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Climate change, mental health and wellbeing – a review of emerging evidence

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1 Executive summary

1.1 Aims

This evidence review addresses: (1) the climate change risks to mental health and wellbeing internationally and in Scotland, (2) the nature and prevalence of eco-distress in Scotland, (3) interventions for mental health and wellbeing in a climate change context from international literature, and (4) the evidence of co-benefits for mental health and wellbeing from climate action.

We undertook the review between February and July 2024 largely drawing on peer-reviewed studies and, where relevant, government strategy documents, risk assessments and evaluations of interventions.

The Scottish National Adaptation Plan (2024-2029) sets out actions to build Scotland's resilience to climate change, it notes that: 'Climate change means that Scotland will be wetter in winters, drier in summers, sea level rise will continue, and our weather will become more variable and unpredictable. Extremes will be more common.' This review explores the possible effects of these changes on mental health and wellbeing in Scotland.

1.2 Findings

Climate-related risks and impacts to mental health

We found an increasing quantity of evidence that climate change can have substantial effects on mental health and wellbeing. The review found limited primary evidence of the impact of climate change on mental health and wellbeing for Scotland specifically, so these findings reflect the international evidence relevant to a Scottish context.

- These effects are the result of key **climate change-related hazards**: acute weather events such as floods; sub-acute weather events such as longer periods of high temperature; or chronic climate changes, such as sea-level rise.
- Each hazard can lead to negative mental health outcomes through **direct pathways** (injury, traumatisation, property loss) and **indirect pathways** (on livelihoods and social networks). There is also increasing evidence that **awareness of climate change** can affect mental health and wellbeing.
- Internationally, the reported **mental health and wellbeing effects of climate change** can include heightened risk of post-traumatic stress disorder (PTSD), suicide, depression, anxiety and overall poorer mental wellbeing. This varies in type and severity depending on the nature of the hazards.
- Climate change amplifies existing mental health risks, affecting already **vulnerable groups** more. It presents particular challenges for coastal and island communities, and workers in agriculture and fisheries.

Definition and prevalence of 'eco-distress'

Eco-distress (including eco-anxiety) is a psychosocial response to the awareness of climate change. While eco-distress currently lacks a consistent definition in published literature, common themes are (a) its future-oriented nature, (b) association with feelings of uncertainty and being overwhelmed, and (c) its rationality as a response to an existential threat.

- Early evidence indicates that distress about climate change is widespread. As many as 70 percent of people in Scotland worry about climate change, with 25 percent reporting it affects their mental wellbeing.
- Eco-distress appears to be more prevalent among young people, those with pre-existing mental health conditions and members of marginalised groups.

Evidence on effective intervention on mental health and wellbeing risks of climate change

The current evidence base for interventions in this field is limited, with few evaluated studies conducted in Scotland. The evidence reviewed in this study comes from a range of international studies and data sources.

Evaluated interventions predominantly focused on building psychological resilience, social connections, nature connection, building capacity of communities and encouraging climate action.

Evaluated interventions measured a wide range of outcomes including improved wellbeing, improved ability to cope and relief from psychological disorders.

Evidence of co-benefits and risks for mental health and wellbeing from climate action

Climate action can lead to improved mental health and wellbeing through addressing some of the social determinants of mental health such as financial security and quality housing. Key areas for action include **energy efficiency measures**, which can improve financial security and general physical health, **active transport measures**, which can improve mental health through increased physical activity and greater social participation, and **nature-based**

climate solutions, which can improve mental health and wellbeing through increased physical activity, nature connection and a greater sense of community.

1.3 Lessons for policy in Scotland

Our review suggests that action to address the mental health and wellbeing impacts of climate change should focus on lessening the frequency and severity of hazards and managing the severity of their impacts. In general, responses should consider **reducing exposure and vulnerability to hazards** through adaptation and mitigation, **increasing access to resources and support** to recover from climate related hazards, and **targeting support** at the most vulnerable groups.

To reduce eco-distress, the findings support government **taking visible action** in relation to adaptation and mitigation that is **clearly communicated** to the public and that seeks to **harness public concern about climate change** to support climate action.

Finally, **monitoring the prevalence and distribution** of climate-related mental health and wellbeing effects and **evaluating interventions and adaptations** to address these, could help better understand the level of need and what best can be done to address this.

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2 Glossary

Biodiversity	The variety of plant and animal life in a particular habitat. A high level of biodiversity means that there is a wide variety of plant and animal life.
Causal pathway	A sequence of events or processes through which an initial cause leads to a given outcome.
Causal relationship	A connection between two factors or events, where one leads to the occurrence or change of another.
Climate change related hazard	Climate-related physical event or trend that is more likely or severe due to the changing climate and may cause damage and loss. These include acute weather events, sub-acute weather events and chronic climate changes.
Climate Change	Long-term shifts in temperature, precipitation patterns, and other aspects of Earth's climate, largely driven by human activities such as burning fossil fuels, deforestation, and industrial processes.
Climate Crisis	The urgent threats posed by the irreversible consequences of climate change, whether environmental, social, political, cultural, or environmental in nature.
Ecological Crisis	The destabilisation of a species or population owing to changes to the environment in which it lives, which threatens its survival.
Ecosystem	A community of living organisms, interacting with one another and their environment to function as an interconnected system.
Eco-distress	The wide range of emotions and thoughts people may experience when they hear bad news about our planet and the environment (Please see section 4.5.1 for review findings about the definition of eco-distress).
Emotional/Psychological distress	The unpleasant and difficult emotions or feelings a person experiences when they are overwhelmed.
Evaluation	A systematic process to judge the merit, worth or significance of an intervention by combining evidence and judgement.
Evidence/literature review	A comprehensive and methodical summary of existing research and publications on a specific topic. In most cases it is analytical, and is used to identify trends, gaps, and key findings.
Mental Health	A part of our overall health, alongside physical health, experienced daily; good mental health means realizing our full potential, feeling safe, secure, and thriving in everyday life.
Mental illness	A health condition that affects emotions, thinking, and behaviour, substantially interfering with or limiting life, and if untreated, impacting daily living, work, and relationships (WHO, 2022a). May be referred to the now outdated term, mental 'disorder'.

