acceptable internal consistency (Mackridge, 2018). The exception was Gkargkavouzi et al who reported a satisfactory Cronbach's alpha of 0.9 for the overall scale, but values of less than 0.7 for three of their six suggested dimensions (Table 3)(Gkargkavouzi et al., 2018). This study suggested more dimensions than any other, and this result indicates inadequate correlation of the questions informing the "attitudes to nature", "contact with nature" and "environmental identity" dimensions (Cronbach's alpha values of 0.58, 0.47, and 0.40, respectively), suggesting that these dimensions may not be robust (Mackridge, 2018).

Of the 8 studies that used a 7-point Likert-type scale, 4 reported mean scores per item (Clark et al., 2019; Clayton & Kiliç, 2013; Curtin & Jia, 2022; Uçar & Canpolat, 2019), 3 reported mean total scores (Ayaz et al., 2021; Kızılay & Önal, 2019; Mah et al., 2020) and 2 reported the average scores of each dimension (one as a total average for each dimension (Atik et al., 2023), and the other as a per-item average for each dimension (Clark et al., 2019)). The provided average total scores were divided by the number of items used in each respective version, to account for variability in the number of items and enable comparison. Atik et al was excluded from this calculation as the reported score of 22.31 for the "closeness to nature" dimension exceeded the upper possible

limit, based on the reported parameters of a 7-point scale for 3 questions (Atik et al., 2023).

Only one study found an average below the mid-point of the scale (3.5): Mah et al reported an average EID score of 58.04 which, when divided by the 24 items in the scale, equates to 2.41 (Mah et al., 2020). This study represented a cross-sectional follow-up of Canadian young adults, aged 32, who were part of a longitudinal study. All other studies found averages above the mid-point of the scale. The highest score was 5.57 (standard deviation 0.76) in a study of university students in Turkey (Clayton & Kiliç, 2013). Considering the dimensions of the EID, Clark et al found that “enjoying nature” had the highest score (M(SD): 5.55 (1.05)) and “environmental identity” had the lowest score (M(SD): 4.91 (1.25))(Clark et al., 2019). The dimension scores reported in Atik et al were excluded from analysis, due to the “closeness to nature” dimension exceeding the upper possible limit.

Of the 7 studies using a 5-point Likert-type scale, 2 studies reported mean scores per item (Monroe et al., 2021; Nartova-Bochaver et al., 2022), 4 reported mean total scores (Kiesling & Manning, 2010; Mathé et al., 2025; Patrasc-Lungu & Iliescu, 2022a, 2022b) and one reported the range of scores for each dimension of the scale, but no total or item average (Sierra-Barón et al., 2023). As above, average total scores were converted to an average per-item score. Mathé et al’s study was excluded from this calculation, because the total reported average score (57.68) exceeded the upper possible limit based on the reported parameters of a 5-point scale for 11 questions (Mathé et al., 2025). Mean scores were all above the halfway point of 2.5, and ranged from 3.03 to 4.30 (standard deviations 0.69 and 0.46, respectively) among samples of university students in Russia and India, respectively (Nartova-Bochaver et al., 2022). In the study that reported the range of scores in each dimension of the scale, the lowest scores were seen in the “environmental identity” and “appreciation of nature” dimensions (both had a minimum of 0.84), and the highest was seen in the “environmentalism” dimension (with a maximum of 4.39)(Sierra-Barón et al., 2023). An inconsistency of note is that this study reported a response scale ranging from 1 to 5, so it is unclear how the minimum values fell below 1.

2.3.3.2 Revised Environmental Identity Scale

Of the 8 studies that used versions of the R-EID, 7 (87.5%) used a 7-point Likert-type scale. The scoring values reported by most studies ranged between 1: “Not at all true of me” to 7: “Completely true of me.” One study used a 5-point Likert scale; scoring values were not reported in this study (Huang et al., 2024). Where reported, Cronbach’s alpha values all exceeded 0.7, indicating acceptable internal consistency (ranging from 0.86 to 0.94, with both minimum and maximum values seen in Clayton et al (Clayton et al., 2021))(Mackridge, 2018).

Six studies reported mean-per-item scores for the R-EID. In all of these studies, the average score exceeded the halfway point of the scale used. Of the studies using 7-point scales, the highest and lowest mean values were both reported in the study describing the development of the R-EID (Clayton et al., 2021). These ranged from a mean (SD) of 4.81 (1.06) in the sample of Taiwanese undergraduate students to 6.02 (0.86) in the sample of US visitors to North Carolina zoos and other natural leisure settings. The study that used a 5-point scale was a study of 101 employees of a manufacturing firm in Taiwan. This study reported a mean (SD) of 4.98 (0.92) however, as the scoring values were not reported, this could not be contextualised (Huang et al., 2024).

Of the studies that used the R-EID, only Ferrajão et al reported finding different dimensions to the scale (Table 3)(Ferrajão et al., 2024). Average scores in the different dimensions were not reported in this study.

2.3.4 Demographic trends

2.3.4.1 Gender

Six studies that used the EID explored differences in scores by gender. Two studies did not find significant differences between female and male participants (Curtin & Jia, 2022; Patrasc-Lungu & Iliescu, 2022b). These studies were both based in the US and involved 201 and 150 participants, respectively. Conversely, 4 studies found that

women had higher EID scores than men (Clayton & Kiliç, 2013; Gkargkavouzi et al., 2018; Irkhin, 2020; Kızılay & Önal, 2019). Kızılay et al's study of 215 preservice science teachers in Turkey found that while female participants had higher mean EID scores, the difference was not statistically significant (M: 131.32 vs 125.59, p-value described as not statistically significant)(Kızılay & Önal, 2019). However, women were found to have statistically significantly higher environmental identity scores than men by Irkhin et al in a study of 312 Russian students (M(SD): 3.16 (0.71) vs 2.89 (0.64) for female vs male participants, $p=0.005$)(Irkhin, 2020) and Clayton et al in a study of 808 Turkish university students (scores not reported, $p<0.05$)(Clayton & Kiliç, 2013). Gkargkavouzi et al found that women had higher scores in the 'contact with nature' dimension of the scale than men in a study of 100 teachers involved in environmental education programmes in Greece, but did not report on other dimensions of the scale (M(SD): 12.17 (1.98) vs 7.11 (2.95), $p=0.026$)(Gkargkavouzi et al., 2018).

Three studies that used the R-EID explored differences in scores by gender. 2 studies did not find significant differences between female and male participants (Clayton et al., 2021; Ferrajão et al., 2024). These were studies of 704 adults in the US, 310 Russian university students, 343 Swiss university students and 91 Taiwanese undergraduate students (Clayton et al., 2021) and 545 adults in Portugal (Ferrajão et al., 2024). However, Pinho et al's research, also based in Portugal, found that that women had significantly higher levels of environmental identity than men (M(SD): 5.73 (0.87) vs 5.59 (0.92), $p<0.001$)(Pinho, 2025a). This research involved a nationally-representative sample of 3300 Portuguese adults. The two Portuguese studies were published at a similar time (2024 and 2025, respectively), so the larger sample size in Pinho et al may have contributed to their finding of a difference in environmental identity between men and women.

Overall, 4 of the 9 studies did not find a significant difference in environmental identity scores between men and women (Clayton et al., 2021; Curtin & Jia, 2022; Ferrajão et al., 2024; Patrasc-Lungu & Iliescu, 2022b). One study found that women had higher environmental identity scores than men, but the difference was not statistically significant (Kızılay & Önal, 2019). The 4 remaining studies found that women had

significantly higher environmental identity than men, although Gkargkavouzi et al only reported results for one dimension of the scale (Clayton & Kiliç, 2013; Gkargkavouzi et al., 2018; Irkhin, 2020; Pinho, 2025a). These results indicate that while a difference between genders may or may not be present, women are more likely to have a higher environmental identity than men if a difference is present. This aligns with the results of the original EID, where it was reported that women tended to have slightly higher environmental identity than men, but that this difference was usually not significant (Clayton, 2003).

2.3.4.2 Age

Three studies that used the EID explored whether there was an association between age and environmental identity (Irkhin, 2020; Patrasc-Lungu & Iliescu, 2022a, 2022b). There was no significant correlation between age and environmental identity in any of the studies. Cumulatively, these studies included a wide age range of participants. While Irkhin et al reported that 90.4% of their participants were aged less than 20 years (Irkhin, 2020), Patrasc-Lungu et al reported an age range of 18 to 67 and 68 years (Patrasc-Lungu & Iliescu, 2022a, 2022b).

Conversely, the 3 studies that used the R-EID and explored correlations with age all reported at least one significant result. In the paper detailing the development of the R-EID, small positive correlations with age were seen in the Russian sample and one of two US samples, indicating a small increase in environmental identity with increasing age (Russia: $r=0.14$, $p=0.017$; US MTurk: $r=0.22$, $p=0.002$)(Clayton et al., 2021). However, correlations with age were not reported among the other samples (Clayton et al., 2021). In Ferrajão et al's Portuguese adaptation of the scale, older participants (37 years and older) were found to have significantly higher environmental identity than younger participants (18 to 36 years) in both the overall scale and the protection of nature dimension, but not the connectedness with nature dimension (overall scale $M(SD)$: 5.29 (1.32) vs 5.01 (1.26), $p=0.01$)(Ferrajão et al., 2024). Finally, a study of older adults in Turkey found that the "old old" group (aged 80+ years) had significantly higher environmental identity than the "old" group (aged 70 to 79 years)($M(SD)$: 4.92 (1.3) vs

4.87 (1.6), $p=0.001$) (Afacan, 2024). Interestingly, the “young old” group (aged 65 to 69 years) had the highest environmental identity of the three groups (M(SD): 4.94 (2.2)), but this was not significantly different (Afacan, 2024).

Overall, these results indicate that there may be a correlation between increasing age and increasing environmental identity, although this relationship was only seen in studies that used the R-EID. No relationship between age and environmental identity was seen in the studies that used the EID.

2.3.4.3 Employment status

None of the included studies explored differences in environmental identity by employment status.

2.3.4.4 Rural vs urban residence

3 studies explored whether environmental identity varied by rural vs urban residence or upbringing. 2 studies found that rural residence or upbringing, compared with urban, was associated with significantly higher environmental identity (Clayton et al., 2021; Sierra-Barón et al., 2023). The first of these included 1705 people from Southern Colombia (Sierra-Barón et al., 2023). This study found that participants living in rural areas had significantly higher scores in all four environmental identity dimensions, compared with participants living in urban areas (environmental identity dimension M(SD): 3.23 (0.63) vs 2.98 (0.85), p -value reported as 0.00). The second was in the sample of 343 Swiss university students included in the development of the R-EID. Clayton et al reported that Swiss participants who grew up in a rural area had significantly higher environmental identity than those who grew up in an urban area, with those who grew up in a suburban area falling between these groups (M(SD): rural 5.6 (0.75), suburban 5.3 (0.87), urban 5.2 (0.85), $p=0.003$ (rural vs urban)) (Clayton et al., 2021). The effect of rural vs urban upbringing was not reported for the other population groups included in the study (Clayton et al., 2021). Finally, the third study that explored this relationship included 312 students in Russia and did not find any significant correlation between residence and environmental identity (Irkhin, 2020). These results

indicate that higher environmental identity is likely among those who live or grew up in rural areas, compared with urban areas.

2.3.4.5 Education level

None of the included studies explored differences in environmental identity by education level.

2.3.4.6 Socioeconomic status

Exploration of a relationship between environmental identity and socioeconomic status was only included in one study. Patrasc-Lungu and Iliescu (2022a) recorded annual household income (used here as a proxy for socioeconomic status) and found no significant relationship between annual household income and environmental identity.

2.3.4.7 Ethnicity

None of the included studies explored differences in environmental identity by ethnicity.

2.3.5 Summary

Environmental identity has been researched more frequently since 2018. All of the eligible studies used a measure of environmental identity adapted from Clayton et al.'s 2003 EID or 2021 R-EID (Clayton, 2003; Clayton et al., 2021). Studies used the scales in different lengths, languages and scoring systems (Table 3), although 5- and 7-point Likert-type systems were most common. No studies were based in New Zealand. No scoring categorisation was described, though it was noted that all studies except one found average scores above the midpoint of the scale (Mah et al., 2020). Studies varied in their assessment of relationships between demographic characteristics and environmental identity. Environmental identity may be higher among women (Clayton & Kiliç, 2013; Gkargkavouzi et al., 2018; Irkhin, 2020; Kızılay & Önal, 2019; Pinho, 2025a); older age groups (Afacan, 2024; Clayton et al., 2021; Ferrajão et al., 2024); and people

who live or grew up in rural environments (Clayton et al., 2021; Sierra-Barón et al., 2023). However, these results were not consistent across all studies.

2.4 Results: Relationship between eco-anxiety and environmental identity

Two eligible studies explored the relationship between eco-anxiety and environmental identity. The first was a study of 275 French adults aged between 18 and 80 years (M(SD)age: 31.2 (13.9) years)(Mathé et al., 2025). This study used the HEAS (translated into French by the research team) and a previously-published French version of the EID (Prévot et al., 2018). They found a moderate, significant, positive correlation between the EID and all four HEAS dimensions (Table 4). The second study included 545 Portuguese adults aged between 18 and 83 years (M(SD)age: 37.1 (16.4) years)(Ferrajão et al., 2024). This study used the HEAS and the R-EID, both translated into Portuguese by the research team. They also found a significant, positive correlation between the R-EID and its two dimensions and the HEAS and three of its four dimensions (affective symptoms, rumination and anxiety about personal impact)(Table 4). There was no significant relationship between the R-EID (either the total scale or either dimension) and the behavioural symptoms dimension of the HEAS (Ferrajão et al., 2024). Overall, while the relationship between eco-anxiety and environmental identity was only explored by two studies, available data suggest a positive correlation between the two concepts: that is, as eco-anxiety increases, environmental identity would also be expected to increase.

Table 4: Correlations between environmental identity and eco-anxiety scales

	EID (Mathé et al., 2025)	R-EID (Ferrajão et al., 2024)	R-EID: Connectedness with nature (Ferrajão et al., 2024)	R-EID: Protection of nature (Ferrajão et al., 2024)
HEAS	Not reported.	0.19 **	0.14 **	0.26 **
Affective symptoms	0.38 **	0.12 *	0.09 *	0.16 *
Rumination	0.43 **	0.20 **	0.15 **	0.29 **
Behavioural symptoms	0.25 **	0.01	<0.01	0.06
Anxiety about personal impact	0.38 **	0.28 **	0.23 **	0.33 **

*p<0.05, **p<0.001

2.5 Summary of hypotheses

The hypotheses of this research are listed in Table 5. Most were informed by the results of the scoping review. However, several planned analysis points were not explored in the studies included in the scoping review. These include potential variation in eco-anxiety by ethnicity and country of birth, and potential variation in environmental identity by ethnicity, country of birth, employment status and educational attainment.

To the author's knowledge, differences in eco-anxiety and environmental identity between people of Māori descent and those who are not of Māori descent have not yet been explored. However, previous research in New Zealand has found that Māori cultural identity is positively related to environmental identity (Apiti et al., 2023) and that people in minority ethnic groups are less likely to be sceptical of climate change than people in the majority, New Zealand European, group (Milfont et al., 2015). It is anticipated that these findings may manifest in a stronger relationship with the natural environment and greater concern about environmental threats among participants of Māori descent than those who are not of Māori descent. Additionally, previous exploration of eco-anxiety found that Indigenous Peoples were more impacted than non-Indigenous people (Coffey et al., 2021). Therefore, this research hypothesises that

both eco-anxiety and environmental identity will be higher among participants of Māori descent.

This analysis will explore whether there is variation in eco-anxiety and environmental identity between participants who were born in New Zealand and those who were born overseas. Country of birth was not explicitly explored by the studies included in the scoping review. However, it is evident that both eco-anxiety and environmental identity measures have been used in research in a wide range of countries. Additionally, the environmental threats of the triple planetary crisis are, by definition, of global relevance. Therefore, it is hypothesised that there will not be a significant difference in either eco-anxiety or environmental identity when stratified by participants' country of birth.

Variation in environmental identity by participants' educational attainment or employment status was not explored by the studies included in the scoping review. However, Prévot et al.'s study of environmental identity among university students found that childhood experiences played an important role in the development of environmental identity, which subsequently influenced students' choice of academic studies (Prévot et al., 2018). Environmental experiences in childhood have also been found to influence career choice (Williams & Chawla, 2016). These studies provide evidence that environmental identity influences both education and employment choices. However, evidence exploring whether this relationship may be bidirectional is limited. Therefore, it is hypothesised that there will not be a significant difference in environmental identity based on participants' educational attainment or employment status.

Table 5: Research hypotheses

Hypothesis	Area	Description
Eco-anxiety		
H1	Total HEAS score	The average per-item scores for the total scale will fall within the observed international range (0.43 to 2.08). The maximum observed value came from a study with only female participants. Therefore, it is anticipated that the value found in this study will fall closer to the lower end of the observed range.
H2	HEAS dimension scores	The average per-item scores of the dimensions will align with international trends. Anxiety about personal impact will have the highest score of the dimensions, and behavioural symptoms the lowest.
H3	Age	There will not be a significant relationship between age and eco-anxiety scores.
H4	Gender	Women will have significantly higher eco-anxiety scores than men.
H5	Māori descent	Participants of Māori descent will have significantly higher eco-anxiety scores than those who are not of Māori descent.
H6	Area-based socioeconomic deprivation	Participants living in areas with a higher socioeconomic status (that is, less deprivation) will have significantly higher eco-anxiety scores.
H7	Country of birth	There will not be a significant difference in eco-anxiety scores between participants who were born in New Zealand and those who were born overseas.
H8	Education level	There will not be a significant relationship between educational attainment and eco-anxiety scores.
H9	Employment	Participants who are not employed will have significantly higher eco-anxiety scores than those who are employed.
Environmental identity		
H10	Total R-EID score	Participants' environmental identity scores will be above the neutral midpoint of the response scale. Mean per-item scores will fall within the observed international range (4.81 to 6.02).
H11	Age	Older participants will have significantly higher environmental identity scores than younger participants.
H12	Gender	Women will have significantly higher environmental identity scores than men.
H13	Māori descent	Participants of Māori descent will have significantly higher environmental identity scores than those who are not of Māori descent.
H14	Area-based socioeconomic deprivation	There will not be a significant relationship between area-based socioeconomic deprivation and environmental identity.
H15	Country of birth	There will not be a significant difference in environmental identity scores between participants who were born in New Zealand and those who were born overseas.
H16	Education level	There will not be a significant relationship between educational attainment and environmental identity.
H17	Employment	There will not be a significant relationship between employment status and environmental identity.
Relationship between eco-anxiety and environmental identity		
H18	Relationship between concepts	There will be a positive correlation between environmental identity and all dimensions of the HEAS except 'behavioural symptoms'.

3 Methods

3.1 Data sources and management

3.1.1 New Zealand Health, Work and Retirement Study (NZHWR Study)

The longitudinal NZHWR Study was established in 2006 by the Health and Ageing Research Team (HART) at Massey University (Phillips, 2023). The aim of the study is to monitor and explore factors associated with health, and the social determinants of health, among older adults in New Zealand (adults aged over 55 years)(Phillips, 2023). The study has been run in 2006, 2008, 2009, 2010, 2012, 2013, 2014, 2016, 2017, 2018, 2020, 2021, 2022 and 2024/25. A variety of methods have been used throughout the span of the study, including a postal survey, interviews and linkage with national datasets including health, mortality and Accident Compensation Corporation data. This thesis focusses on data collected by postal survey in the 2024/25 study, because this was the first wave of the study that incorporated the HEAS and R-EID.

Excluding the first instance of the study, each wave has included two participant groups: existing and refresh participants. Existing participants are those who have previously completed the study and were not excluded or lost to follow-up (Table 6). The refresh participants are newly invited participants aged between 55 and 65, recruited to maintain representation in this age bracket as the existing participants age. Refresh participants are recruited through steady state sampling from the New Zealand electoral roll, with over-sampling of people of Māori descent to ensure adequate representation (Phillips, 2023). Projected response rates are taken into account during the calculation of the approach sample size (Phillips, 2023).

Table 6: Criteria for exclusion or lost to follow-up for existing participants in the NZHWR Study

Exclusion group	Criteria
Excluded	• Withdrawn from study • No response since 2020 or earlier • Moved overseas • Deceased
Lost to follow-up	• No forwarding details available for a person, when there was evidence that they no longer lived at that address.

Adapted from Phillips, 2023 (Phillips, 2023).

The 2024/25 study used the same distribution method as the 2022 postal survey.

Participants were initially sent an introductory letter, information sheet and consent form along with a pen, a pre-paid return envelope and a survey booklet (Phillips, 2023). One reminder postcard was sent two weeks later. A second reminder (which included the study information and survey materials) was sent eight weeks after the initial invitation. The second reminder was only sent to those who had not returned the survey and had not otherwise been notified as withdrawn, lost to contact, or deceased.

3.1.2 Data access and management

Data was requested in accordance with the HART data access and conditions of use agreement (Massey University, 2025b). Separate raw and working copies of the data were stored locally on a password-protected laptop. Synchronised backups of the unedited and working copies were stored in Microsoft OneDrive, accessed through Massey University, in line with University recommendations (Massey University, 2025a). In line with the HART data access agreement, all copies of the data will be deleted upon study completion.

3.1.3 Study design

The NZHWR Study is a longitudinal research effort. However, the focus of this thesis is participants’ responses to the HEAS and R-EID scales, included for the first time in the 2024/25 NZHWR Study. Therefore, this analysis used a quantitative, cross-sectional design.

3.2 Variables and measures

3.2.1 Eco-anxiety

Eco-anxiety was assessed using the Hogg Eco-Anxiety Scale (HEAS), a 13-item scale with four dimensions: affective symptoms, rumination, behavioural symptoms and anxiety about personal impact (Hogg et al., 2021). The scale was originally measured with a 4-point frequency scale (Hogg et al., 2021) and most subsequent studies have maintained this (Section 2.2.3.1). The values of the frequency scale, which respondents are asked to contextualise over the last two weeks, are:

- 0. Not at all.
- 1. Several of the days.
- 2. Over half of the days.
- 3. Nearly every day.

The categorisation of the HEAS into its four dimensions, and the possible scores for each, are summarised in Table 7. The scale is provided in Appendix C: HEAS and R-EID scales.

Table 7: HEAS and dimension configuration and scoring

Aspect	Number of items	Range of possible scores
HEAS	13	0 to 39
Affective symptoms	4	0 to 12
Rumination	3	0 to 9
Behavioural symptoms	3	0 to 9
Anxiety about personal impact	3	0 to 9

Hogg et al recommend calculating a mean score for each dimension of the scale (Hogg et al., 2021). They describe scores corresponding to several of the days across a two-

week period (corresponding to a response of ~1) as mild eco-anxiety and note that higher scores indicate more frequent symptoms of eco-anxiety. The authors recommended further research to establish clinical norms of eco-anxiety, which would facilitate score stratification, but did not comment on stratification boundaries.

As such, this analysis will use the score categorisation method proposed by Vecina et al (Vecina et al., 2025). This method categorised individuals as having mild, moderate or severe eco-anxiety by evenly partitioning the response scale into three. In this analysis, an additional category of “no” eco-anxiety has been added for participants who received a mean score of 0. Consequently, the score boundaries used in this analysis are:

1. No eco-anxiety (mean score = 0).
2. Mild eco-anxiety ($0 < \text{mean score} \leq 1$).
3. Moderate eco-anxiety ($1 < \text{mean score} \leq 2$).
4. Severe eco-anxiety ($2 < \text{mean score} \leq 3$).

Content and construct validation of the HEAS in this population (older adults in New Zealand) was not required, because English-language scale validity has been established by previous research in similar populations. The HEAS has been validated in New Zealand with undergraduate students (Hogg et al, 2021) and in adults up to 86 years of age in an Australian sample (Hogg et al, 2023). Internal reliability was satisfactory across all four dimensions in both studies, with Cronbach’s alpha values ranging from 0.86 to 0.92 in the New Zealand study (Hogg et al, 2021) and 0.78 to 0.88 in the Australian study (Hogg et al, 2023).

3.2.2 Environmental identity

Environmental identity was assessed using the Revised Environmental Identity Scale (R-EID)(Clayton et al., 2021). The revised scale is an adaptation of Clayton’s original 2003 scale that has been updated to enhance its applicability to different cultures and populations (Clayton, 2003; Clayton et al., 2021). The R-EID is a 14-item, unidimensional scale. It is measured with a 7-point response scale ranging from 1 (not

at all true of me) to 7 (completely true of me), with a neutral midpoint of 4 (neither true nor untrue). This corresponds to a range of possible scores from 14 to 98. The scale is provided in Appendix C: HEAS and R-EID scales.

No methods of score categorisation have been reported in the literature (Section 2.3.3). However, Clayton et al reflected on the position of the mean R-EID score relative to the neutral midpoint of the response scale (4)(Clayton et al., 2021). Therefore, this will be used as a comparative marker in this analysis.

Content and construct validation of the R-EID in this population was not required, because English-language scale validity has been established by previous research in a similarly-aged population. The R-EID has been validated in a sample of American adults aged 18 to 75+ (Clayton et al, 2021). The internal reliability of the scale in this sample, represented by a Cronbach's alpha value, was found to be satisfactory at 0.94.

3.2.3 Age

Participants' age in years was provided in the dataset. During data cleaning, 79 participants aged younger than 55 years were removed from the dataset, to align with the described population of the NZHWR Study (that is, adults aged over 55 years)(Phillips, 2023).

Age was summarised as both a continuous variable and a categorical variable (5-year age groups). The age groups used in this analysis were:

- 55 to 59 years
- 60 to 64 years
- 65 to 69 years
- 70 to 74 years
- 75 to 79 years
- 80+ years.

3.2.4 Gender

Participants' gender was provided in the dataset. Two variables were provided: a binary categorisation into male or female and a self-defined categorisation of male, female or gender diverse. The binary variable was used for analysis as the number of people (<5) in the gender diverse group was too small to permit analysis (Stats NZ, 2022).

Therefore, gender was summarised as a categorical variable in line with the relevant StatsNZ data standard (Stats NZ, 2024). The categories were:

- Female
- Male.

3.2.5 Māori descent

Māori descent was analysed as a binary variable. Participants were defined as being either of Māori descent or not of Māori descent, as indicated by the electoral roll. This variable was provided in the dataset. The decision to explore Māori descent as an investigative variable, in preference to ethnicity groups, was made in acknowledgement of Māori as the Indigenous people of New Zealand. This approach aligns with other outputs from the NZHWR Study.

3.2.6 Socioeconomic deprivation

Socioeconomic deprivation was analysed using the New Zealand Index of Deprivation (NZDep), a measure of area socioeconomic deprivation. In the NZDep, nine census variables have been used to assign areas with a socioeconomic deprivation score, reflected by an ordinal value from 1 (areas with the least deprived scores) to 10 (areas with the most deprived scores)(Atkinson et al., 2024). The index reflects eight dimensions of socioeconomic deprivation, including communication, income, employment, qualifications, owned home, support, living space and living conditions.

This analysis used a binary categorisation of participants that was provided in the dataset. Participants were grouped into:

- Those living in an area with lower deprivation (NZDep score between 1 and 5, inclusive).
- Those living in an area with higher deprivation (NZDep score between 6 and 10, inclusive).

3.2.7 Country of birth

Participants' country of birth was provided in the dataset. This was transformed into a binary categorisation for analysis, which grouped participants into those born in New Zealand and those born overseas.

3.2.8 Employment status

Participants' current work status was provided in the dataset as one of 13 options. These were grouped into three categories for analysis: paid work, retired and other. Group categorisation is detailed in Table 8.

Table 8: Categorisation of current work status

Category	NZHWR Study response option
Paid work	1. Full time paid work for an employer 2. Part time paid work for an employer 3. Full time self-employed paid employment 4. Part time self-employed paid employment 5. Flexible work schedule negotiated with employer 6. Project or contract work (short term and full time) 7. Project or contract work (short term and part time)
Retired	8. Fully retired, no paid work
Other	9. Full time homemaker 10. Full time student 11. Unable to work due to health or disability issue 12. Unemployed and seeking work 13. Other

3.2.9 Retirement age

Participants' age at retirement, where applicable, was provided in the dataset. There were more responses to this question than the number of people who identified themselves as being fully retired with no paid work (see Section 3.2.8). This may

indicate participants who have taken up an occupation after retiring from a regular job. Exploration of the data revealed uncertain face validity of some participants' responses to this question, including two participants who responded "0", one who responded "6", an additional five who responded with ages of 30 or younger and one who responded "1971". It was therefore decided to report the mode average age of retirement only, due to the potential of these uncertain extreme values to skew the mean or median.

3.2.10 Education level

Participants' highest education qualification was provided in the dataset as one of four options:

1. No qualifications.
2. Secondary school qualifications (for example, School Certificate, University Entrance or NCEA).
3. Post-secondary certificate, diploma or trade diploma.
4. University degree.

These groups were maintained for analysis.

3.3 Statistical analysis plan

3.3.1 Data cleaning

The 2024/25 NZHWR dataset underwent some cleaning prior to provision, in alignment with the methods reported in the 2022 technical report (Phillips, 2023). This cleaning included review of gender and date of birth combinations against previously reported data and exclusion of responses with inconsistent data.

Data cleaning for this analysis included removal of participants who did not have a value in the sociodemographic variables of interest (that is, age, gender, NZDep,

country of birth, employment status, Māori descent and education level). In total, 541 observations were excluded during this stage of cleaning.

Data cleaning also included review of participants' responses to the HEAS and R-EID scales. Responses were excluded from the relevant analysis if they were incomplete or exceeded the range of possible scores for either scale, as this was assumed to indicate that the response had been scored incorrectly. Exploration of response bounds identified that the HEAS had been scored along a frequency of 1 to 4, rather than the more commonly used 0 to 3 (Sections 2.2.3.1 and 3.2.1). Therefore, scores were transformed from 1 to 4 to their corresponding value on a scale of 0 to 3, to facilitate comparison with wider literature.

3.3.2 Study outcomes

The primary outcomes of the study were the average total and dimensional eco-anxiety and environmental identity scores of older adults in New Zealand, as measured by the HEAS and R-EID scales (Clayton et al., 2021; Hogg et al., 2021). Additional primary outcomes were the proportion of participants experiencing various severity levels of eco-anxiety, and the proportion of participants with environmental identity above or below neutrality.

The secondary outcomes of the study were the average total and dimensional eco-anxiety and environmental identity scores stratified by demographic characteristics (age, gender, Māori descent, socioeconomic area deprivation, education and employment status). The final outcomes of interest were the correlations between total and dimensional eco-anxiety and environmental identity scores.

3.3.3 Statistical analysis

R Statistical Software (version 4.5.1), run in RStudio (version 2026.1.0.392), was used for statistical analysis (Posit team, 2026; R Core Team, 2025). R packages that were used in addition to the standard functions of R are summarised in

Table 9.

Table 9: R packages used for analysis

Package	Function
tidyverse (Wickham H, 2019), including dplyr (Wickham H, 2023) and ggplot2 (Wickham, 2016)	Writing code, manipulating data and generating graphs.
psych (Revelle, 2025)	Calculating Cronbach's alpha values.
rstatix (Kassambara, 2025)	Computing Kruskal Wallis tests, eta squared effect size tests and Dunn's tests.
multcompView (Graves et al., 2024)	Automating compact letter display of Dunn's test results.
effectsize (Ben-Shachar et al., 2020)	Calculating omega squared effect size.
rcompanion (Salvatore S Mangiafico, 2026)	Calculating effect size r.

ChatGPT (version 5.2), a generative artificial intelligence (AI) tool, was used to develop some pieces of R code (OpenAI, 2026). A summary of, and reflection on, ChatGPT use is provided in Appendix D: Summary of, and reflection on, generative AI use. The analysis planning and design, running of R code and interpretation of results was all done by the author. No individual participant data was provided in interactions with ChatGPT.

3.3.3.1 Descriptive statistics

Descriptive statistics were used to summarise demographic characteristics of the study participants and the results of the HEAS and R-EID measures. These statistics summarised continuous variables as mean $\pm$ standard deviation (SD) unless otherwise specified, and categorical variables as counts and percentages (Lau, 2017). No demographic groups contained less than 5 people, so descriptive statistics were able to be shown for all demographic groups (Stats NZ, 2022).

The descriptive statistics summarising participants' HEAS and R-EID scores, and the dimensions of the HEAS, include:

- Mean $\pm$ SD
- Median (IQR)
- Minimum and maximum
- Internal consistency (indicated by Cronbach's alpha).

The participants who completed the HEAS were categorised into no, mild, moderate and severe eco-anxiety groups (Section 3.2.1). Participants who completed the R-EID were categorised into those above, at and below the neutral response point (Section 3.2.2). The proportion of participants in each group has been presented as count (%).