Mental wellbeing	Our internal positive view that we are coping well psychologically with the everyday stresses of life, working productively, feeling happy, and living our lives as we choose.
Meta-analysis	A type of evidence review that carries out statistical analysis about the body of evidence on a given topic, comparing different studies to identify inconsistencies and discrepancies.
Narrative Review	A type of evidence review that summarises different primary studies from which conclusions may be drawn in a systematic way and from a holistic point of view.
Physiological	Concerning the way in which a living organism or bodily part functions when it is healthy.
Qualitative	Research or analysis that focusses on understanding the subjective characteristics, meanings, and experiences of a given subject.
Quantitative	Research or analysis that focusses on measuring numerical data to identify patterns, relationships, or trends in a subject.
Systematic review	A type of evidence or literature review using a highly structured methodology, which looks to answer a specific research question, offering an analysis of the existing research and publications.
Trauma	A deeply distressing or disturbing experience that overwhelms an individual's ability to cope, often having lasting emotional, psychological, or physical effects.
Unvalidated measures/ scales	Questionnaires that measure specific attitudes, behaviours, or psychological attributes that have not been through the process of validation
Validated measures/ scales	Questionnaires that measure specific attitudes, behaviours, or psychological attributes that have been rigorously tested using both qualitative and quantitative methods to demonstrate that they reliably measure the construct they intend to.
Vulnerability	The characteristics of individuals and groups that influence their potential to experience poorer mental health and wellbeing from exposure to a climate change related hazard.
Weather event	A natural phenomenon that occurs in the Earth’s atmosphere that has significant impacts on the environment and human activities. This can include storms, hurricanes, tornadoes, heatwaves, and droughts.

3 Introduction

3.1 Context for the study

Scotland's climate is already changing. It has become warmer and wetter over the last two decades with changes projected to intensify in the coming years (UK Climate Risk, 2021). As the Scottish National Adaptation Plan 2024-2029 states (Scottish Government, 2004): "Climate change means that Scotland will be wetter in winters, drier in summers, sea level rise will continue, and our weather will become more variable and unpredictable. Extremes will be more common".

While there is a substantial body of scientific literature on the damaging effects of climate change on physical health (e.g., Costello et al. 2009; Rocque et al. 2021), the mental health and wellbeing effects of climate change remain comparatively under-explored. This is despite the growing recognition that climate change can have a significant impact on mental health and wellbeing (Vigo et al, 2016). The Intergovernmental Panel on Climate Change (IPCC) and the World Health Organisation (WHO) have both highlighted the risks climate change presents for mental health and wellbeing and have called for greater understanding of these issues and the evidence around the impact of mitigation and adaptation strategies on mental health and wellbeing (Vigo et al, 2016).

Scotland continues to develop a range of responses to the impacts of climate change, built around their national adaptation plan, Climate Ready Scotland 2019-2024, and its successor. This plan already acknowledges the mental health and wellbeing impacts of a changing climate in terms of the risks to the general population and how to support vulnerable groups, as well as the readiness of services to meet the emerging needs. Scotland's Climate Change Plan 2018 – 2032, which sets out Scotland's approach to reducing its greenhouse gas emissions and achieving its Net Zero goal, also emphasises the importance of supporting population wellbeing and health throughout the necessary transformations. These strategies are supported by Scotland's Just Transition plan, which sets out a vision of how the transition to net zero and climate resilience can be done in a fair way that reduces existing health inequalities.

3.2 Research aims

Our research has been conducted to support the Scottish Government in developing its adaptation and mitigation plan for climate change. We have done this by reviewing the latest available evidence on how climate change affects mental health and wellbeing, which groups are particularly vulnerable to these effects, and what steps can be taken to mitigate and protect against the worst impacts. Specifically, we answer four research questions:

1. What is the evidence of climate related risks and impacts to mental health and wellbeing in Scotland, and how these might differentially affect population groups?
2. How is 'eco-distress' (including 'eco-anxiety') currently defined, what is the current/potential prevalence in Scotland and how might this differentially affect population groups?

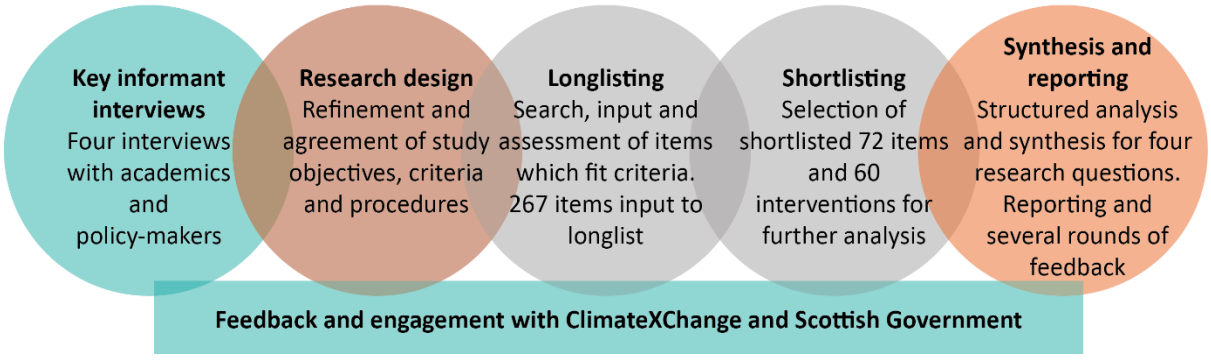
3. What is the evidence on effective prevention and early intervention, and on responding to mental health and wellbeing risks and impacts in a climate change context in Scotland?
4. What is the evidence of co-benefits and risks, or unintended consequences, for mental health and wellbeing from climate action (both mitigation and adaptation) relevant in a Scottish context?

3.3 Methodology

This rapid evidence review (RER) was conducted between February and July 2024. A rapid evidence review is a type of systematic review which takes place over a relatively short period of time. Rapid reviews are accelerated by focused research questions, scope restrictions, and a narrower search strategy (Smela, 2023; Klerings et al., 2023). Given the research had four broad research questions and a limited time frame, our rapid review systematically focused on the most relevant literature with a narrow focus; for instance, secondary effects of climate change, such as climate migration, were not considered as within scope for this review. This allowed us to explore the research questions in depth, though with the limitation that some possible secondary or tertiary effects of climate change on mental health were not within scope.

This review was conducted in five stages: (1) key informant interviews; (2) refinement and agreement of research design; (3) scoping, collating, and assessment of a longlist of relevant literature as per the research questions in Appendix A; (4) collating and assessing our shortlist; and (5) synthesising the results and reporting on them. Appendix A gives a full overview of the methodology which is represented in Figure 1 below.

Figure 1 Process of the Rapid Evidence Review



3.3.1. Research design

We began the review with a scoping stage which had two objectives: to agree the review procedures and to understand the scope of the research through key informant interviews. In total we undertook four interviews, with two policy staff and two academics. The purpose of these interviews was to understand the scope of literature, relevant national policies, contextual factors, and adaptation/mitigation interventions which were less likely to be identified in databases.

The review procedures were agreed during the scoping phase. These set out the longlisting, shortlisting and analysis processes for the study. For longlisting, this included data sources,

search terms, procedures for entering items in extraction spreadsheet, inclusion/exclusion criteria and scoring of items added to the longlist. Whilst the methodology is presented in full in Appendix A, it is worth providing and overview of the principles of the review here to guide the reader. Our team of four researchers were assigned to a research question each. The researchers undertook their reviews in parallel with frequent team meetings. Each researcher used search terms which differed according to the research question. We used four different sources for the search terms: academic search engines, generic search engines for grey literature, Scottish and other government websites, and references of relevant documents including documents referred to by experts. Each relevant item found was input to a shared database, and each item was checked for quality assurance purposes by at least one other researcher. Reviewers also noted which research questions the item was relevant to, since many covered multiple questions.

In terms of the criteria for inclusion, as a Rapid Evidence Review, items were only included if they directly addressed both climate change and mental health/wellbeing. Items were excluded from the long list if they did not fulfil this criterion. Items were scored out of ten on the criteria shown in Table 1 below.

Table 1 Scoring criteria for the evidence review

Criteria	Scoring
Domain relevance	Score 1 if directly addresses both climate change and mental health/wellbeing. Exclude if criterion is not fulfilled
Recency	Score 1 if from 2015 or later
Geographical relevance	Score 2 if study in Scotland, score 1 if in the rest of the UK
Addresses target group	Score 1 if addresses vulnerable groups
Primary evidence	Score 1 if the item included high quality primary evidence
Scoping review	Score 2 if the item was a scoping review, literature review, or systematic review
Research gap	Score 1 if this item addresses emerging research gap
Direct relevance	Score 1 if directly addresses a research question

The longlisting process resulted in 267 items being scored and considered for further analysis. Most items were recent, with 87 percent of items written since 2015. 45 percent of the items were either a systematic or a scoping review. The majority of studies were not Scotland specific, with only 34 items (13 percent) concerning Scotland directly. Items were scored 0-10 according to these criteria and, in total, 55 items scored 7 or above.

Following the scoring process, each researcher filtered the longlist for studies that related to their specific research question and then selected the most relevant items for their purposes. This process led to a total shortlist of 72 items for Research Questions for 1,2 and 4, which can be seen in Appendix C. The unit of analysis for Research Question 3 differed from the rest of the study, being concerned with interventions (programmes, policies, and practices) that have been delivered to support mental health/wellbeing in the context of climate change. Literature from the longlist was extracted to identify relevant interventions, resulting in a list of 60 interventions relevant to Research Question 3, which can be viewed in Appendix D.

In the analysis phase, we conducted a shortlist analysis for each research question. We scanned each item in the shortlist manually, and iteratively developed a classification framework and coding constructs to ensure that each finding was directly derived from the literature and traceable. This helped us to develop themes for each domain to understanding relationship between themes for each research question. Our classification frame and set of constructs were added to and modified as new material came to light. Following synthesis and reporting, the report underwent a series of feedback and revision cycles, to address concerns from multiple stakeholder groups.

3.4 Describing the field

3.4.1. Defining mental health and wellbeing

In answering the research questions, we have adopted a broad definition of mental health and wellbeing, encompassing a range of concepts, including 'mental health', 'mental wellbeing', 'mental disorder,' and 'mental illness.'

In its broadest sense, mental health refers to an aspect of overall health that includes our emotional, psychological, and social wellbeing. It describes how we think, feel, and act, how we cope with challenging situations, how we relate to others, and how we generally function in our lives. Good mental health and wellbeing is understood to be more than simply the absence of mental illness. Good mental health is a positive psychological state of functioning well in the world (WHO, 2022b).

We drew on the current Scottish Government definitions as set out in the 2023 Mental Health and Wellbeing Strategy (Scottish Government, 2023). These suggest:

- Mental health is a part of our overall health, alongside our physical health. It is what we experience every day, and like physical health, it ebbs and flows daily. Good mental health means we can realise our full potential and feel safe and secure. It also means we thrive in everyday life.
- Mental wellbeing is our internal positive view that we are coping well psychologically with the everyday stresses of life and can work productively and fruitfully. We feel happy and live our lives the way we choose.
- Mental illness is a health condition that affects emotions, thinking and behaviour. Mental illness substantially interferes with or limits our life. If left untreated, mental illnesses can impact daily living, including our ability to work, care for family, and relate and interact with others (WHO, 2022a).[1]

The impact of climate change on mental health and wellbeing can be seen in several ways: the overall population may have poorer mental health and wellbeing, those with existing mental health conditions may deteriorate, or more people may develop mental illnesses. We have found variation in the literature we reviewed, both in terms of the focus of different studies and the terminology they used to describe mental health. Some studies focused on the impact of climate change on clinical diagnosis such as Major Depressive Disorder (MDD) or PTSD. Others described effects on this wider conception of mental health

[1] This source suggests that common mental illness and mental disorders include Anxiety Disorders, Depression, Bipolar Disorder and Post-Traumatic Stress Disorder (PTSD)

and wellbeing that encompasses general life satisfaction, and social and emotional functioning. Where we draw on evidence from studies focused on a specific or narrow aspect of mental health, we state this in the text.