3.3.3.2 Inferential statistics

Statistical tests were used to assess the significance of differences between demographic groups for the total scales and for the dimensions of the HEAS. Sample sizes in all demographic subgroups were large enough that, in accordance with the central limit theorem, parametric tests could be appropriate even for nonnormally distributed data (Frost, 2017c, 2018a; Ghasemi & Zahediasl, 2012). However, in line with robust statistical practice, the choice between parametric and nonparametric statistical tests was informed by an assessment of normality and consideration of the most appropriate measure of central tendency for each distribution of data (Bobbitt, 2022a; Frost, 2017c, 2018b).

Assessment of normality included visual inspection of a histogram of responses and use of Shapiro-Wilk tests (Bobbitt, 2022a). Transformation of nonnormal data using log, square root and cube root transformations was trialled in an attempt to achieve normality. The distribution of data was used to inform which measure of central tendency was most appropriate for analysis (Frost, 2018b).

In the case of R-EID scores, data was skewed to the left, with most scores in the higher ranges and a long leftward tail to the lower score ranges. As such, the median was deemed the most appropriate measure of central tendency, to avoid skewness in the mean (Frost, 2018b). Consequently, nonparametric tests to assess the difference between group medians were deemed more appropriate than parametric tests (which would assess the difference between group means)(Frost, 2017c). Total and dimensional scores for the HEAS were also skewed but tended to be skewed to the

right, with most scores in the lower ranges and a long rightward tail to the higher score ranges. The statistical tests that were used in each case are summarised in Table 10.

Table 10: Choice of statistical tests

Characteristic	Distribution (HEAS)	Distribution (R-EID)	Statistical tests	Rationale
Age (continuous)	Non-normal, right-skewed. Monotonic relationship but not clearly linear.	Non-normal, left-skewed. Monotonic relationship but not clearly linear.	Spearman's correlation	The monotonic but not clearly linear relationship between age and scale scores supported the use of Spearman's correlation.
Age (categorical)	Nonnormal, right-skewed for all subgroups. Same distributional shape in each group for all scale dimensions. Transformation did not achieve normal distribution.	Nonnormal, left-skewed for all subgroups. Subgroups had different distribution shapes but equal variance. Transformation did not achieve normal distribution.	R-EID: One-way classic ANOVA with Tukey's post-hoc tests and omega squared effect size. HEAS: Kruskal Wallis test with post-hoc Dunn's test (Bonferroni correction) and eta squared effect size.	R-EID: The Kruskal Wallis test of differences between medians was ruled out due to violation of the same shape assumption. The central limit theorem and large sample size permitted use of parametric ANOVA methods. Equal variance supported use of the classic ANOVA. HEAS: The assumptions of the Kruskal Wallis test were met and, due to the skewness of the data, this was the most appropriate test.
Education	Nonnormal, right-skewed for all subgroups. Same distributional shape in each group for all scale dimensions. Transformation did not achieve normal distribution.	Nonnormal, left-skewed for all subgroups. Same distributional shape in each group. Transformation did not achieve normal distribution.	Kruskal Wallis test with post-hoc Dunn's test (Bonferroni correction) and eta squared effect size.	The skewness of the data promoted the median as a more appropriate measure of central tendency than the mean and the assumptions of the Kruskal Wallis test were met.
Employment				
Gender	Nonnormal, right-skewed for all characteristics. Transformation did not achieve normal distribution.	Nonnormal, left-skewed for all characteristics. Transformation did not achieve normal distribution.	Mann-Whitney U test with effect size r.	The skewness of the data promoted the median as a more appropriate measure of central tendency than the mean. This supported the choice of the nonparametric Mann-Whitney U test.
Māori descent				
NZDep				
Country of birth				
Relationship between total HEAS, HEAS dimensions and R-EID	In each case, the relationship between the variables looked positively monotonic but not clearly linear.		Spearman's correlation	The monotonic but not clearly linear relationships supported the use of Spearman's correlation.

Spearman's correlation was used to analyse age in years for each of the scales, and to analyse the relationship between the HEAS (total and dimensions) and the R-EID (Bobbitt, 2021a; Frost, 2021b). Spearman's correlation was chosen in each case as the relationship between variables was monotonic but not clearly linear.

Mann Whitney U tests were used for comparison of binary categorical variables (Bobbitt, 2022b, 2024; Sundjaja et al., 2023). Effect size r tests were used to measure the effect size of statistically significant differences (Fiel Peres, 2026). The assumptions for Kruskal Wallis tests were satisfied for most categorical analyses involving three or more groups. The Kruskal Wallis test (Frost, 2024; Lomuscio, 2021) was used alongside Dunn's post-hoc tests (with Bonferroni correction) (Bobbitt, 2020; University of Lincoln Libraries and Learning Skills) and the eta squared effect size (Salvatore S. Mangiafico, 2026).

One-way ANOVA was used to analyse age groups in participants who completed the R-EID, as the Kruskal Wallis assumptions were not met (Frost, 2026). Classic ANOVA was used in preference to Welch's ANOVA as Bartlett's test identified equal variance (Bobbitt, 2021b, 2021c; Delacre et al., 2019; Frost, 2017a). ANOVA was used alongside Tukey's post-hoc tests (Frost, 2019) and omega squared effect size (Frost, 2021a).

Effect size was assessed in cases where there was a significant difference between demographic groups. Effect sizes were reported as absolute values. The significance level was set at $p < 0.05$.

3.4 Ethics

The NZHWR study has been approved by the Massey University Human Ethics Committee (Southern A Application – 23/28; Health, Work and Retirement Study 2024). As this analysis was informed by de-identified data from the NZHWR study, no additional ethical approval was required for this project.

4 Results

This chapter details the results of the quantitative analysis of the 2024/25 NZHWR Study data. Results are presented in four sections: demographic characteristics; eco-anxiety results (measured by the HEAS); environmental identity results (measured by the R-EID); and the relationship between these two concepts.

4.1 Demographic characteristics

The raw dataset included 6245 participants. Data for 5625 participants (90.1%) remained after data cleaning. Of these, 5201 (92.5%) completed the HEAS, 5387 (95.8%) completed the R-EID and 97 (1.7%) did not complete either scale. 5060 (90.0%) participants completed both scales. The demographic characteristics of each of these groups are summarised in Table 11.

The groups that completed the HEAS and the R-EID were similar in terms of all reported demographic characteristics (Table 11). In contrast, the group that did not complete either scale had a higher proportion of women and a higher proportion of participants aged 80 years or older; of Māori descent; living in more deprived areas; with no educational qualification and participants who are retired.

Table 11: Summary of demographic characteristics

Characteristic	HEAS N = 5201	R-EID N = 5387	Neither scale N = 97
Age (years)			
Range	55 to 94	55 to 94	55 to 90
Mean $\pm$ SD	65.7 $\pm$ 6.8	65.8 $\pm$ 6.9	69.4 $\pm$ 8.9
Age groups (n, %)			
55-59	887 (17.1)	920 (17.1)	13 (13.4)
60-64	1717 (33)	1746 (32.4)	25 (25.8)
65-69	1320 (25.4)	1373 (25.5)	15 (15.5)
70-74	694 (13.3)	719 (13.3)	18 (18.6)
75-79	328 (6.3)	348 (6.5)	9 (9.3)
80+	255 (4.9)	281 (5.2)	17 (17.5)
Gender (n, %)			
Female	2876 (55.3)	3002 (55.7)	65 (67)
Male	2325 (44.7)	2385 (44.3)	32 (33)
Māori descent (n, %)			
Māori	2193 (42.2)	2288 (42.5)	45 (46.4)
Non-Māori	3008 (57.8)	3099 (57.5)	52 (53.6)
NZDep (n, %)			
Low (1-5)	2970 (57.1)	3049 (56.6)	43 (44.3)
High (6-10)	2231 (42.9)	2338 (43.4)	54 (55.7)
Place of birth (n, %)			
New Zealand	4503 (86.6)	4661 (86.5)	85 (87.6)
Overseas	698 (13.4)	726 (13.5)	12 (12.4)
Highest educational qualification (n, %)			
No qualification	827 (15.9)	872 (16.2)	34 (35.1)
Secondary school	1273 (24.5)	1309 (24.3)	20 (20.6)
Post-secondary qualification	1714 (33)	1782 (33.1)	33 (34)
University degree	1387 (26.7)	1424 (26.4)	10 (10.3)
Work status			
Paid work	3007 (57.8)	3070 (57)	47 (48.5)
Fully retired	1702 (32.7)	1798 (33.4)	40 (41.2)
Other	492 (9.5)	519 (9.6)	10 (10.3)
Age of retirement (years)			
Mode	65	65	65

4.2 Eco-anxiety

4.2.1 Descriptive statistics

This section of results focusses on the 5201 participants who completed the HEAS. Participants' scores for the HEAS and its four dimensions are summarised in Table 12. Of note, all Cronbach's alpha values for the HEAS and its dimensions exceeded 0.7, indicating satisfactory reliability of the HEAS in this population (Table 12).

Table 12: Summary of HEAS and dimension scores

Measure	Range	Mean $\pm$ SD	Median (IQR)	Cronbach's alpha
Total scale	0 to 39	3.4 $\pm$ 5.4	1.0 (0.0 to 5.0)	0.92
Affective symptoms	0 to 12	1.0 $\pm$ 1.9	0.0 (0.0 to 1.0)	0.87
Rumination	0 to 9	1.1 $\pm$ 1.8	0.0 (0.0 to 2.0)	0.90
Behavioural symptoms	0 to 9	0.4 $\pm$ 1.1	0.0 (0.0 to 0.0)	0.72
Anxiety about personal impact	0 to 9	1.0 $\pm$ 1.7	0.0 (0.0 to 2.0)	0.89

Scores for the total HEAS ranged from 0 to 39, including both the minimum and maximum possible scores for the scale. 2434 (46.8%) people had the minimum score of 0, indicating that, in the last two weeks, they had not experienced any of the problems described in the scale. Conversely, 4 (0.1%) people had the maximum score of 39, indicating that they had experienced all of the problems described in the scale nearly every day in the last two weeks.

Participants' mean score for the total scale was 3.4. Considering the scale dimensions, mean scores were highest in the rumination dimension and lowest in the behavioural symptoms dimension (mean $\pm$ SD: 1.1 $\pm$ 1.8 versus 0.4 $\pm$ 1.1; Table 12).

The mean score per item was also calculated for the total HEAS and all four dimensions, to facilitate comparison with the response scale that each item was scored against (0 to 3; Table 13). This showed that the rumination and anxiety about personal impact dimensions had the highest mean per item results (0.35 and 0.32, respectively). Behavioural symptoms had the lowest mean per item (0.14). The mean per item fell between 0 and 1 for all dimensions and the total scale. This indicates that,

on average, participants experienced the problems described in the HEAS on less than several of the days in the preceding two-week period. The mean per-item score of 0.26 for the total HEAS falls below the observed international range (Section 2.2.3.1), which disproves hypothesis H1. Hypothesis H2 was partially proved; behavioural symptoms were the lowest-scoring dimension, which aligns with the results of the scoping review (Section 2.2.3.1). However, the highest-scoring dimension was rumination rather than anxiety about personal impact, which differs from the results of the scoping review.

Table 13: Mean HEAS total and dimension scores, per item

	Number of items	Range	Mean per item
Total scale	13	0 to 3	0.26
Affective symptoms	4	0 to 3	0.24
Rumination	3	0 to 3	0.35
Behavioural symptoms	3	0 to 3	0.14
Anxiety about personal impact	3	0 to 3	0.32

Participants were grouped into no, mild, moderate and severe experiences of eco-anxiety based on their mean-per-item scores for the total HEAS (Table 14; Figure 5). Most participants had experienced mild eco-anxiety (n=2472, 47.5%). The next-largest category were those who had not experienced any eco-anxiety (n=2434, 46.8%). Only 43 people were categorised as experiencing severe eco-anxiety (0.8%).

Table 14: Categorisation of eco-anxiety experiences

	No eco-anxiety (M = 0)	Mild eco-anxiety (0 < M ≤ 1)	Moderate eco-anxiety (1 < M ≤ 2)	Severe eco-anxiety (2 < M ≤ 3)
N (%)	2434 (46.8%)	2472 (47.5%)	252 (4.8%)	43 (0.8%)

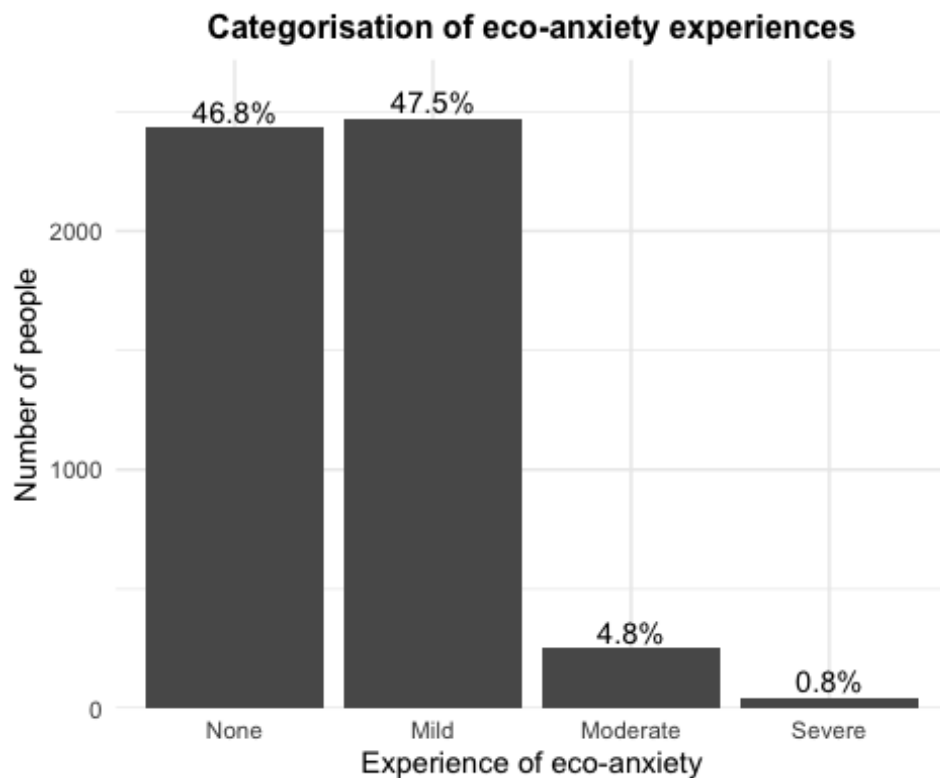


Figure 5: Categorisation of eco-anxiety experiences

4.2.2 Demographic trends

4.2.2.1 Age

There is a small, significant, positive correlation between age and scores for the total HEAS and the rumination dimension ($\rho=0.03$ and 0.05 , $p=0.033$ and <0.001 , respectively; Table 15). This indicates that HEAS scores and rumination dimension scores tend to increase with age, but the increase is small. There was no significant correlation between age and any other dimension of the HEAS. These results partially disprove hypothesis H3 as, while there was not a significant relationship between age and every dimension of the HEAS, there was a significant correlation between increasing age and increasing scores for the total scale and rumination dimension.

Table 15: Trends in HEAS scores by age

Age (years)	Correlation coefficient	P value
HEAS	0.03	0.033
Affective symptoms	0.01	0.493
Rumination	0.05	<0.001
Behavioural symptoms	-0.01	0.645
Anxiety about personal impact	0.00	0.773

Analysis of age groups found significant differences between age groups in the total scale and rumination dimension, both with negligible effect sizes ($\eta^2=0.002$ and $\eta^2=0.004$, respectively; Table 16). Participants aged 80+ had the highest average scores in both of these areas, followed by participants aged 75-79. There were no significant differences between age groups in the affective symptoms, behavioural symptoms or anxiety about personal impact dimensions.

The results of Dunn's post-hoc tests (Bonferroni-adjusted) are shown in compact letter display in Table 16. Interestingly, Dunn's tests found no significant differences between groups in any of the pairwise comparisons for the total scale. In the rumination dimension, the 55-59, 60-64 and 65-69 age groups each had significantly lower scores than both the 75-79 and 80+ age groups.