3.4.2. Wider determinants of mental health

An individual's mental health is shaped by a wide variety of contextual factors. These are often referred to as the 'social' or 'wider determinants' of mental health (Allen et al, 2014). These are defined as:

> "…the set of structural conditions to which people are exposed across the life course, from conception to death, which affect individual mental health outcomes, and contribute to mental health disparities within and between populations." (Kirkbride at al., 2024)

These determinants operate at individual, social, and societal levels. This includes an individual's social relationships and networks, their living conditions, income, education, employment status, as well as wider factors such their exposure to inequality or discrimination. These wider determinants can act as risks or protective factors in relation to mental health. For example, mental health is protected by secure housing, stable employment, and supportive social networks. Mental health is put at risk by poverty, unemployment, social isolation, and exposure to trauma. We acknowledge the wider determinants of mental health to help explain why some groups within society are at greater risk of poor mental health than others (WHO and Calouste Gulbenkian Foundation, 2014.). This report explores these determinants in the context of climate change.

3.4.3. Climate change related hazards

When describing the mental health impacts of climate change, the scientific literature tends to distinguish between different types of climate change related hazards. These are the impacts of climate change that people are most likely to encounter and therefore are most likely to have an impact on their mental health. Major reviews in this field (Charlson et al, 2021; Hayes et al. 2018; Manning and Clayton, 2018; Cianconi et al, 2020) demonstrate a high level of consensus on the classification of these phenomena, dividing them into three categories based on their duration in time:

1. 'Acute' (or 'extreme') weather events such as floods, wildfires, storms, and hurricanes (lasting days or weeks)
2. Sub-acute weather events, including droughts and long-periods of high temperatures (lasting months or years)
3. 'Chronic' climate changes such as loss of habitat and biodiversity, sea-level rises, coastal erosion, and permanently higher temperatures (lasting centuries)

3.4.4. Major climate related hazards in Scotland

Of these hazards, the third UK Climate Change Risk Assessment (CCRA3) highlights flooding, overheating, and coastal change as the most severe climate risks for Scotland. Increased winter rainfall and heavy rainfall events make flooding a major threat, impacting communities and infrastructure, with vulnerable populations at greater risk (UK Climate

Risk, 2021). High temperatures pose risks to health and wellbeing due to overheating which are known to disproportionately affect vulnerable groups such as care home residents (UK Climate Risk, 2021). Loss of and change to coastal areas due to rising sea levels threatens 19 percent of Scotland's coastline within 30 years, posing significant risk to coastal communities and essential infrastructure.

3.4.5. Defining causal pathways between climate change on mental health and wellbeing

Several evidence reviews in this field highlight that the relationship between climate hazards and mental health and wellbeing outcomes is complex and multi-faceted. These reviews found many pathways through which each hazard disrupts the conditions that support good mental health and wellbeing (Lawrance et al, 2020). These effects occur by disrupting the conditions for positive physical health, for positive social relationships, and for economic and political security.

Most major reviews adopt and build on the conceptual framework for these pathways. This framework, first proposed by Berry, Bowen, and Kjellstrom (2008) and Fritze et al. (2008) aimed to differentiate the causal relationships into 'direct' and 'indirect' effects of climate events through disruption to the determinants of mental health. Subsequent reviews argue for the inclusion of a third pathway that is understood to result from psycho-social and emotional response to climate change **awareness** rather than experience of events. This third pathway has latterly been described as 'overarching' (Hayes et al. 2018) and is commonly described as 'climate' or 'eco-distress'.

More recently, some authors have also argued for the direct/indirect frame to be understood as a continuum, ranging from more direct to more indirect (Lawrance et al. 2022). An explanatory figure for the direct-indirect continuum is provided in Appendix B. For this report, the causal relationship between climate change and mental health includes:

1. Direct causal pathways:
    - via traumatic events (such as risk to life, injury, or witnessing injury)
    - loss of or damage to property
    - via physical health such as the effects of high temperature
2. Indirect causal pathways:
    - via effects on food supply and diet, increased risk or spread of infectious diseases
    - via community wellbeing (such as effects on livelihoods, economic and social functioning, service disruption, poverty, isolation, bereavement, and displacement)
3. Overarching psycho-social response to climate change awareness (climate or eco- distress):
    - A type of indirect pathway related to how people respond psychologically and emotionally to the fact of climate change and news/information about its effects

While conceptualising causal pathways in this way is helpful to demonstrate the full range of possible mental health effects of climate change. In real world scenarios, single events may have both direct and indirect effects on mental health as well as increased eco-distress over

time. For example, a flood can cause injury and trauma immediately and lead to longer term economic disruption to local businesses, and increased anxiety about climate change more generally for those caught up in the events.

Given the wide range of factors that influence mental health, and the range of pathways through which climate change interacts with these, many authors stress that the effects of climate change are not distributed equally across populations. Certain groups are especially vulnerable to its mental health impacts. They describe climate change variously as an 'exacerbator' (Berry et al, 2010) 'amplifier', or 'multiplier' (Lawrance et al. 2022) of risk. This means that climate change related hazards interact with existing vulnerabilities to poor mental health such as deprivation, marginalisation, poor health, or existing mental health problems to create greater negative effects for some groups.

3.5 Report structure

The report is structured in line with the research questions. Chapter 4 addresses both Research Questions 1 and 2 as these both focus on the impact on climate change on mental health, its prevalence in Scotland, and an analysis of vulnerable populations. Chapter 5 addresses Research Question 3 with an analysis of available evidence on effective measures to mitigate negative mental health outcomes. Chapter 6 addresses Research Question 4 about the co-benefits and unintended mental health effects of climate action more generally. Chapter 7 contains the conclusion of our review including a section on policy implications.

3.6 Limitations of the study

We drew on aspects of systematic review methodology in the identification and appraisal of relevant evidence. However, given the breadth of the research questions, the quantity of potentially relevant evidence, and the time available to conduct the review, this paper is not a systematic review. We therefore acknowledge the risk that some key evidence on these topics may have been missed by our search and appraisal procedures.

This report is based predominantly on UK and international literature (rather than being specific to Scotland) that draws its findings from the study of climate change and mental health in different countries and geographies around the world. Inevitably, some of these studies are more relevant than others to a Scottish context. Through our appraisal process we have sought to identify evidence from settings that share similar features to Scotland, in terms of climate, populations demographics, and social and political context, for example particularly drawing on studies based in the UK and Northern Europe. However, it remains a possibility that research evidence quoted in the report from other regions is not fully applicable to Scotland. The literature reviewed is provided in Chapter 12: References.

The researchers note that in the international literature reviewed, the terms such as mental health, mental illness, wellbeing are defined in different ways, with occasional conflation of clinical mental illness and negative impacts on wellbeing. Where possible we refer to the definitions set out in the Scottish Government Mental Health Wellbeing strategy but urge the reader to proceed on the basis of a broader understanding of the range of concepts as set out in 3.4.1.

4 Climate related risks and impacts to mental health and wellbeing

Summary of findings from Chapter 4

This chapter addresses two research questions:

1. What is the evidence of climate related risks and impacts to mental health and wellbeing in Scotland, and how these might differentially affect population groups?
2. How is 'eco-distress' (including 'eco-anxiety') currently defined, what is the current/potential prevalence in Scotland and how might this differentially affect population groups?

Evidence of climate-related risks and impacts to mental health:

We found strong evidence that links climate change to increased mental health risks. Scotland specific studies focus on the impacts of flooding.

- Scotland's main climate change-related hazards are flooding, higher temperatures, and coastal changes due to sea-level rises.
- Each of these hazards can lead to various negative mental health outcomes. These can happen through direct pathways (injury, traumatisation, property loss) and indirect pathways (impacts diet, livelihoods, social networks, or displacement).
- The negative effects on mental health have a wide range in their severity depending on the nature of the hazard and the degree of disruption caused.
- Vulnerable groups are disproportionately affected by these effects. These include older people, children, women, ethnic minorities, individuals with low-income, those with pre-existing conditions, coastal and island communities, and workers in agriculture and fisheries.

Definition and prevalence of 'eco-distress':

Eco-distress (including eco-anxiety) is a psychosocial response to the awareness of climate change.

- There is currently no consistent definition for eco-distress in published literature. We found definitions ranged from any distressing psychological response to climate change, to a narrow focus on specific severe responses.
- Common themes in eco-distress are (a) its future-oriented nature, (b) association with feelings of uncertainty and being overwhelmed, and (c) its rationality as a response to an existential threat. Eco-distress can lead to positive, pro-environmental behaviours.
- Early evidence indicates that distress about climate change is widespread. As many as 70 percent of Scottish people worry about climate change, with 25 percent reporting it affects their mental wellbeing.
- Eco-distress is associated with certain sub-groups, including youth, people with pre-existing mental health conditions, and being a member of a marginalised group.

4.1 Introduction

In this chapter we present the available evidence on links between climate change and mental health. We divide this into two parts: Section 4.2 and 4.3 address Research Question 1 and describe the current evidence about 'direct' and 'indirect' impacts of climate change related hazards on mental health. Section 4.5 addresses Research Question 2 and focuses on the nature of psycho-social responses to an awareness of climate change, what is often described as 'climate anxiety, 'climate distress', or 'eco-emotions.' Here we outline the current state of research in relation to these emerging concepts, their definitions, their measurement, and research gaps.

4.1.1. Methodology

We undertook content analysis of the material related to Research Questions 1 and 2 through the 'inspection' method. We read the material manually to create a classification framework that logged each item by name, source, and summary of the content. Each item was then analysed across three dimensions: themes, constructs, and codes. We highlighted evidence particularly relevant to Scotland, research examining Scottish or UK populations; relating to common climate change hazards in Scotland (e.g., flooding); or from similar climatic, geographical, or social/governmental contexts.

Our searches in relation to Research Questions 1 and 2 revealed a high number of primary research outputs accompanied by a growing amount of literature and evidence reviews that summarise the overall state of the field. We focused our analysis on the most recent and most highly cited literature and evidence reviews, supplementing review findings with reference to original studies or additional evidence where useful.

The reader should note that the evidence identified for this section is drawn from international and UK literature and therefore caution should be taken in applying directly the lessons from other geographies to a Scottish context. To aid with this we have marked throughout the section where evidence in international or Scottish/ UK based.

4.2 Direct effects of climate change on mental health

We found strong evidence[2] of the direct effects of climate change impacts on mental health outcomes drawn from research conducted around the world. These occurred through the increased likelihood of experiencing traumatic events as the result of extreme weather events, or through the direct physiological effects of increased higher temperatures.

As we described in Section 3.4.5, some climate events, including flooding, have both direct and indirect mental health effects (i.e., can cause both injury and loss of property in the short run and impact livelihoods or social networks in the longer-term). The types of events examined in this section are those identified in the literature as causing, as a first step,

[2] E.g., substantial numbers of high-quality research papers linking climate change impacts (such as flooding, wildfires, increased temperatures) to poorer mental health outcomes (such as increased risk of mental disorders, suicide, or poorer mental wellbeing).

direct mental health impacts, though in most cases they will have both direct and indirect effects.

4.2.1. Flooding

Flooding is the most common extreme weather event globally, accounting for 47 percent of all weather-related disasters (CRED, 2015; CRED, 2019).

4.2.1.1. Scottish context

A recent comprehensive review of climate risks in Scotland states that flooding is among the most severe risks (UK Climate Risk, 2021). Winters have been 19 percent wetter in the last decade (2010-2019) compared to 1961-1990 with a rising proportion of rainfall coming from heavy rainfall events (UK Climate Risk, 2021). Flooding poses a risk to people, communities, buildings, infrastructure, and businesses. In the coming decades, flooding in Scotland is likely to be more frequent and more severe (UK Climate Risk, 2021). It is also likely to affect food availability, affect agriculture and food production, cause damage to cultural heritage assets, and impact ecosystems. A study on the public awareness of climate risks in Scotland showed that flooding was also seen as one of the most urgent weather-related problems. In a nationally representative survey of the Scottish public, 51 percent of respondents indicated that flooding is already a serious problem (Millar et al, 2022). We know from the CCRA3 (UK Climate Risk, 2021) that those living in the Glasgow City Region, coastal areas, and rural communities are most likely to be at flood disadvantage. This is the result of a combination of flood risk due to where people live and wider social vulnerabilities.

We found that flooding in the UK has been extensively studied over the last 10 years providing high quality, relevant evidence for a Scottish context. A narrative review and meta-analysis of the effects of flooding in the UK found that flood victims show higher levels of common mental health problems compared with the wider public, displaying higher rates of PTSD and anxiety disorders (Cruz et al, 2020). The meta-analysis found flood victims were up to four times as likely to report long-term mental health problems, including PTSD, and anxiety, compared to the general population. We do not know what the mental health status of individuals was prior to the flooding event or that of other individuals living in a similar area but not exposed to flooding.