Table 16: Differences in HEAS scores by age group

Dimension	Mean ± SD	Median (IQR)	P value	Effect size
HEAS				
55-59 ^a	3.5 ± 5.6	1.0 (0.0 to 5.0)	0.024	Negligible 0.002
60-64 ^a	3.3 ± 5.2	1.0 (0.0 to 5.0)		
65-69 ^a	3.3 ± 5.6	1.0 (0.0 to 5.0)		
70-74 ^a	3.4 ± 5.3	1.0 (0.0 to 5.0)		
75-79 ^a	3.6 ± 5.0	2.0 (0.0 to 5.0)		
80+ ^a	4.2 ± 5.9	2.0 (0.0 to 6.0)		
Affective symptoms				
55-59	1.0 ± 2.0	0.0 (0.0 to 1.0)	0.409	NA
60-64	0.9 ± 1.9	0.0 (0.0 to 1.0)		
65-69	0.9 ± 1.9	0.0 (0.0 to 1.0)		
70-74	0.9 ± 1.8	0.0 (0.0 to 1.0)		
75-79	1.0 ± 1.9	0.0 (0.0 to 1.0)		
80+	1.2 ± 2.2	0.0 (0.0 to 1.0)		
Rumination				
55-59 ^a	1.0 ± 1.8	0.0 (0.0 to 2.0)	<0.001	Negligible 0.004
60-64 ^a	1.0 ± 1.7	0.0 (0.0 to 2.0)		
65-69 ^a	1.0 ± 1.8	0.0 (0.0 to 2.0)		
70-74 ^{ab}	1.1 ± 1.9	0.0 (0.0 to 2.0)		
75-79 ^b	1.2 ± 1.7	0.0 (0.0 to 2.0)		
80+ ^b	1.5 ± 2.1	0.0 (0.0 to 3.0)		
Behavioural symptoms				
55-59	0.4 ± 1.2	0.0 (0.0 to 0.0)	0.858	NA
60-64	0.5 ± 1.2	0.0 (0.0 to 0.0)		
65-69	0.4 ± 1.2	0.0 (0.0 to 0.0)		
70-74	0.4 ± 1.1	0.0 (0.0 to 0.0)		
75-79	0.3 ± 0.8	0.0 (0.0 to 0.0)		
80+	0.5 ± 1.1	0.0 (0.0 to 0.0)		
Anxiety about personal impact				
55-59	1.0 ± 1.7	0.0 (0.0 to 2.0)	0.636	NA
60-64	0.9 ± 1.6	0.0 (0.0 to 2.0)		
65-69	1.0 ± 1.8	0.0 (0.0 to 2.0)		
70-74	0.9 ± 1.7	0.0 (0.0 to 1.0)		
75-79	1.0 ± 1.7	0.0 (0.0 to 2.0)		
80+	1.0 ± 1.8	0.0 (0.0 to 2.0)		

^{a, b} denote the results of Dunn's post-hoc tests. Groups that differ significantly from each other do not share a letter, while groups that are not significantly different will share a letter.

4.2.2.2 Gender

Average HEAS scores were significantly higher among women than men in the total scale and all dimensions except behavioural symptoms, where there was no significant difference (Table 17). Effect sizes were negligible ($r < 0.1$) in all cases. The significantly higher HEAS scores among women prove hypothesis H4.

Table 17: Differences in HEAS scores by gender

Dimension	Mean ± SD	Median (IQR)	P value	Effect size
HEAS				
Female	3.5 ± 5.4	1.0 (0.0 to 5.0)	0.002	Negligible 0.044
Male	3.2 ± 5.4	1.0 (0.0 to 4.0)		
Affective symptoms				
Female	1.0 ± 2.0	0.0 (0.0 to 1.0)	<0.001	Negligible 0.056
Male	0.9 ± 1.9	0.0 (0.0 to 1.0)		
Rumination				
Female	1.1 ± 1.7	0.0 (0.0 to 2.0)	0.011	Negligible 0.035
Male	1.0 ± 1.8	0.0 (0.0 to 2.0)		
Behavioural symptoms				
Female	0.4 ± 1.1	0.0 (0.0 to 0.0)	0.118	NA
Male	0.4 ± 1.2	0.0 (0.0 to 0.0)		
Anxiety about personal impact				
Female	1.0 ± 1.7	0.0 (0.0 to 2.0)	<0.001	Negligible 0.047
Male	0.9 ± 1.7	0.0 (0.0 to 1.0)		

4.2.2.3 Māori descent

Participants of Māori descent had significantly higher average HEAS scores than those not of Māori descent in the total scale and all dimensions except anxiety about personal impact, where there was no significant difference (Table 18). The effect size of the difference was negligible ($r < 0.1$) in all dimensions. The significantly higher HEAS scores among participants of Māori descent prove hypothesis H5.

Table 18: Differences in HEAS scores by Māori descent

Dimension	Mean ± SD	Median (IQR)	P value	Effect size
HEAS				
Māori	3.9 ± 6.1	1.0 (0.0 to 6.0)	<0.001	Negligible 0.065
Non-Māori	3.0 ± 4.8	1.0 (0.0 to 4.0)		
Affective symptoms				
Māori	1.1 ± 2.2	0.0 (0.0 to 1.0)	<0.001	Negligible 0.054
Non-Māori	0.8 ± 1.7	0.0 (0.0 to 1.0)		
Rumination				
Māori	1.2 ± 1.9	0.0 (0.0 to 2.0)	<0.001	Negligible 0.070
Non-Māori	0.9 ± 1.7	0.0 (0.0 to 1.0)		
Behavioural symptoms				
Māori	0.6 ± 1.4	0.0 (0.0 to 0.0)	<0.001	Negligible 0.088
Non-Māori	0.3 ± 0.9	0.0 (0.0 to 0.0)		
Anxiety about personal impact				
Māori	1.0 ± 1.7	0.0 (0.0 to 2.0)	0.054	NA
Non-Māori	0.9 ± 1.6	0.0 (0.0 to 1.0)		

4.2.2.4 Area deprivation

Participants living in areas with higher socioeconomic deprivation had significantly higher average HEAS scores than those living in areas with lower socioeconomic deprivation in the total scale and all dimensions except anxiety about personal impact, where there was no significant difference between groups (Table 19). However, effect sizes were negligible ($r < 0.1$) in all cases. This result is opposite to what was hypothesised, therefore, hypothesis H6 is disproved.

Table 19: Differences in HEAS scores by area deprivation

Dimension	Mean ± SD	Median (IQR)	P value	Effect size
HEAS				
Low (1-5)	3.0 ± 4.8	1.0 (0.0 to 4.0)	<0.001	Negligible 0.046
High (6-10)	3.9 ± 6.0	1.0 (0.0 to 6.0)		
Affective symptoms				
Low (1-5)	0.8 ± 1.7	0.0 (0.0 to 1.0)	<0.001	Negligible 0.050
High (6-10)	1.1 ± 2.2	0.0 (0.0 to 1.0)		
Rumination				
Low (1-5)	1.0 ± 1.6	0.0 (0.0 to 2.0)	0.010	Negligible 0.036
High (6-10)	1.2 ± 2.0	0.0 (0.0 to 2.0)		
Behavioural symptoms				
Low (1-5)	0.3 ± 1.0	0.0 (0.0 to 0.0)	<0.001	Negligible 0.073
High (6-10)	0.5 ± 1.3	0.0 (0.0 to 0.0)		
Anxiety about personal impact				
Low (1-5)	0.9 ± 1.6	0.0 (0.0 to 1.0)	0.088	NA
High (6-10)	1.0 ± 1.8	0.0 (0.0 to 2.0)		

4.2.2.5 Place of birth

Participants who were born overseas had significantly higher average anxiety about their personal impact than participants who were born in New Zealand (mean $\pm$ SD: 1.1 ± 1.8 versus 0.9 ± 1.7 , $p=0.002$; Table 20). The effect size of this difference was negligible ($r=0.042$). There were no significant differences between groups in the total HEAS or the other three dimensions. These results partially prove hypothesis H7, which did not anticipate any significant differences in eco-anxiety between participants who were born in New Zealand compared to those who were born overseas.

Table 20: Differences in HEAS scores by country of birth

Dimension	Mean ± SD	Median (IQR)	P value	Effect size
HEAS				
New Zealand	3.4 ± 5.4	1.0 (0.0 to 5.0)	0.346	NA
Overseas	3.5 ± 5.3	1.0 (0.0 to 5.0)		
Affective symptoms				
New Zealand	1.0 ± 1.9	0.0 (0.0 to 1.0)	0.797	NA
Overseas	1.0 ± 1.9	0.0 (0.0 to 1.0)		
Rumination				
New Zealand	1.1 ± 1.8	0.0 (0.0 to 2.0)	0.745	NA
Overseas	1.0 ± 1.8	0.0 (0.0 to 2.0)		
Behavioural symptoms				
New Zealand	0.4 ± 1.2	0.0 (0.0 to 0.0)	0.494	NA
Overseas	0.4 ± 1.0	0.0 (0.0 to 0.0)		
Anxiety about personal impact				
New Zealand	0.9 ± 1.7	0.0 (0.0 to 2.0)	0.002	Negligible 0.042
Overseas	1.1 ± 1.8	0.0 (0.0 to 2.0)		

4.2.2.6 Education

Participants' average HEAS scores followed a 'U' shape with increasing educational attainment: those with no formal qualification had the highest scores, participants with secondary school or post-secondary qualifications had lower scores and participants with a university degree had higher scores (Table 21). This pattern was evident in the total HEAS and all dimensions except behavioural symptoms, in which average scores decreased as educational attainment increased. Kruskal Wallis tests identified a significant difference between the groups for the total scale and all dimensions (Table

21). The effect size of these differences was small for the anxiety about personal impact dimension ($\eta^2=0.015$) and negligible in all other dimensions ($\eta^2<0.01$).

Dunn's post-hoc tests (Bonferroni-adjusted) showed different patterns of significance between scale dimensions. Average scores of the university group were significantly different to those of the secondary school group in the total scale and all dimensions except rumination: the university group had higher average scores in all areas except behavioural symptoms. Additionally, the average scores of the university group were significantly higher than those of the post-secondary qualification group for the total scale, affective symptoms dimension and anxiety about personal impact dimension. The group with no qualifications had significantly higher average scores than the secondary school group in the rumination and behavioural symptoms dimensions. Interestingly, the group with no qualifications had significantly higher behavioural symptom scores than the university group, but significantly lower scores in the anxiety about personal impact dimension. These results disproved hypothesis H8, as a relationship between eco-anxiety and educational attainment had not been anticipated.

Table 21: Differences in HEAS scores by highest educational qualification

Dimension	Mean ± SD	Median (IQR)	P value	Effect size
HEAS				
No qualification ^{ab}	4.1 ± 6.7	1.0 (0.0 to 6.0)	<0.001	Negligible 0.006
Secondary school ^a	3.0 ± 5.0	0.0 (0.0 to 4.0)		
Post-secondary qualification ^a	3.1 ± 5.2	1.0 (0.0 to 4.0)		
University degree ^b	3.6 ± 5.1	2.0 (0.0 to 5.5)		
Affective symptoms				
No qualification ^{ab}	1.2 ± 2.4	0.0 (0.0 to 1.0)	<0.001	Negligible 0.004
Secondary school ^a	0.9 ± 1.8	0.0 (0.0 to 1.0)		
Post-secondary qualification ^a	0.9 ± 1.8	0.0 (0.0 to 1.0)		
University degree ^b	1.0 ± 1.8	0.0 (0.0 to 1.0)		
Rumination				
No qualification ^a	1.3 ± 2.1	0.0 (0.0 to 2.0)	0.013	Negligible 0.002
Secondary school ^b	0.9 ± 1.6	0.0 (0.0 to 2.0)		
Post-secondary qualification ^{ab}	1.0 ± 1.7	0.0 (0.0 to 1.8)		
University degree ^{ab}	1.1 ± 1.8	0.0 (0.0 to 2.0)		
Behavioural symptoms				
No qualification ^a	0.7 ± 1.5	0.0 (0.0 to 1.0)	<0.001	Negligible 0.008
Secondary school ^b	0.5 ± 1.2	0.0 (0.0 to 0.0)		
Post-secondary qualification ^{bc}	0.4 ± 1.1	0.0 (0.0 to 0.0)		
University degree ^c	0.3 ± 1.0	0.0 (0.0 to 0.0)		
Anxiety about personal impact				
No qualification ^a	1.0 ± 1.9	0.0 (0.0 to 1.0)	<0.001	Small 0.015
Secondary school ^a	0.7 ± 1.5	0.0 (0.0 to 1.0)		
Post-secondary qualification ^a	0.9 ± 1.6	0.0 (0.0 to 1.0)		
University degree ^b	1.2 ± 1.7	0.0 (0.0 to 2.0)		

^{a, b, c} denote the results of Dunn's post-hoc tests. Groups that differ significantly from each other do not share a letter, while groups that are not significantly different will share a letter.

4.2.2.7 Employment

Participants in the 'Other' category (which included full-time homemakers and students, people seeking work and people unable to work due to a health or disability issue) had higher HEAS scores than those in paid work and those who were retired, for the total HEAS and all dimensions (Table 22). Kruskal Wallis tests were performed on the total and dimension scores and identified a significant difference between the three groups in each case (Table 22). The effect size of this difference was negligible in all cases ($\eta^2 < 0.01$ for all dimensions). Dunn's post-hoc tests (Bonferroni-adjusted) highlighted that the significance of the differences between groups varied by scale dimension. Considering the total HEAS, all three groups were significantly different from each other. Considering the dimensions, the rumination dimension was the only one in which the scores of the paid work group differed significantly from those of the

retired group. Conversely, the ‘other’ group had significantly higher scores than the paid work group in all dimensions of the scale. These results partially prove hypothesis H9 because while participants in the ‘Other’ group had significantly higher eco-anxiety than employed participants in all dimensions, retired participants’ scores only differed significantly from employed participants’ scores in the total scale and rumination dimension.

Table 22: Differences in HEAS scores by employment status

Dimension	Mean ± SD	Median (IQR)	P value	Effect size
HEAS				
Paid work ^a	3.1 ± 5.0	1.0 (0.0 to 4.0)	<0.001	Negligible 0.004
Fully retired ^b	3.5 ± 5.5	1.0 (0.0 to 5.0)		
Other ^c	4.8 ± 6.9	2.0 (0.0 to 7.0)		
Affective symptoms				
Paid work ^a	0.9 ± 1.8	0.0 (0.0 to 1.0)	<0.001	Negligible 0.003
Fully retired ^a	1.0 ± 2.0	0.0 (0.0 to 1.0)		
Other ^b	1.3 ± 2.4	0.0 (0.0 to 2.0)		
Rumination				
Paid work ^a	0.9 ± 1.7	0.0 (0.0 to 2.0)	<0.001	Negligible 0.004
Fully retired ^b	1.2 ± 1.9	0.0 (0.0 to 2.0)		
Other ^b	1.4 ± 2.1	0.0 (0.0 to 2.0)		
Behavioural symptoms				
Paid work ^a	0.4 ± 1.0	0.0 (0.0 to 0.0)	<0.001	Negligible 0.009
Fully retired ^a	0.4 ± 1.1	0.0 (0.0 to 0.0)		
Other ^b	0.8 ± 1.7	0.0 (0.0 to 1.0)		
Anxiety about personal impact				
Paid work ^a	0.9 ± 1.6	0.0 (0.0 to 1.0)	0.010	Negligible 0.001
Fully retired ^{ab}	0.9 ± 1.7	0.0 (0.0 to 2.0)		
Other ^b	1.2 ± 2.0	0.0 (0.0 to 2.0)		

^{a, b, c} denote the results of Dunn’s post-hoc tests. Groups that differ significantly from each other do not share a letter, while groups that are not significantly different will share a letter.

4.3 Environmental identity

4.3.1 Descriptive statistics

This section focusses on the 5387 participants who completed the R-EID. Participants' scores for the R-EID are summarised in Table 23. Importantly, the Cronbach's alpha value of 0.93 indicates satisfactory reliability of the R-EID in this population (Table 23).

Table 23: Summary of R-EID scores

Measure	Range	Mean $\pm$ SD	Median (IQR)	Cronbach's alpha
Total scale	14 to 98	80.9 $\pm$ 13.5	83.0 (73.0 to 92.0)	0.93
Per item	1 to 7	5.78	NA	NA

R-EID scores ranged from 14 to 98, including both the minimum and maximum possible scores for the scale. Eight (0.1%) people had the minimum score of 14, indicating that they felt that none of the statements were at all true of them. Conversely, 286 (5.3%) people had the maximum score of 98, indicating that they felt that all statements were completely true of them.