Flood victims also reported relationship difficulties, and sadness around ‘a loss of a sense of place and security’ after loss of or damage to possessions (Cruz et al, 2020). These issues often persisted in the long-term (sometimes years after the floods) with flood victims more likely to report anxiety during heavy rain, which was associated with heightened stress, poor sleep, panic attacks, mood swings and increased use of alcohol or prescription drugs. Physical health problems linked with the flooding (such as waterborne diseases) were also associated with psychological distress (Cruz et al, 2020).

A study in Scotland on the floods in Ballater and Garioch in 2016-17 (Margaret, Philip, and Dowds, 2020) supported these findings. This study used a validated measure of wellbeing (Short Warwick and Edinburgh Mental Wellbeing Scale) at two time points to track the wellbeing of those affected by flooding in combination with interviews. This found that those whose homes had been flooded had significantly lower mental wellbeing immediately after the floods than those from the same areas whose homes had not been. While both

groups' wellbeing improved as time went on, those whose homes had been flooded continued to lag at the 18-month follow-up. In this follow-up, the findings showed that that the communities of Ballater and Garioch were still grappling with emotional repercussions following the floods. Residents, even those whose homes were not flooded, continue to experience high levels of anxiety, particularly triggered by rain and flood warnings. Interviewees reported sleep disturbances, increased stress, and worsened health conditions. The stress of dealing with insurance claims, home renovations, and financial burdens compounded these impacts. These findings highlight the long-lasting negative impact of flooding on mental wellbeing.

4.2.1.2. Vulnerable groups – UK context

We found that several factors worsened the mental health impacts of flooding. These included: the flood water depth; lack of flood warning; repeat flooding; evacuation and/or temporary rehousing, and disruption to domestic utilities. Each of these factors led to higher rates of anxiety, depression, and PTSD. As well as this, issues with home or property insurance were associated with greater stress levels and difficulties recovering from the flood, either from being uninsured or facing difficulties claiming insurance. The review also noted that when little support arrived from relevant authorities, this also led to poor mental health outcomes (Cruz et al, 2020).

In keeping with the factors above, the meta-study found that the severity and duration of the mental health impact of flooding varied between different groups of people (Cruz et al, 2020). This depended on their susceptibility to harm, their (in)ability to prepare, respond, and recover, and their access to resources, services, and support. Women's mental health was affected more severely than that of men, people under 65 years old experienced greater psychological distress than those over 65, and those from higher income groups reported lower levels of poor mental health in the long run than those from lower income groups. The CCRA3 also highlights the particular risk to those with mobility difficulties, and black and Asian people (UK Climate Risk, 2021).

4.2.2. Temperature - International

In their recent review of evidence quality and gaps, Charlson et al (2021), found that temperature was the most studied climate-change related hazard in international literature, identifying 27 original studies of the relationship between temperature and mental health. These studies focused on hazards of extreme heat (heatwaves) and longer-term increases in ambient temperature. Both higher ambient temperatures and extreme temperatures have been found to impact mental health and wellbeing negatively, showing associations to poorer mental health in the general population (Charlson et al. 2021). These effects occur through physiological impacts, such as overheating and dehydration, leading to cognitive changes, heat stress, sleep disruption, and worsening cardiovascular disease and pre-existing conditions (Berry et al, 2010). This international study also found that rising temperatures can be associated with a general increase in aggression. A recent analysis found "increasing evidence that is suggestive of a relationship between temperature and violence at the population level" which sees increases in the frequency of both interpersonal violence and intergroup conflict as temperature exceeds local seasonal norms (Mahendran et al, 2021). Increased temperatures may also reduce people's capacity to

undertake manual tasks and increase the risk of accidents. This can result in injury or loss of income which both have negative mental health impacts (Berry et al, 2010).

International evidence also suggests that increased ambient temperatures are associated with increased death by suicide. Several recent meta-analyses concluded that each 1°C increase in temperature (above local norms) was significantly associated with a between 1-1.7 percent increase in the incidence of suicide with those living in tropical or temperate zones more vulnerable (Gao et al, 2019; Thompson, et al, 2023). However, caution in interpreting these findings is urged due to the finding that this link was not always linear, varied between countries, and was influenced by factors such as humidity and sunlight (Ngu et al. 2021). Heatwaves have been found to be associated with increased hospital admissions for mental illness. In Thompson et al.'s (2023) meta-analysis, heatwaves (defined as temperatures of at least 35°C lasting for at least 3 days) were correlated with a 9·7 percent increase in hospital attendance for mental illness when compared with periods of non-heatwave in three studies in Australia and Vietnam.

4.2.2.1. Scottish context

Historically, overheating and rising temperatures have not been perceived to be major threats in Scotland. Ready.scot, informed by the Met Office, defines a heatwave in Scotland as a period of at least three consecutive days in a location with maximum temperatures above 25°C. However, a recent paper on heat-health management in Scotland, argued that while Scotland has historically had low average temperatures, climate change driven increases in temperature still present challenges for the physical and mental health of the nation. The paper noted that Scotland's low average temperature present "socio-cultural barriers to intervention" including a "perceived lack of heat-health risks and policy priority, as well as unsuitable building stock" (Wan et al, 2023). Indeed, some studies on effects of temperature have used a relative measure of extreme heat that considers the regional temperature norms. For example, heatwaves can be defined as a minimum daily temperature in that exceeds the 99th percentile for the region (Chambers, 2020) meaning that in colder countries a lower temperature may still be considered extreme.

As the CCRA3 demonstrates, along with flooding, rising temperatures are one of the most severe climate change risks for Scotland now and in the future. The ten warmest years on record have all occurred since 1997, with annual temperatures expected to rise by 1.1°C by the 2050s, leading to an increase in average ambient temperature and greater frequency and severity of extreme heatwave events nationally (UK Climate Risk, 2021). Despite this trend, there is limited evidence of the effects of increased ambient temperature and heatwaves on population mental health in Scotland or in the wider UK. However, as part of the above international study on suicide and temperature, Kim et al (2019) investigated UK records between 1990-2011. They found a near linear increase in suicide rates associated with increases in ambient temperature with the highest risk of suicide recorded when temperature reach the 99th percentile of national norms (Kim et al, 2019). In relation to the effects of heatwaves, a 2018 review of the effects of extreme weather on mental health in the UK identified only one paper specifically addressing heatwaves and was therefore unable to draw comprehensive conclusions.

4.2.2.2. Vulnerability – UK and international

High temperatures are likely to have an effect on health and social outcomes (UK Climate Risk, 2021). The evidence reviewed for this paper found that the groups most affected by heat are those with 'impaired thermoregulation' and those unable to access cooler spaces, such as people in care homes, hospitals, and prisons. This group includes the elderly and those with substance abuse problems, and particularly those with pre-existing mental health problems on certain prescription medications (including hypnotics, anxiolytics, and antipsychotics) that can affect the bodies ability to regulate temperature (Hayes et al, 2018; Liu et al, 2021). Higher temperatures have been found to be associated with worsened mental health for people with existing mental health issues. International studies have shown that, during heatwaves, hospital admissions increase for mental health conditions such as schizophrenia, dementia, mania, so-called 'neurotic disorders', and substance misuse (Hayes et al, 2018). Internationally, heatwaves have also been shown to significantly increase mortality risk for individuals with mental illnesses which again appears to be partly due to medications impairing the body's temperature regulation (Lawrance et al. 2022).

Relevant reviews have concluded that there is limited evidence of the impact on increased temperature and heatwaves on more common mental health issues such as depression and anxiety and have encouraged further investigation (Thompson et al, 2018). The other groups most affected include people of colour, members of deprived and marginalised communities, those living in insecure housing, people experiencing homelessness, and prisoners owing to reduced access to air conditioning, tree cover or green spaces (Lawrance et al, 2022; UK Climate Risk, 2021).

4.2.3. Wildfire - International

In its three-year strategy, the Scottish Wildfire Forum stated that it anticipates a growth in the number and intensity of wildfires year by year (Scottish Wildfire Forum, 2021). While there was no research evidence of the wildfires' effects in Scotland we found international evidence that wildfires can negatively affect mental health through several pathways. They negatively impact physical health, particularly through prolonged smoke inhalation, which can lead to respiratory problems. This can affect mental health and wellbeing as poorer physical health is known to be strongly associated with poorer mental health (Ohrnberger et al, 2017). Wildfires also disrupt social and community functioning through displacement and evacuation. Wildfires can directly affect psychological health by causing traumatic events, feelings of fear, stress, and anxiety, all of which contribute to severe, long-term negative impacts on mental health (Charlson et al. 2021). For example, a six-month follow-up after a particularly severe wildfire in Canada found those affected had an almost eight times higher rate of Generalised Anxiety Disorder (GAD) than the general population (Agyapong, et al. 2018). These effects are compounded by increased periods of time spent indoors due to smoke, and general disruptions to lives and livelihoods, with a negative impact on earnings associated with greater psychological distress (Agyapong et al, 2018). Caution should be taken in applying these findings directly to Scotland given the magnitude of wildfire events in Canada are much greater than in Scotland.

4.3 Indirect effects on mental health

We found that over the past two decades there have been substantial developments in the conceptualisation and evidence of the indirect impacts of climate change on mental health internationally. However, these pathways are still less well understood than the direct effects. This is due to the increasing complexity of the causal pathways in this category. Indirect pathways involve a larger number of steps between cause and effect. Some evidence reviews, when addressing this topic, describe 'potential' or 'likely' mental health effects of climate change, drawing on illustrative research evidence to build a picture of how these effects operate. For example, Lawrance et al (2022) propose a model whereby climate change is understood to have a destabilising effect on political, governmental, and cultural domains of society. This destabilisation causes 'cascading effects,' disrupting living and working conditions, community networks, physical health, and inequalities (Lawrance et al, 2022).

4.3.1. Drought - International

We found no direct evidence of the impacts of drought on mental health in Scotland or the UK. However, drought has been extensively studied in Australia. The key finding from these studies is that drought affects mental health through a range of pathways. By affecting both food and water supplies, it is associated with higher levels of psychological distress in rural communities, with urban areas less affected. Drought is particularly associated with negative mental health effects on farmers due to their reliance on the land for their livelihoods. The economic consequences of land degradation, crop loss, and reduced yield result in high levels of stress and potential increase in risk of suicide among farmers (Hayes et al. 2018). Factors exacerbating psychological distress associated with drought include unemployment and prior exposure to adverse life events. Conversely, negative mental health effects are reduced by factors such as financial security, access to social support (Charlson et al. 2021).

4.3.1.1. Scottish context

While we cannot directly transfer the findings from an Australian context to a Scottish one given the different geographies, the likely economic and social disruption of increased droughts in Scotland can be predicted to impact the mental health and wellbeing of communities dependant on the land for work. A recent NatureScot analysis projects extreme droughts will become more frequent and prolonged across Scotland in the coming years, increasing from an average of one event every 20 years (in the period 1981-2001) to one every three years by 2021-2040, with typical events each lasting 2-3 months longer (Baird et al, 2021). The authors anticipate the greatest increases in the eastern regions, including the Borders, Grampian, Caithness, Orkney, and Shetland. These areas are home to substantial economic activity vulnerable to drought, including the whisky industry in Speyside, extensive areas of agriculture and forestry and a rural population dependant on wells as water sources (Kirkpatrick et al, 2021).

4.3.2. Biodiversity - International

Climate change is an ongoing driver of biodiversity loss, which is expected to negatively affect mental health (Lawrance et al. 2022). This impacts population groups that depend on biodiversity for their livelihood, such as agricultural workers that rely on the pollination of

insects (Vasiliev and Greenwood, 2021) and those who work in fisheries. For example, the North Sea has experienced significant decreases in the maximum sustainable yield of fish populations over the past 25 years, linked to warmer seas and reduced food availability (Pinnegar et al, 2020). Reductions in and uncertainty around yields from agriculture and fisheries can affect those working in these industries both by reducing income, increasing the likelihood of unemployment, and raising stress and anxiety.

More broadly, nature connectedness and time spent in biodiverse environments are both strongly correlated with positive mental health (Lawrance et al. 2022). A key evidence review on the relationship between human health and wellbeing and nature and biodiversity found a number of psychological benefits of access to biodiverse settings, including reduced depression and anxiety, increased vitality, pro-social behaviour and life satisfaction (Sandifer et al, 2015). Therefore, through its negative effect on biodiversity, climate change is likely to have detrimental effect on those for whom contact with nature plays a protective role in their mental health (Sandifer et al, 2015). Conversely, where climate action increases or restores biodiversity there will be a likely positive effect on mental health and wellbeing (discussed in Chapter 6). Again, access to 'high quality' green space is not equally distributed, with especially deprived urban communities having less access.