The mean score for the total scale was 80.9. The mean score per item across all 14 items of the scale was 5.78. This exceeds the neutral midpoint of 4 and indicates that, on average, participants tended to agree with the items in the R-EID. The lowest mean score per item was 3.96 for "I feel that I have a lot in common with wild animals." This was the only item that had an average value below the neutral midpoint of the response scale. The highest mean score per item was 6.36 for "An important part of my life would be missing if I was not able to get outside and enjoy nature from time to time." The mean score per item falls into the observed international range (Section 2.3.3), which proves hypothesis H10.

Considering the strength of participants' environmental identity, 5090 (94.5%) participants had a score above 56 (the point of neutrality), indicating a higher environmental identity. 54 (1.0%) had a neutral score and 243 (4.5%) had a score below

56, indicating a lower environmental identity (Figure 6).

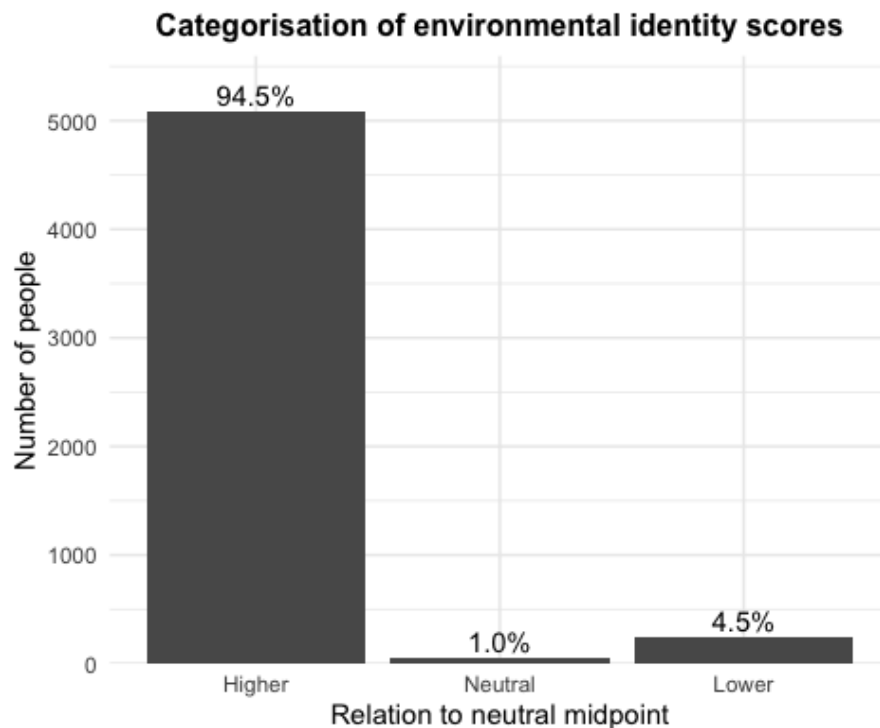


Figure 6: Categorisation of R-EID scores

4.3.2 Demographic trends

This section explores demographic trends in participants' mean R-EID scores. Mean R-EID scores for different demographic groups are shown in Table 24, along with measures of significance and, where required, effect size. These results are discussed in further detail in the subheadings below.

Table 24: Demographic trends in R-EID scores

Characteristic	Correlation coefficient		P value	Effect size
Age (years)	0.03		0.028	NA
	Mean ± SD	Median (IQR)	P value	Effect size
Age groups (n, %)				
55-59 ^a	80.2 ± 13.5	83.0 (73.0 to 91.0)	0.037	Negligible 0.001
60-64 ^a	80.7 ± 13.4	83.0 (73.0 to 91.0)		
65-69 ^a	81.6 ± 13.7	84.0 (74.0 to 92.0)		
70-74 ^a	81.7 ± 12.7	84.0 (74.0 to 92.0)		
75-79 ^a	80.9 ±13.8	84.0 (72.8 to 92.0)		
80+ ^a	79.6 ± 14.7	83.0 (71.0 to 91.0)		
Gender (n, %)				
Female	81.7 ± 13.6	85.0 (74.0 to 92.0)	<0.001	Negligible 0.080
Male	80.0 ± 13.4	82.0 (72.0 to 90.0)		
Māori descent (n, %)				
Māori	81.1 ± 13.9	84.0 (73.0 to 92.0)	0.094	NA
Non-Māori	80.8 ± 13.2	83.0 (73.0 to 91.0)		
NZDep (n, %)				
Low (1-5)	81.4 ± 12.9	84.0 (74.0 to 92.0)	0.113	NA
High (6-10)	80.4 ± 14.2	83.0 (72.0 to 92.0)		
Country of birth (n, %)				
New Zealand	80.8 ± 13.5	83.0 (73.0 to 92.0)	0.017	Negligible 0.033
Overseas	81.9 ± 13.5	85.0 (75.0 to 92.0)		
Highest educational qualification (n, %)				
No qualification ^a	78.2 ± 16.2	82.0 (68.0 to 91.0)	<0.001	Small 0.020
Secondary school ^a	79.3 ± 13.5	81.0 (71.0 to 90.0)		
Post-secondary qualification ^b	81.1± 13.2	83.0 (74.0 to 91.0)		
University degree ^c	84.0 ± 11.4	86.0 (78.0 to 93.0)		
Work status				
Paid work ^a	80.6 ± 13.5	83.0 (73.0 to 91.0)	0.005	Negligible 0.002
Fully retired ^{ab}	81.2 ± 13.5	84.0 (74.0 to 92.0)		
Other ^b	82.2 ± 13.3	85.0 (74.0 to 92.0)		

^{a, b, c} denote the results of post-hoc tests. Groups that differ significantly from each other do not share a letter, while groups that are not significantly different will share a letter.

4.3.2.1 Age

There is a small, significant, positive correlation between age and R-EID score ($\rho=0.03$, $p=0.03$; Table 24). This indicates that R-EID scores tend to increase with age, but the increase is small.

When age groups were analysed, average R-EID scores followed an inverted U shape, with higher average scores in the middle age groups and lower average scores in the younger and oldest age groups (Table 24). A one-way ANOVA identified a statistically significant difference between the means of the six groups ($F(5,5381)=2.4$, $p=0.037$).

The effect size of this difference was negligible ($\omega^2=0.001$). Interestingly, post-hoc Tukey tests found no significant differences between pairwise comparisons of all groups ($p>0.05$ for all pairwise comparisons). This may be due to the number of comparisons required for pairwise comparisons of all six groups (Frost, 2019).

Overall, continuous and categorical analysis of R-EID scores by age provided slightly conflicting results. The small positive correlation found in the analysis of age as a continuous variable aligns with hypothesis H11. However, the lack of significant differences in the post-hoc testing of age groups indicates no significant difference between older and younger participants. Ultimately this analysis does not provide sufficient evidence of a significant difference in environmental identity between older and younger participants and, hence, hypothesis H11 is considered disproved.

4.3.2.2 Gender

Women had significantly higher average R-EID scores than men (mean $\pm$ SD: 81.7 ± 13.6 versus 80.0 ± 13.4 , $p<0.001$; Table 24). The effect size of this difference was negligible ($r=0.080$). This result aligns with hypothesis H12.

4.3.2.3 Māori descent

Participants of Māori descent had slightly higher average R-EID scores than those of non-Māori descent, but the difference was not significant (mean $\pm$ SD: 81.1 ± 13.9 versus 80.8 ± 13.2 , $p=0.094$; Table 24). This trend aligns with that predicted in hypothesis H13 but, as significance was not reached, the hypothesis is considered disproved.

4.3.2.4 Area deprivation

Participants living in areas with low socioeconomic deprivation had slightly higher average R-EID scores than those living in areas with high socioeconomic deprivation, but the difference was not significant (mean $\pm$ SD: 81.4 ± 12.9 versus 80.4 ± 14.2 , $p=0.113$; Table 24). This result aligns with hypothesis H14.

4.3.2.5 *Country of birth*

Participants who were born overseas had significantly higher average R-EID scores than those who were born in NZ (mean $\pm$ SD: 81.9 $\pm$ 13.5 versus 80.8 $\pm$ 13.5, $p=0.017$; Table 24). The effect size of this difference was negligible ($r=0.033$). This result disproves hypothesis H15, which had anticipated that there would be no significant difference between groups.

4.3.2.6 *Education*

Participants' average R-EID scores increased as educational attainment increased, from a secondary school qualification and beyond (Table 24). A Kruskal Wallis test identified a statistically significant difference between the medians of the four groups ($H(3, n=5387)=111$, $p<0.001$). The effect size of the difference was small ($\eta^2=0.020$). Dunn's post-hoc tests found that there was no significant difference in median R-EID scores between those with no qualification and those with a secondary school qualification (Table 24). However, all other pairwise comparisons were significant. Participants with a post-secondary qualification had significantly higher R-EID scores than those with no qualification or a secondary qualification ($p<0.001$ for both comparisons). Participants with a university degree had significantly higher R-EID scores than those with no qualification, a secondary school qualification or a post-secondary qualification ($p<0.001$ for all comparisons). The significant increase in R-EID scores with higher educational attainment disproves hypothesis H16, which had not anticipated a significant difference between groups.

4.3.2.7 *Employment*

Participants in paid work had lower average R-EID scores than those who were retired or in the 'Other' category (Table 24). A Kruskal Wallis test identified a statistically significant difference between the medians of the three groups ($H(2, n=5387)=10.4$, $p=0.005$), although the effect size of the difference was negligible ($\eta^2=0.002$). Dunn's post-hoc tests confirmed that participants in the 'Other' group had significantly higher R-EID scores than those in paid work ($p=0.009$; Table 24). There was no significant difference between those who were in paid work and those who were retired, or those

who were retired and the 'Other' group. This result disproves hypothesis H17, which had not anticipated a significant difference between groups.

4.4 The relationship between eco-anxiety and environmental identity

There was a small, significant, positive correlation between participants' R-EID scores and their HEAS scores, for both the total HEAS and all its dimensions (Table 25). This indicates that participants with greater environmental identity tended to have higher levels of eco-anxiety. The relationship between eco-anxiety and environmental identity was weakest in the behavioural symptoms dimension of the HEAS ($\rho=0.03$) and strongest when the total HEAS score was considered ($\rho=0.21$). This result largely aligns with hypothesis H18, although a significant correlation between R-EID scores and the behavioural symptoms dimension of the HEAS had not been anticipated.

Table 25: Correlation between R-EID and HEAS (total and dimension) scores

HEAS dimension	Correlation coefficient	P value
HEAS	0.21	<0.001
Affective symptoms	0.18	<0.001
Rumination	0.19	<0.001
Behavioural symptoms	0.03	0.016
Anxiety about personal impact	0.20	<0.001

5 Discussion

This thesis has explored the concepts of eco-anxiety and environmental identity in adults, through a scoping review of existing international literature and analysis of a large dataset from older adults in New Zealand (aged 55 years and over). To the author's knowledge, this is the first study to quantify both eco-anxiety and environmental identity among older adults in New Zealand. This section will contextualise the results of the analysis with respect to international observations, acknowledge the limitations of the study and discuss recommendations for future research.

5.1 Eco-anxiety

5.1.1 Contextualisation of results

This study found that 94.3% of participants had experienced no or mild eco-anxiety in the two weeks preceding the NZHWR Study (46.8% and 47.5%, respectively). This is lower than the single previous paper using this categorisation method, which found that 51.8% of a Spanish sample had mild eco-anxiety and 48.2% had moderate or severe eco-anxiety (Vecina et al., 2025). This low prevalence of eco-anxiety among older adults in New Zealand is also reflected in the low mean score per item (0.26 on a scale of 0 to 3). This result subceeded the internationally observed range of 0.43 to 2.08 in an Australian and Turkish study, respectively (Mathers-Jones & Todd, 2023; Özkan et al., 2025). A low level of eco-anxiety among adults in New Zealand has also been reflected in recent research, which highlighted a decline in the proportion of people who are concerned about the local impacts of climate change and who believe that individual action is urgently required (Dudding, 2025). This trend is concerning, given both the need for individual action and New Zealand's risk of climate-related disasters (ranked as "very high" in the WorldRiskIndex, a composite measure of exposure and vulnerability) (Bündnis Entwicklung Hilft / IFHV, 2025).

In this study, the highest mean score per item was in the rumination dimension, followed by anxiety about personal impact. This differs slightly from wider literature, in

which 66.7% of studies found that anxiety about personal impact was the highest-scoring dimension (Section 2.2.3.1). The mean score per item in the rumination dimension was 0.35, which fell within the internationally-observed range of 0.33 to 1.10 in a study of New Zealand undergraduate students (Hogg et al., 2021) and a study of Turkish university students and school teachers, respectively (Çimşir et al., 2024). It is surprising that rumination was the highest-scoring dimension in this population of older adults, as previous literature has found that negative rumination tends to decrease with age (Emery et al., 2019; Sütterlin et al., 2012). Behavioural symptoms was the lowest-scoring dimension, which aligns with the results of wider literature (Çimşir et al., 2024; Heinzl et al., 2023; Henschel et al., 2025; Hogg et al., 2023; Hogg et al., 2024; Larionow et al., 2024; Mathé et al., 2025; Rocchi et al., 2023; Türkarslan et al., 2023).

The finding of higher eco-anxiety among women than men aligns with international literature from various eco-anxiety scales (see citations in Section 2.2.4.1). This also aligns with wider research into gender and sex differences in anxiety, which has identified a higher prevalence of anxiety disorders among women (Farhane-Medina et al., 2022; McLean et al., 2011). Research has suggested that biological factors, including genetic factors, and psychosocial factors, such as femininity and environmental influences, may contribute to the observed difference in prevalence in anxiety disorders (Ask et al., 2014; Farhane-Medina et al., 2022). Within the context of anxiety about the environment, it has been found that a significant difference between women and men is only seen in wealthier countries (Bush & Clayton, 2023; Knight & Givens, 2026). This is thought to reflect variation in the perception of the relative costs and benefits of climate change mitigation efforts by countries' extent of economic development (Bush & Clayton, 2023).

People who were not either in paid work or retired (for example, full-time homemakers and students, people seeking work and people unable to work due to a health or disability issue) had the highest eco-anxiety scores of the three employment groups. This result aligns with some research using other eco-anxiety scales (Ágoston et al., 2022; Cebeci et al., 2025; Henschel et al., 2025), although not all studies found

significant differences between employment groups (Micoulaud-Franchi et al., 2024; Özkan et al., 2025). Interestingly, a significant difference between retired participants and those in paid work was only found for the total scale and the rumination dimension. This may be a reflection of the correlation between increasing age and increasing rumination, if the retired participants are, on average, older than those in paid work. This would be an interesting aspect to explore with multivariate analysis.

This analysis identified a small increase in total HEAS score with increasing age, driven by an increase in rumination with age. This result differs from available literature. Most studies that used the HEAS found no significant difference in scores for the total scale or rumination dimensions with age, and higher anxiety about personal impact among younger participants (see citations in Section 2.2.4.2). Studies using other measures found that eco-anxiety tended to be higher among younger participants (Devecchi et al., 2025; Jalin et al., 2025; Micoulaud-Franchi et al., 2024). Conversely, the finding of a positive correlation between rumination and age in this analysis aligns with the results of two studies based on an Australian sample of 519 adults aged between 18 and 86 years old. This differs from literature outside the environmental scope, which has indicated that rumination tends to reduce with age (Emery et al., 2019; Sütterlin et al., 2012). This may reflect that environmental rumination follows a different pattern to non-environmental rumination.

The finding of higher eco-anxiety among people living in more deprived areas was not anticipated. Most studies of eco-anxiety have found higher eco-anxiety in people of higher socioeconomic status (Ágoston et al., 2022; Henschel et al., 2025; López-García et al., 2025). Conversely, the results of this analysis align with those of Özkan et al. (2025), a study of 491 Turkish women that found that participants whose income was less than their expenses had significantly greater eco-anxiety than those whose income equalled their expenses. This result may reflect a tendency for those living in more deprived areas to have less access to support and, consequently, a tendency towards maladaptive coping techniques that may exacerbate anxiety symptoms (Brouwer & Menard, 2020; Sharma & Saini, 2025). It is difficult to ascertain whether eco-anxiety differs by socioeconomic status internationally, due to the small number of studies that

have explored this relationship, and the diverse range of measures used to represent socioeconomic status. An additional consideration is that this analysis used a measure of area deprivation as an indicator of socioeconomic status, rather than a personal measure. Therefore, the usual direction of the relationship between eco-anxiety and socioeconomic status is, as yet, uncertain.

To date, evidence regarding the relationship between educational attainment and eco-anxiety has found mixed results. Various studies using different eco-anxiety scales have reported no significant relationship; an increase in eco-anxiety in more-educated groups; and a decrease in eco-anxiety in more-educated groups (see citations in Section 2.2.4.5). This study identified a different relationship: a 'U' shape where participants in the lowest and highest educational attainment groups tended to have higher eco-anxiety than participants in the middle groups. This pattern was seen in all dimensions except behavioural symptoms, which decreased as educational attainment increased. The increase in eco-anxiety symptoms among participants with higher educational attainment contradicts existing literature. Typically, higher educational attainment has been found to be protective against anxiety (Chlapecka et al., 2023; Erickson et al., 2016; Jareebi & Alqassim, 2024). Literature has identified a tendency towards less climate change scepticism among those with more education (Hoekstra et al., 2024): perhaps lower scepticism is contributing to the higher levels of eco-anxiety among those high educational attainment in this population.

To the author's knowledge, this study is the first to use the HEAS to quantitatively explore differences in eco-anxiety between older adults of Māori descent and those not of Māori descent. The analysis found that participants of Māori descent had significantly higher scores in the total HEAS and all dimensions except anxiety about personal impact. This aligns with what was hypothesised, based on the importance of kaitiakitanga in mātauranga Māori (Harmsworth & Awatere, 2013). In contrast, one previous study of climate change anxiety (rather than eco-anxiety) did not find a significant difference among university students of different ethnic groups in New Zealand (McBride, 2022). However, the author noted that low participant numbers in

ethnic groups other than Pākehā may have contributed to this finding, and suggested further research to confirm the relationship.

Another novel area explored by this analysis was the difference in eco-anxiety between participants who were born in New Zealand and those who were born overseas. The only dimension that was significantly different between these groups was anxiety about personal impact, which was significantly higher in participants who were born overseas. This result appears to align with research showing that migrants have lower per capita carbon dioxide emissions than native-born individuals in countries in the Organisation for Economic Co-operation and Development (OECD) (Bollino & Galeotti, 2025). Perhaps greater anxiety about one's impact among people born overseas contributes to behaviour change, leading to lower emissions. Alternatively, this may instead reflect the declining proportion of New Zealanders who feel that individual action to combat climate change is urgently needed (Dudding, 2025).

5.1.2 Implications of results

One previous study quantified eco-anxiety among New Zealand adults – specifically, among undergraduate students (Hogg et al., 2021). Therefore, this is the first study to quantify eco-anxiety among older adults in New Zealand. As such, these results provide useful insight to the norms of eco-anxiety among this population. This may assist clinicians in the risk-stratification of people experiencing eco-anxiety, so that people experiencing eco-anxiety that disrupts their daily life are referred to appropriate services in a timely manner.

A widely-used method of score categorisation for the HEAS has not yet been established (Section 2.2.3.1). This study adapted a method proposed by Vecina et al. (2025) by adding a category of 'no' eco-anxiety for those who scored zero, then evenly dividing the response scale into three. This approach aligns well with the score descriptors of the four-point scale (Appendix B: Characteristics of included studies). For example, categorisation of 'mild' eco-anxiety corresponds with experiencing symptoms on several of the days in the preceding two-week period, while 'severe' eco-

anxiety corresponds with experiencing symptoms nearly every day. This logic supported the choice of this categorisation method in favour of the alternative method proposed by Larionow et al. (2024), which defined a binary variable of clinically-significant eco-anxiety based on participants' responses to the first two items of the HEAS. The rationale for basing categorisation solely on the first two items of the scale was not clear, nor was the basis for defining clinical significance. As such, this research suggests that the use of this modified categorisation adapted from Vecina et al. (2025) would be a suitable categorisation method to be widely used by future research using the HEAS.

Finally, this study established that moderate to severe eco-anxiety affects a minority of older adults in New Zealand. This result is useful for the planning of service provision, as it indicates that this is not a priority concern for many older adults, and resources could therefore be directed to other areas. It also indicates that strategies to improve the uptake of PEBs among this population should not rely on high levels of eco-anxiety as the motivator for behaviour change.

5.2 Environmental identity

5.2.1 Contextualisation of results

This study adds to the growing body of literature quantifying environmental identity among older adults. To the author's knowledge, this is the first study using the R-EID to be based in New Zealand. This highlights the importance of this update to the NZHWR Study in progressing environmental identity research among older adults in New Zealand. An additional benefit of the NZHWR Study is its longitudinal nature. Most studies of environmental identity to-date have used a cross-sectional design (Section 2.3.1), and the longitudinal study of environmental identity through the NZHWR Study presents a valuable opportunity to contribute to this literature gap.

This study found a mean environmental identity score per item of 5.78 (range 1 to 7). This result falls within the internationally-observed range of 4.81 to 6.02, found with

samples of Taiwanese undergraduate students and US visitors to natural leisure settings, respectively (Clayton et al., 2021). No methods of score categorisation were identified in the literature review (Section 2.3.3). Therefore, this study used the neutral midpoint of the response scale (4, in a scale of 1 to 7) as a descriptive marker, in line with Clayton et al. (2021). Categorisation found that 94.5% of participants had an environmental identity above neutrality. The tendency of scores to lie above neutrality was noted during the development of the R-EID, and the authors reflected that a scale of 1 to 7 may not have adequately captured response variation (Clayton et al., 2021). Future research using alternative measures of environmental identity may help to determine whether the high environmental identity observed in this study is due to the scale inadequately capturing response variation or, conversely, a true reflection of high environmental identity among older adults in New Zealand.

This study identified a small, significant increase in R-EID scores with increasing age. However, categorical analysis found no significant differences between age groups in post-hoc testing. Interestingly, these contrasting results both align with previous literature. Most studies using Clayton's original environmental identity scale (Clayton, 2003) have found no significant relationship between age and environmental identity, but studies using the R-EID have found higher environmental identity among older participants (see citations in Section 2.3.4.2). Additionally, one New Zealand-based study using the original EID also found a weak positive correlation between age and environmental identity (Apiti et al., 2023). The large sample size of this study may have contributed to the identification of a positive correlation between age and environmental identity. However, the correlation was very small ($\rho=0.03$) and it may be that this relationship, while statistically significant, is not large enough to be meaningful and be reflected in the categorical analysis.

The finding of higher environmental identity among women than men aligns with the majority of previous literature, although a significant difference between genders has not always been identified (see citations in Section 2.3.4.1). This also aligns with previous New Zealand-based research using the original EID (Apiti et al., 2023). The result of no significant difference in environmental identity by socioeconomic

deprivation aligns with the result of the single study identified in the scoping review that explored this relationship (Patrasc-Lungu & Iliescu, 2022a). In contrast, previous research in New Zealand found a weak negative association between income and environmental identity in their study of 314 Māori adults (Apiti et al., 2023). This result is not directly comparable to this analysis of NZHWR Study data, which explored the influence of socioeconomic impact using the NZDep measure of area deprivation, rather than income. Additionally, the large sample size of the NZHWR Study supports the finding of no significant difference in environmental identity among people living in areas with higher, or lower, socioeconomic deprivation.

This study was the first to explore differences in environmental identity by Māori descent, education, employment, and country of birth (New Zealand or overseas). Interestingly, the study found no significant difference in environmental identity between participants of Māori descent and those not of Māori descent. This differed from the hypothesised result (higher environmental identity among participants of Māori descent), which was based on recognition of the importance of kaitiakitanga in mātauranga Māori (Harmsworth & Awatere, 2013). This result indicates that older adults in New Zealand have a similar environmental identity (when measured with the R-EID), whether or not they are of Māori descent. However, to the author's knowledge, the R-EID has not yet been validated for Māori populations. Further research into whether the R-EID is the most appropriate measure of environmental identity among Māori populations would be useful in contextualising the result of this study.

The analysis highlighted a significant difference between groups based on their country of birth. Participants who were born overseas had significantly higher environmental identity than those who were born in NZ. Canadian-based qualitative research has found that migrants' engagement with natural environments in Vancouver helped to establish a sense of belonging in their new country (Ono et al., 2023): perhaps a similar process occurs in New Zealand and contributes to the observed difference in environmental identity.

Two further unexpected results related to education and employment characteristics. First, environmental identity was found to increase significantly as educational attainment increased from secondary school qualifications. Secondly, participants in the 'Other' employment category had significantly higher environmental identity than those who were in paid work. The relationship between environmental identity and educational attainment, and environmental identity and employment, has not been explored in previous research. Within the scope of this project, while the former demonstrated a more linear relationship than that seen for eco-anxiety, the latter was found to align with the result observed for eco-anxiety. Given the acknowledged relationship between socioeconomic status, ethnicity, education and employment in New Zealand, it is interesting that environmental identity should differ significantly only by the latter two factors (Boven N, 2022). Further research to explore potential reasons for this relationship – for example, to explore whether gender is a confounding factor – is required.

5.2.2 Implications of results

Most participants in the NZHWR Study had a sense of environmental identity that was stronger than neutrality. Given that the participants are representative of adults aged 55 years and over in New Zealand, these results could be extrapolated to surmise that older adults in New Zealand have a sense of environmental identity. This knowledge could be used to inform strategies designed to increase the uptake of PEBs among this population. For example, advertising could use language that appeals to people's sense of belonging to the natural environment as a motivating factor to support and protect the environment. Similar strategies could facilitate the operationalisation of environmental identity as a motivator for PEBs (Clayton & Czellar, 2023; Clayton & Kiliç, 2013).

The scoping review did not identify any methods of scoring categorisation for the R-EID. This analysis derived a categorisation method using the neutral midpoint of the response scale, based on Clayton et al. (2021). This method could be used in future research. However, Clayton et al. (2021) also noted that the tendency of mean scores

to fall above the midpoint of the scale may indicate insufficient capture of response variation. They suggested that adaptation of the scale – for example, shortening the scale or expanding the response length from seven to nine points – may improve the performance of the scale. The results of this analysis therefore support future research to explore whether adaptations to the R-EID improve the capture of response variation.

5.3 Relationship between eco-anxiety and environmental identity

This analysis found a small, significant, positive correlation between the R-EID and all dimensions of the HEAS, indicating that as environmental identity increases, eco-anxiety also tends to increase. This result aligns with international literature (Section 2.4). Further research into this relationship would be interesting, to establish whether there are any indications of causality.

5.4 Limitations

The first challenge of this project was setting appropriate conceptual boundaries. As acknowledged in Sections 1.2 and 1.3, both eco-anxiety and environmental identity are distinct terms with a plethora of related concepts. This study excluded evidence from related but distinct concepts such as climate change anxiety, environmental self-identity and ecological identity. This strict exclusion criterion maintained definitional clarity within the scoping review and aligned with the scales used in the NZHWR Study. However, it created the risk that potentially eligible research may have been excluded if the authors described an eligible scale (for example, an eco-anxiety scale) with inaccurate terminology (for example, “climate change anxiety”). Such examples were noted during the screening process of this review. The risk of excluding studies with potentially-eligible research was minimised by using clear inclusion and exclusion criteria, conducting parallel screening for the scoping review with two researchers and resolving contention through discussion. These measures are felt to have been sufficient to capture the vast majority of eligible research, leading to a robust scoping review.

A further limitation of the literature review was the exclusion of books and book chapters. This decision was made to ensure that only peer-reviewed research would be included and to maintain a manageable scope for the review. This was felt to be justifiable in the context of a scoping review. However, it created the risk that some relevant research may have been excluded from the review. For example, the original EID was published in a book chapter, so this was not included in the review (Clayton, 2003). The impact of this exclusion criterion was minimised by including additional targeted searches to inform hypothesis development and contextualisation of results. Therefore, it is expected that most relevant research has been captured in this project.

One limitation of the analysis is that gender diversity was not well captured. The NZHWR Study included two variables for gender: a binary “male/female” variable and a categorical “male/female/gender diverse” variable. The number of responses to “gender diverse” was too small to permit analysis and the binary variable was used for analysis (Stats NZ, 2022). Accordingly, results specific to gender-diverse participants in the studies included in the scoping review were not extracted. This limitation does not have a substantial impact on analysis of the NZHWR results as <5 people were recategorized from “gender diverse” to a binary descriptor. However, an implication of this is that neither the scoping review nor the analysis of NZHWR data was able to contribute to the literature gap regarding eco-anxiety and environmental identity among gender diverse people.

An additional limitation of the analysis was the predominant use of nonparametric statistical tests rather than parametric tests. This decision was informed by the distribution of the data, which was right-skewed for the HEAS and left-skewed for the R-EID. This skew meant that the median was a more appropriate measure of central tendency than the mean and, consequently, nonparametric tests were more appropriate than parametric tests (Frost, 2017c, 2018b). However, the large sample size would have supported application of the central limit theorem, assumption of normality and the use of parametric tests (Frost, 2018a). It is possible that the use of parametric tests may have identified statistically significant differences that the nonparametric tests may have missed (Frost, 2017c). It was decided that prioritising

the distribution of data over the theoretical assumption of normality would be both the most conservative approach and the most statistically-robust approach. Additionally, previous research has found near-equivalence between parametric and nonparametric tests for analysing 5-point Likert scale data (de Winter & Dodou, 2010; Frost, 2017b). Therefore, the statistical tests used in the analysis are considered to be appropriate for the data, leading to robust results.

A final limitation of this study is that multivariate analysis could not be included within the scope of this preliminary project. This analysis presents a descriptive overview of eco-anxiety, environmental identity and demographic trends within each concept. However, development of a more nuanced understanding of these concepts will require multivariate analysis.

5.5 Future research

Multivariate analysis is a natural next step for this research. Such analysis would enable exploration of the combined interactions of demographic characteristics. For example, the educational attainment of older adults in New Zealand may vary with age, due to a historical tendency to finish school at a younger age. Could age therefore be a contributing factor to the observed pattern of eco-anxiety in groups with varying educational attainment? Alternatively, the 'Other' employment category had the highest eco-anxiety and environmental identity scores. This group included full-time homemakers and students, people seeking work and people unable to work due to a health or disability issue. As, historically, women may have been more likely to be full-time homemakers, could gender be contributing to the observed pattern of eco-anxiety and environmental identity among employment groups? Multivariate analysis will be an essential part of the further exploration of these concepts.

This project was not able to explore differences in eco-anxiety and environmental identity by rural versus urban residence of participants due to meshblock data not being available. However, this is an important demographic characteristic that may further enhance our understanding of these concepts. For example, understanding the

level of eco-anxiety and environmental identity among urban participants would inform whether these concepts could be effective motivators to encourage PEBs in this population. Therefore, further exploration of the impact of residential location is recommended.

Further research to explore how eco-anxiety and environmental identity relate to other concepts would aid in applying this knowledge to practical situations. A first step could be to explore the relationship between eco-anxiety and a wider mental health measure, such as the General Anxiety Disorder-7 (GAD-7) scale. This could aid recommendations to clinicians as to when to screen for eco-anxiety. For example, if a positive correlation between GAD-7 and HEAS scores is noted it could be recommended that clinicians screen people with high GAD-7 scores for eco-anxiety, to facilitate recognition and support. Secondly, including measures of climate change belief and PEBs in the NZHWR Study would inform the operationalisation of conceptual knowledge about eco-anxiety and environmental identity in this population. For example, identifying low levels of belief in climate change, in association with the observed low levels of eco-anxiety among older adults in New Zealand, may support implementation of strategies to increase climate change belief and encourage uptake of PEBs.

6 Conclusion

This study represents the first quantification of eco-anxiety and environmental identity among older adults in New Zealand, using data from the 2024/25 wave of the longitudinal NZHWR Study. This is the first iteration of the NZHWR Study to include these concepts. A scoping review of published literature was also performed. This review highlighted the increasing frequency of publications exploring these concepts in recent years and informed contextualisation of the results.

Analysis of participants' responses to the HEAS identified a low prevalence of severe eco-anxiety among this population, with average scores subceeding the internationally-observed range identified in the scoping review. Analysis of R-EID responses found an environmental identity above neutrality and within the internationally-observed range seen in the scoping review. This analysis proposes an updated score categorisation method for research using the HEAS scale, based on an adaptation of the method used by Vecina et al. (2025). No score categorisation methods were identified for the R-EID. Therefore, categorisation was guided by the point of neutrality in the response scale. Further research to establish population norms and inform more detailed score categorisation would be useful.

Demographic patterns in eco-anxiety and environmental identity were explored with bivariate analysis. Future research exploring multivariate analysis of demographic characteristics is recommended. It is likely that some demographic characteristics interact and, therefore, demonstrate combined influence on observed demographic patterns within these concepts. For example, societal trends in the average age of school leavers may influence the distribution of participants across educational attainment and employment groups and, consequently, the observed patterns in eco-anxiety and environmental identity may be attributable to one or more of these characteristics. Multivariate analysis is essential for developing a more nuanced understanding of the observed demographic patterns.

Finally, international research to-date has found that both eco-anxiety and environmental identity are correlated with PEBs (Clayton & Czellar, 2023; Pihkala, 2020a; Verplanken & Roy, 2013). To operationalise this knowledge in a New Zealand context it would be useful to explore the relationship between eco-anxiety, environmental identity, climate change belief and PEBs in this population. The addition of measures of climate change belief and PEBs to the NZHWR Study could facilitate such analysis.

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8 Appendix A: Scoping review search string (Scopus)

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TITLE-ABS-KEY(  
  (( "eco-anxiety" ) OR ( "eco anxiety" ) OR ( "ecological anxiety" ))  
  OR  
  (( "environmental identity" ) AND (( "climate" ) OR ( "behavior" ) OR ( "behaviour" )))  
  OR  
  (  
    (( "environmental identity" ) AND (( "climate" ) OR ( "behavior" ) OR ( "behaviour" )))  
  )  
  AND  
  (( "eco-anxiety" ) OR ( "eco anxiety" ) OR ( "ecological anxiety" ))  
)
```

9 Appendix B: Characteristics of included studies

9.1 Eco-anxiety studies

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
(Jalin et al., 2024)	To investigate the associations between the level of eco-anxiety and other variables such as environmental affect traits, connectedness to nature, depression, anxiety and media exposure.	Setting: France Population: French-speaking adults who attended climate awareness workshops. Sample size: 522	Design: Cross-sectional survey Recruitment: Recruitment through climate awareness workshops organised by La Fresque du Climat, a French nonprofit organisation.	Eco-Anxiety Measurement Scale (EMEA).
(Jalin et al., 2025)	To validate a French-language scale (EMEA) measuring eco-anxiety.	Setting: Not specified, but focussed on a French-language scale. Population: French-speaking adults. Sample size: 429 (Phase 2, confirmation of factor structure and finalisation of scale items)	Design: Cross-sectional survey repeated once at approximately 40 days later for a subset of participants. Recruitment: Online advertisement (including social media).	EMEA.
(Ágoston, Buvár, et al., 2024)	To explore the complex relationship between environmental knowledge, nature relatedness, different eco-emotions (anxiety, guilt and grief), general PEB and the intention to change behaviour in the future.	Setting: Hungary Population: A representative sample (in terms of sex, age, region and settlement size) of the Hungarian population. Sample size: 1000	Design: Cross-sectional survey Recruitment: Recruitment via survey company.	Eco-Anxiety Questionnaire (EAQ): Short version.
(Zeier & Wessa, 2024)	To analyze the factor structure and construct validity of all three questionnaires [the Eco-Guilt Questionnaire (EGuiQ-11), the Ecological Grief Questionnaire (EGriQ-6), and the Eco-Anxiety Questionnaire (EAQ-22)] in German to enable further research of eco-emotions in German-speaking populations.	Setting: Germany Population: German adults in the SoSci Panel online respondent pool. Sample size: 871	Design: Cross-sectional survey Recruitment: Convenience sampling via an online platform (SoSci Survey).	EAQ: German version.

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
(Micoulaud-Franchi et al., 2024)	To translate and validate the French EAQ-22 and to evaluate the prevalence of the level of the two dimensions of eco-anxiety and the relationship with anxiety and depressive symptoms in a representative adult sample of the French general population.	Setting: France Population: Representative adult sample of the French general population. Sample size: 1004	Design: Cross-sectional survey Recruitment: Recruitment by Opinion Way, an institute specialised in quotas sampling.	EAQ: French version.
(Ágoston et al., 2022)	To develop questionnaires to assess these psychological consequences [eco-anxiety, eco-guilt and ecological grief], and to examine their relationship with pro-environmental behavior (PEB).	Setting: United States Population: Adults Sample size: 4608	Design: Cross-sectional survey Recruitment: Online advertisement (including social media).	EAQ.
(Devecchi et al., 2025)	To assess the relationships between eco-concerns and the risk of eating disorders (EDs) and orthorexia nervosa (ON) in a group of adult females without self-reported history of psychiatric diseases.	Setting: Italy Population: Adult Italian females without known psychiatric diseases. Sample size: 880	Design: Cross sectional study Recruitment: Online advertisement (including social media).	EAQ.
(Baykara Mat & Yilmaz, 2024)	To determine nursing students' awareness of global climate change and eco-anxiety levels, and the relationship between these two factors.	Setting: Turkey Population: Nursing students at a foundation university. Sample size: 374	Design: Cross-sectional survey Recruitment: Not reported.	Hogg Eco-Anxiety Scale (HEAS): Turkish version.
(Er et al., 2024)	To determine the eco-anxiety levels of nursing students and the relationship between eco-anxiety and their mental health.	Setting: Turkey Population: Nursing students at university. Sample size: 609	Design: Cross sectional study Recruitment: eMail	HEAS: Turkish version.
(Çolak et al., 2025)	To examine the effect of the Climate Change and Health course on global warming knowledge and attitude, environmental literacy, and eco-anxiety levels in nursing students.	Setting: Turkey Population: Undergraduate nursing students in the Climate Change and Health course. Sample size: 117	Design: Quasi-experimental Recruitment: Study advertised during university course.	HEAS: Turkish version.
(Baroni et al., 2025)	To investigate differences between individuals with and without eco-anxiety in terms of their engagement in sustainable habits by also examining the psychological determinants in terms of readiness to change	Setting: Italy Population: People aged 14+ and proficient in Italian (NB: results for participants outside the age range of this review were excluded).	Design: Cross-sectional survey Recruitment: Online advertisement (including social media).	HEAS: Italian version.

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
	(RTC); and to examine potential associations between these variables.	Sample size: 501		
(Hervé & Marsat, 2023)	To study the role of environment-related emotions in investment decision-making in green equity funds.	Setting: France Population: Investors Sample size: 671	Design: Cross-sectional survey Recruitment: Online survey by research company.	HEAS.
(Mathers-Jones & Todd, 2023)	To investigate whether differential patterns of selective attention towards climate-related information, and variability in this attention, might explain this inconsistent relationship [between eco-anxiety and adaptive behaviour].	Setting: Australia Population: Young adult Australian residents. Sample size: 96	Design: Two-part prospective study. Only part one (a cross-sectional baseline assessment) was relevant for this review. Recruitment: Social media advertisements and psychology student research pools.	HEAS.
(Çimşir et al., 2024)	To examine the psychometric properties of the Turkish version of the Hogg Eco-Anxiety Scale (HEAS-13), using exploratory structural equation modeling (ESEM).	Setting: Turkey Population: Turkish adults (Sample 1 consists of university students and school teachers, and Sample 2 consists of junior and sophomore counselling students). Sample size: 445 (Only the 385 in Sample 1 are relevant for the extracted results, as Sample 2 were used to explore test-retest reliability which is outside the scope of this review).	Design: Cross-sectional survey Recruitment: During university classes and in-service teacher training programmes.	HEAS: Turkish version.
(Kabasakal-Cetin, 2023)	To find out what predicts eco-anxiety or sustainable and healthy eating behaviours among university students.	Setting: Turkey Population: Undergraduate university students. Sample size: 605	Design: Cross-sectional survey Recruitment: Voluntary.	HEAS: Turkish version.
(Larionow et al., 2024)	To introduce a Polish version of the HEAS-13 and examine its psychometric properties.	Setting: Poland Population: Polish-speaking adults. Sample size: 634	Design: Cross-sectional survey Recruitment: Online advertisement (including social media).	HEAS: Polish version.

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
(Henschel et al., 2025)	To investigate the psychometric properties of the German Hogg Eco-Anxiety Scale (HEAS) as a reliable and valid instrument to measure eco-anxiety, and to explore its associations with sociodemographic and psychological variables.	Setting: Germany Population: German-speaking adults from Germany, Austria and Switzerland. Sample size: 322	Design: Cross-sectional survey Recruitment: Flyers, email distribution lists and private social media channels.	HEAS: German version.
(Hogg et al., 2021)	To explore eco-anxiety in Australia and New Zealand and validate a new eco-anxiety scale.	Setting: Australia and New Zealand Population: Undergraduate students at Victoria University of Wellington in New Zealand. Sample size: Sample 1: 365; Sample 2: 370. Samples were randomly drawn from the cross-sectional sample of students who participated in the first survey. Sample 1 was used for exploratory factor analysis and sample 2 was used for confirmatory factor analysis.	Design: Cross-sectional survey with a longitudinal subgroup completing the survey at two time points, an average of 12 weeks apart. Recruitment: Not reported.	HEAS.
(Hogg et al., 2023)	To synthesise current evidence on their [the Climate Anxiety Scale and Hogg Eco-Anxiety Scale] psychometric performance across countries and examine their performance in Australia using new data.	Setting: Australia Population: Adults living in Australia. Sample size: 529	Design: Cross-sectional survey Recruitment: Not reported.	HEAS.
(Hogg et al., 2024)	To examine the differential relationships between eco-anxiety dimensions (as measured by the Hogg Eco-Anxiety Scale), personal pro-environmental behaviour and mental wellbeing.	Setting: Australia Population: Adults living in Australia. Sample size: 530	Design: Cross-sectional survey with longitudinal data on a subset of participants who completed the survey twice, two weeks apart. Recruitment: Range of techniques, including snowball	HEAS.

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
			method and social media advertising.	
(Höller et al., 2025)	To investigate whether different sources of air pollution are associated with distinctive worries.	Setting: Iceland Population: Citizens living in Oddeyrin (exposed to seasonal air pollution) and Giljahverfi (control group). Sample size: 47	Design: Cross-sectional survey Recruitment: Letter, newspaper advertisement and phone calls.	HEAS: Icelandic version.
(Mathé et al., 2025) NB: This study was also included in the environmental identity section of the review.	To translate and validate the Hogg Eco-Anxiety Scale (HEAS; Hogg et al., 2021) in French (HEAS-FR) and analyse its psychometric properties.	Setting: France Population: French-speaking adults. Sample size: 275	Design: Cross-sectional survey Recruitment: Social media advertisements and posts on University of Lille campuses.	HEAS: French version.
(Heinzel et al., 2023)	To translate the original English Hogg Eco-Anxiety Scale (HEAS) into German and to assess its reliability and validity in a German sample.	Setting: Germany Population: University students and staff. Sample size: 486	Design: Cross-sectional survey Recruitment: Online advertisements, mailing lists, flyers, posters, emails, online recruitment system.	HEAS: German version.
(Pavani et al., 2023)	To deepen our understanding of the effect of eco-anxiety on pro-environmental behaviours by addressing the above-mentioned limitations of recent research [cross-sectional design and neglect of potential confounding variables].	Setting: France Population: French adults. Sample size: 167	Design: Two-wave longitudinal study Recruitment: Convenience sampling through personal and professional networks; social media advertisements; flyers at authors' university.	HEAS: French version.
(Rocchi et al., 2023)	To assess the preliminary psychometric properties of the Italian version of the Hogg Eco-Anxiety Scale (HEAS).	Setting: Italy Population: Italian adults. Sample size: 335	Design: Cross-sectional survey Recruitment: Through an online platform (psytoolkit.org).	HEAS: Italian version.
(Türkarslan et al., 2023)	To investigate the psychometric properties of the HEAS-13 in Turkish-speaking samples.	Setting: Turkey Population: Turkish-speaking adults. Sample size: 605	Design: Cross-sectional survey Recruitment: Online advertisement (including social media).	HEAS: Turkish version.

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
(Sampaio et al., 2023)	To validate the Portuguese version of the Hogg Eco-Anxiety Scale (HEAS) in young adults and examine the associations among eco-anxiety, sociodemographic characteristics, and pro-environmental behaviours.	Setting: Portugal Population: Portuguese undergraduate students. Sample size: 623	Design: Cross-sectional survey Recruitment: Students were emailed by their higher education institutions.	HEAS: Portuguese version.
(Trifunović & Rajčević, 2024)	To examine the nature of eco-anxiety among geography teachers in the Banja Luka region of the Republic of Srpska, Bosnia and Herzegovina (B&H).	Setting: Bosnia and Herzegovina Population: Geography teachers from the Banja Luka region. Sample size: 40	Design: Cross-sectional survey Recruitment: Participants were recruited during a seminar for geography teachers.	HEAS: Serbian-language version.
(Orrù et al., 2024)	To explore the relationships between these three constructs [emotion regulation, eco-anxiety and worry about one's future] with the use of a mediation analysis.	Setting: Italy Population: Italian adults. Sample size: 343	Design: Cross-sectional survey Recruitment: Online advertisement (including social media).	HEAS.
(Vecina et al., 2024)	To better understand the mechanisms that connect climate change perceptions and general willingness to engage in pro-environmental behaviour.	Setting: Spain Population: Spanish adults, including members of national environmental associations. Sample size: 403	Design: Cross-sectional survey Recruitment: Snowball recruitment via mail and social networks.	HEAS.
(Özkan et al., 2025)	To determine the relationship between eco-anxiety caused by climate change and the fertility preferences of women.	Setting: Turkey Population: Women registered at a family health centre. Sample size: 491	Design: Cross-sectional survey Recruitment: Clinic patients.	HEAS: Turkish version.
(Spano et al., 2025)	To complement previous preliminary validation work on the Italian version of the Hogg Eco-Anxiety Scale (HEAS) by providing a comprehensive overview of the reliability of the scores and the validity of inferences drawn from the scale on a large sample of approximately 1300 participants located across the Italian peninsula and belonging to four generations.	Setting: Italy Population: Italians. Sample size: 685 (NB: 1293 people participated in the study, but the extracted results excluded 597 people who belonged to Generation Z, due to some people in this generation being below the age threshold for this study).	Design: Cross-sectional survey Recruitment: "Snowball" recruitment from authors' social network.	HEAS: Italian version.

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
(Cebeci et al., 2025)	To investigate the relationship between various socio-demographic factors and levels of eco-anxiety.	Setting: Turkey Population: Adults living in Turkey. Sample size: 1009	Design: Cross-sectional survey Recruitment: Convenience sampling.	HEAS: Turkish version.
(Kryazh & Baranov, 2025)	To conduct a psychometric evaluation of the first Ukrainian-language version of the Hogg Eco-Anxiety Scale (HEAS) with subsequent comparative analysis of eco-anxiety indicators in different gender and age groups.	Setting: Ukraine Population: Ukrainians. Sample size: 446 (participant age range began at 17, therefore results have been extracted for eligible participants only: mature age group, N=158).	Design: Cross-sectional survey Recruitment: Snowball method, not further described.	HEAS: Ukrainian version.
(Vecina et al., 2025)	To analyze...the incremental validity of the eco-worry construct concerning that of eco-anxiety at three levels of environmental commitment: high (environmental activists), medium (people who are not part of any environmental organization but who would like to), and low (people who neither belong to environmental groups nor want to).	Setting: Spain Population: Representative sample of the Spanish population (in terms of gender, age and place of residence). Sample size: 1911	Design: Cross-sectional survey Recruitment: Stratified random sampling from a market research company.	HEAS.
(Yesildere Saglam & Mizrak Sahin, 2025)	To determine the impact of climate change anxiety [NB: used Eco-Anxiety Scale] on premenstrual syndrome (PMS) in women of reproductive age.	Setting: Turkey Population: Adult women of reproductive age. Sample size: 456	Design: Cross-sectional survey Recruitment: Online advertisement (including social media).	HEAS: Turkish version.
(López-García et al., 2025)	To analyze the mediating role of eco-worry and eco-anxiety in the relationship between two cognitive antecedents (general willingness to behave pro-environmentally and climate change agency) and two types of PEB (sustainable consumption and active participation).	Setting: Spain Population: Spanish young adults. Sample size: 308	Design: Cross-sectional survey Recruitment: Pooling research company with online panelists.	HEAS.
(Innocenti et al., 2023)	To explore the moderating effect of Climate Change Worry on the relationship between eco-anxiety and eco-paralysis by validating the Italian version of Hogg's HEAS and	Setting: Italy Population: Italian adults. Sample size: 150	Design: Cross-sectional survey, repeated after three months. Recruitment: Research protocol shared in the Italian	HEAS: Italian version.

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
	developing and validating a new scale for assessing eco-paralysis.		Climate Change Anxiety Association newsletter and 45 participants were selected, then convenience and snowball sampling continued until data saturation.	

9.2 Environmental identity studies

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
(Patrasc-Lungu & Iliescu, 2022b)	To explore whether work climate (WCQ) and environmental identity (EID) impact GA and, through it, in-role job performance (IRB), organizational citizenship behaviors (OCB) and wellbeing, as well as organizational citizenship behaviors for the environment (OCBE).	Setting: United States Population: Employed adults living in the US. Sample size: 201	Design: Survey conducted at two time points, 3 months apart. Recruitment: Online research platform (Prolific).	Environmental identity scale (EID): Spanish version.
(Patrasc-Lungu & Iliescu, 2022a)	To test goal self-concordance as a mediating mechanism in each of these relationships [between core self-evaluations and organisational citizenship behaviour for the environment, and environmental identity and organisational citizenship behaviour for the environment].	Setting: United States Population: Employed adults in the US. Sample size: 297	Design: Cross sectional study Recruitment: Recruitment was through a dedicated data collection platform (Prolific Academic).	EID: Spanish version.
(Gkargkavouzi et al., 2018)	To assess Greek in-service teachers' environmental knowledge, eco-friendly behaviour, and their connectedness to nature and environmental identity as aspects of their environmental consciousness.	Setting: Greece Population: Primary and secondary teachers involved in environmental education programmes. Sample size: 100	Design: Cross-sectional survey Recruitment: Phone.	EID: Greek version.
(Sierra-Barón et al., 2023)	To describe and identify possible significant differences between these variables [environmental identity, connectedness with nature, and well-being] to establish whether they predict pro-environmental behaviour, considering the rural-urban provenance.	Setting: Colombia Population: People from southern Colombia. Sample size: 1705	Design: Cross-sectional survey Recruitment: Not reported.	EID: Spanish version.
(Kızılay & Önal, 2019)	To examine the environmental identity of pre-service science teachers and their behaviours towards environmental problems according to gender and grade.	Setting: Turkey Population: Pre-service science teachers at university. Sample size: 215	Design: Cross-sectional survey Recruitment: Convenience sampling, not further specified.	EID: Turkish version.

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
(Clayton & Kiliç, 2013)	To examine predictors of environmental concern and behaviour in Turkey, with a particular focus on the role of national and environmental identity.	Setting: Turkey Population: University students. Sample size: 808	Design: Cross-sectional survey Recruitment: Voluntary.	EID: Turkish version.
(Kiesling & Manning, 2010)	To investigate whether "environmental gardening identity" is a measurable construct that motivates environmentally-friendly home gardening cultivation practices above that predicted by the previously validated environmental identity scale (EID, Clayton, 2003).	Setting: United States Population: Urban-suburban self-identified gardeners. Sample size: 464	Design: Cross-sectional survey Recruitment: Mail.	EID.
(Uçar & Canpolat, 2019)	To examine the relationships among the preservice science teachers, proenvironmental behaviours, environmental identity, and ecocentric and anthropocentric attitudes toward environment.	Setting: Turkey Population: Preservice science teachers. Sample size: 576	Design: Cross-sectional and correlational study Recruitment: Convenience sampling, not further defined.	EID: Turkish version.
(Monroe et al., 2021)	To tease out the impact of these variables [factors that are commonly assumed to contribute to environmental behaviour] in this context rather than develop a model to explain adult behaviour.	Setting: United States Population: Brevard Zoo members and volunteers, members and visitors to a local nature center and people who receive a St Lucie County utility newsletter. Sample size: 1008	Design: Cross-sectional survey Recruitment: eMail.	EID: Short version.
(Irkhin, 2020)	1) to test the connection between Environmental Identity and Mental Wellbeing on a Russian sample 2) to discover which personality traits are connected with Environmental Identity 3) to find out whether or not these personality traits moderate the Environmental Identity and Mental Wellbeing connection.	Setting: Russia Population: Students. Sample size: 312	Design: Cross-sectional survey Recruitment: Not specified.	EID.
(Nartova-Bochaver et al., 2022)	To investigate some global, cultural, and personal predictors of climate change denial.	Setting: Armenia, China, Cuba, Estonia, India, Poland, Russia, Turkey, Ukraine. Population: University students. Sample size: 2751	Design: Cross-sectional survey Recruitment: Convenience sampling of university students.	EID: Various languages.

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
(Curtin & Jia, 2022)	1. To replicate the relationship [between humans and the environment] by administering a decomposed game. 2. To explore the [environmental] attitude-identity-behaviour path in the prosocial and proself value orientation groups using a moderated mediation analysis.	Setting: United States Population: Undergraduate university students at a private university in America. Sample size: 150	Design: Cross sectional study Recruitment: Not reported.	EID: Short version.
(Ayaz et al., 2021)	To examine the effects of activity-based teaching on the development of environmental identities of pre-service primary school teachers and to reveal their views on this method.	Setting: Turkey Population: Pre-service teachers (sophomores at university). Sample size: 46	Design: Non-randomised experimental study Recruitment: Convenience sampling.	EID: Turkish version.
(Atik et al., 2023)	To assess environmental identity (EID) in terms of connectedness to nature, eco-friendly behaviour (EFB) and closeness to nature variables.	Setting: Turkey Population: Pre-service teachers - college students studying at a public university in South-eastern Turkey. Sample size: 518	Design: Cross-sectional survey Recruitment: Unclear.	EID: Turkish version.
(Clark et al., 2019)	To understand if a whale watching/swimming experience can positively impact nature-based tourists' intentions toward pro-environmental behaviours, particularly intentions to reduce plastic use.	Setting: Australia and Tonga Population: Wildlife tourists participating in a whale watching/swim adventure tourism experience. Sample size: 267	Design: Cross-sectional survey Recruitment: Convenience sample approached at tour locations.	EID.
(Mah et al., 2020)	To explore how political ideological development during emerging adulthood may influence environmental beliefs, identity and actions in adulthood.	Setting: Canada Population: Young Canadian adults who participated in a longitudinal study (recruitment at age 17). Sample size: 94 participants were surveyed at age 32.	Design: Longitudinal study, but this study analysed a cross-sectional extraction of environmental identity data. Recruitment: Recontacting of previous longitudinal study participants.	EID.

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
(Ferrajão et al., 2024)	To conduct a validity and reliability study of the Revised EID in native speakers of Portuguese.	Setting: Portugal Population: Adult, native speakers of Portuguese. Sample size: 545	Design: Cross-sectional survey Recruitment: Online advertisement (including social media).	Revised EID (R-EID): Portuguese version.
(Contreras et al., 2024)	To assess the dynamic within-subject interplay between eco-emotions (eco-anger, eco-sadness, eco-anxiety), possible associations with their non-climate-related emotional counterparts (i.e., anger, sadness, anxiety), and their possible relationships with adaptive responses (i.e., intentions to behave in an environmentally friendly manner, as well as actual environmentally-friendly behaviours).	Setting: Belgium Population: French-speaking Belgian adults. Sample size: 102	Design: Exploratory survey, daily for 60 days. Recruitment: Social media, flyers and local news.	R-EID.
(Huang et al., 2024)	1. To employ data to analyse the relationship between environmental leadership, the environmental corporate social responsibility policy, pro-environmental behaviours, and environmental identity... at three time points. 2. To propose how to promote pro-environmental behaviour through organisational mechanisms so that companies can actively promote employees' environmental behaviours through leadership mechanisms.	Setting: Taiwan Population: Employees of technology manufacturing firms. Sample size: 101	Design: Cross-sectional survey Recruitment: Contacted via employers.	R-EID.
(Smith & Wolfe, 2025)	To examine how three life-threatening water messages (specifically drowning, contaminated water consumption, dehydration) influenced environmental identity compared to a standard mortality threat and a control among 455 Canadian and American adults.	Setting: Canada and United States Population: American and Canadian adults. Sample size: 455	Design: Cross-sectional survey Recruitment: Recruitment through Amazon's Mechanical Turk (MTurk) platform.	R-EID.
(Pinho, 2025b)	To examine the role of social psychological characteristics on climate change anxiety and pro-environmental behaviour.	Setting: Portugal Population: Portuguese parents. Sample size: 2055	Design: Cross-sectional survey Recruitment: Stratified random sampling	R-EID.

Author (Year)	Aim	Sample (setting, study population, sample size)	Study design and recruitment	Scale used
			through a survey company (Qdata).	
(Pinho, 2025a)	To explore how climate change anxiety and pro-environmental behaviour vary with gender and social psychological characteristics.	Setting: Portugal Population: A nationally-representative Portuguese sample. Sample size: 3300	Design: Cross-sectional survey Recruitment: Stratified random sampling from a survey company (Qdata).	R-EID.
(Afacan, 2024)	To shift views away from negative perceptions towards aging by exploring how the multiple levels of the gerotranscendence theory are influenced by the sustainable behavior and attitude toward the biophilic design of older adults.	Setting: Turkey Population: Older Turkish adults exposed to biophilic elements in their living environment. Sample size: 300	Design: Mixed methods, including quantitative cross-sectional survey Recruitment: Purposive sampling based on living environments.	R-EID: Turkish version.
(Clayton et al., 2021)	To reexamine the EID items, update them to be more inclusive of a broad variety of populations and experiences, and test their reliability and validity in a diverse multinational sample.	Setting: US, Russia, Switzerland, Taiwan Population: Various: 1. US residents 2. US visitors to North Carolina zoos and other natural leisure settings 3. Russian university students 4. Swiss university students 5. Taiwanese undergraduate students Sample size: 1623 (results extracted for 1448 eligible participants, some excluded due to age)	Design: Cross-sectional survey Recruitment: Convenience samples.	R-EID: Various languages.

10Appendix C: HEAS and R-EID scales

10.1 HEAS (Hogg et al., 2021)

“Over the last 2 weeks, how often have you been bothered by the following problems, when thinking about climate change and other global environmental conditions (e.g., global warming, ecological degradation, resource depletion, species extinction, ozone hole, pollution of the oceans, deforestation)?”

1. Feeling nervous, anxious or on edge
2. Not being able to stop or control worrying
3. Worrying too much
4. Feeling afraid
5. Unable to stop thinking about future climate change and other global environmental problems
6. Unable to stop thinking about past events related to climate change
7. Unable to stop thinking about losses to the environment
8. Difficulty sleeping
9. Difficulty enjoying social situations with family and friends
10. Difficulty working and/or studying
11. Feeling anxious about the impact of your personal behaviours on the earth
12. Feeling anxious about your personal responsibility to help address environmental problems
13. Feeling anxious that your personal behaviours will do little to help fix the problem

Response scale: 0 =not at all, 1 =several of the days, 2 =over half the days, 3 =nearly every day.

10.2 R-EID (Clayton et al., 2021)

Please indicate the extent to which each of the following statements describes you by using the appropriate number from the scale below.

1	2	3	4	5	6	7
<i>Not at all true of me</i>			<i>neither true nor untrue</i>			<i>completely true of me</i>

1. I like to spend time outdoors in natural settings (such as woods, mountains, rivers, fields, local parks, lake or beach, or a leafy yard or garden)
2. I think of myself as a part of nature, not separate from it.
3. If I had enough resources such as time or money, I would spend some of them to protect the natural environment.
4. When I am upset or stressed, I can feel better by spending some time outdoors surrounded by nature.
5. I feel that I have a lot in common with wild animals.
6. Behaving responsibly toward nature – living a sustainable lifestyle – is important to who I am.
7. Learning about the natural world should be part of everyone's upbringing.
8. If I could choose, I would prefer to live where I can have a view of the natural environment, such as trees or fields.
9. An important part of my life would be missing if I was not able to get outside and enjoy nature from time to time.
10. I think elements of the natural world are more beautiful than any work of art.
11. I feel refreshed when I spend time in nature.
12. I consider myself a steward of our natural resources.
13. I feel comfortable out in nature.
14. I enjoy encountering elements of nature, like trees or grass, even when I am in a city setting.

11 Appendix D: Summary of, and reflection on, generative AI use

ChatGPT was used to aid development of parts of the R code for data analysis. To do this, I provided specific prompts describing the function of each piece of code that was required (Figure 7 to Figure 9). Where applicable, I requested that ChatGPT use dplyr to structure code as this is the conventions I am most familiar with, which facilitated a check of the face validity of the code. I also reviewed the explanations provided by ChatGPT, to check that my prompt had correctly conveyed my request and that ChatGPT had, in turn, correctly interpreted my prompt. I did not provide any individual participant data to ChatGPT.

This use of ChatGPT was beneficial in multiple ways. Firstly, I learnt new and more efficient ways of writing code by reviewing the examples and explanations. This allowed me to develop my code-writing skills, which I'll be able to apply to my future work. Secondly, I found that using ChatGPT to help develop R code was faster and more accurate than reviewing other sources of coding advice, such as StackOverflow. Questions on StackOverflow are responded to by a variety of contributors who often volunteer conflicting solutions. It can be difficult to assess the credibility of contributors and, as I'm still a beginner in this field, it can be difficult to assess how robust their responses are. Conversely, ChatGPT provided annotated examples of code and explanations. This aided my learning and simplified my face-validity checks of ChatGPT's suggestions.

ChatGPT is recognised as a supportive tool for code development, but one that requires interpretation and validation by a person (Winberg et al., 2026). I agree with this assessment. My prior knowledge of research methods and data analysis was central to planning and designing the analysis and informing the prompts that I used to generate useful output from ChatGPT. Consequently, using ChatGPT to help develop parts of R

code enabled me to actualise my contextual knowledge. It has been a useful tool and has helped me to develop my skills in R coding.

Figure 7: Prompt and ChatGPT output for categorisation of nominal data

Please use dplyr to write R code for a dataset "Data", to categorise a character variable "work". "work" has 13 response levels, and I'd like to categorise responses 1, 2, 3 and 4 as "employed", response 5 as "retired" and anything else as "other"

Here's how you can use the `dplyr` package in R to categorize the `work` variable in your `Data` dataset based on your specified logic:

```
r Copy code  
  
library(dplyr)  
  
Data <- Data %>%  
  mutate(work_category = case_when(  
    work %in% c("1", "2", "3", "4") ~ "employed",  
    work == "5" ~ "retired",  
    TRUE ~ "other"  
  ))
```

Explanation:

- `mutate()` creates a new variable called `work_category`.
- `case_when()` allows for conditional logic:
 - If `work` is any of "1", "2", "3", or "4", it's categorized as "employed".
 - If `work` is "5", it's "retired".
 - Anything else falls under "other".
- `work` is assumed to be a **character** variable — if it's numeric, you can drop the quotes around the numbers.

Let me know if you want to overwrite the original `work` variable or handle NAs separately.

Figure 8: Prompt and ChatGPT output for troubleshooting code

What's wrong with this R code?
`summary(Data$Age[Scale == "Yes"])`

Good question! The issue with this line:

```
r                                                                    Copy code
summary(Data$Age[Scale == "Yes"])
```

is that `Scale` is not defined in the current environment — it's likely a column in the `Data` dataframe, but you're referencing it as if it were a standalone object.

What's wrong?

- R is trying to find a variable named `Scale` in your global environment, but it doesn't exist there — it's a column inside `Data`.
- So, `Scale == "Yes"` throws an error like:

```
typescript                                                                    Copy code
Error in Scale == "Yes" : object 'Scale' not found
```

Corrected version:

You need to reference `Scale` using the dataframe it belongs to:

```
r                                                                    Copy code
summary(Data$Age[Data$Scale == "Yes"])
```

Explanation:

- `Data$Scale == "Yes"` creates a logical vector within the context of `Data`.
- This logical vector is then used to filter `Data$Age`.

Figure 9: Prompt and ChatGPT output for data exploration

Please use dplyr to write R code for a dataset called "Data" that will look at a character variable called "ID" and summarise how many observations have a value in "ID" and how many have are blank or NA.

Certainly! Here's how you can use `dplyr` to summarize how many observations in the `Data` dataset have:

- 1. A non-missing, non-blank value in the character variable `ID`
- 2. A missing (`NA`) or blank (`""`) value

✓ R Code:

rCopy code

```
library(dplyr)

Data %>%
  summarise(
    non_missing_IDs = sum(!is.na(ID) & ID != ""),
    missing_or_blank_IDs = sum(is.na(ID) | ID == "")
  )
```

🔍 Explanation:

- `!is.na(ID) & ID != ""` → counts entries that are **not NA** and **not an empty string** (`""`)
- `is.na(ID) | ID == ""` → counts entries that are **either NA or blank**

✓ Sample Output:

non_missing_IDs	missing_or_blank_IDs
235	15

Let me know if you'd like to turn this into a long-format table, percentage breakdown, or group it by another variable!