Awareness of biodiversity loss both locally but also further afield, along with other visible climate change impacts such as floods, may also contribute to an experience of eco-distress by making climate change more salient to people. This pathway between the impacts of climate change and mental health and wellbeing is further explored in Section 4.5 of this chapter.

4.3.3. Air quality - International

Some international reviews on the impacts of climate change on mental health identify air quality as a pathway for climate change to affect mental health. Poor air quality has been found to be associated with increased instances of a range of mental health conditions such as anxiety, psychosis, and dementia as well as increased use of mental health services and rates of suicide. (Sandifier et al, 2015; Lawrance et al., 2022). This is thought to result both from the association between exposure to air pollution and wider socio-economic vulnerabilities and the effect pollutants have on brain function: as Lawrence et al. (2022) states "Air pollution, specifically particulate matter (PM), and nitrogen oxides (NOx), increase the risk of mental health problems, potentially via mechanisms of inflammation and neuronal injury". While the main cause of poor air-quality is the burning of fossil fuels, which is a cause of climate change rather than a consequence of it, increasing global temperatures and wildfires (both climate-change related hazards) can degrade air quality and increase the presence of pollutants and particulate matter in the air (Sandifer et al, 2015, Cianconi et al, 2020).

4.3.3.1. Scottish context

The CCRA3 ranks poor air quality as a medium risk for health and wellbeing in Scotland. While it states that Scotland faces challenges with poor air quality, despite reductions in

emissions and improved pollution control, it acknowledges that the contribution of climate change to these issues is hard to establish and therefore needs further investigation.

4.3.4. Displacement and migration - International

Extended periods of extreme heat, long-term droughts, excessive rain, and loss of coastal land are expected to lead to displacement of populations from their homes and land. Climate change can cause both temporary displacement through evacuations and permanent displacement through physical changes to the environment, such as soil no longer being viable for crops, or loss of coastal land. Estimates of the scale of displacement because of climate change vary widely, with the figure of 200 million people globally being displaced by 2050 most frequently cited (Hayes et al. 2018).

Both temporary and permanent displacement because of extreme weather has been shown to be associated with mental illnesses and poor mental health, including instances of PTSD, depression, anxiety, and stress. (Tunstall et al, 2006; Hayes et al. 2018; Berry et al., 2010).

4.3.4.1. Scottish context

In Scotland, the most likely cause of temporary displacement is flooding, however the most likely cause of permanent displacement is changes to and loss of coastal land. The CCRA3 states that one of the most severe risks is sea levels rising and the associated coastal change. Erosion, landslips, and permanent inundation threaten the long-term viability of coastal communities. It predicts that within the next 30 years, 19 percent of Scotland's coastline is at risk of erosion, which has projected knock-on effects for transport, energy, water, and housing infrastructure, and a knock-on effect on livelihoods and community wellbeing (UK Climate Risk, 2021). Scotland is also renowned worldwide for its coast and coastal wildlife which contribute to national identity as well as tourism. Coastal change is likely to have a considerable impact on this, threatening the preservation of Scotland's cultural heritage. Naturally, coastal communities are most at risk with Falkirk, West Dunbartonshire, Highland and Dumfries and Galloway expected to be most vulnerable to coastal flooding. Moreover, the study on public awareness showed that the increase in concern surrounding climate change was higher than average among respondents in the Highlands and Islands (62 percent). This could be attributed to vulnerability of island communities from extreme weather and coastal erosion (ClimateXChange, 2021).

4.4 Vulnerable groups

Climate change related hazards amplify existing risks for individuals and groups, and further compound existing social injustices and inequalities (McMichael, 2017). Watts et al. state that "by undermining the social and environmental determinants that underpin good health, climate change exacerbates social, economic, and demographic inequalities" (Watts et al, 2018). This means that some population groups are more vulnerable to the mental health effects of climate change than others. Some are more vulnerable in general to poor mental health and therefore to all climate related risks. Such groups include older people, children, women, ethnic minorities, people from deprived and marginalised communities, and people with pre-existing health conditions (Hayes et al, 2018). There are also groups that are vulnerable owing to the specific hazards they are exposed to, such as people living

in areas subject to flooding; people who work in agriculture and fisheries; and outdoor labourers. In a Scottish context this also includes coastal and island communities who are more likely to face disruption to services and infrastructure due to extreme weather events and face a higher risk of displacement in the long run.

These risks are mediated by the ability of individuals and groups to protect against and recover from the harmful effects of climate change. This is largely determined by access to services, resources, and social support. Different groups have varying access to these resources, further compounding risks for the already vulnerable (Berry et al, 2010; Lawrance et al, 2022; Charlson et al, 2021).

The CCRA3 identifies flooding, high temperatures, air quality and coastal change as the four key climate hazards facing Scotland now and, in the future, (UK Climate Risk, 2021). A study on population groups vulnerable to climate change likewise identifies low-income groups; people with poor health; and people living areas with high levels of social and private rented housing, and people from Black ethnic groups as those most at risk (Sayers et al, 2023). While these reports focused on overall risks, rather than just risk to mental health and wellbeing, their findings align closely with the wider literature on mental health vulnerabilities.

4.5 Psycho-social responses to climate change

In addition to the causal pathways described in the previous sections, we found increasing evidence of a pathway which affects the general population's mental health through awareness of the changing climate. This may occur through learning about the risks of climate change via the media or the response to these risks by state actors. The heightened awareness of climate change and its impacts can result in psychological strain. This section examines definitions of eco-distress, its prevalence in Scotland and how it affects different population groups.

4.5.1. Definitions of eco-distress

We found that the emotional and psychological responses to climate change awareness have generated increasing attention and interest in the media and academia. New terms have recently emerged to describe these responses including 'climate anxiety,' 'eco-anxiety,' and 'eco-distress' (Thoma et al, 2021). These terms are often used inconsistently and usually interchangeably in the literature. For the sake of consistency, this report uses the term 'eco-distress' when referring to the broad range of these emotional responses unless otherwise stated.

Eco-distress is a relatively novel term in academic literature. Environmental philosopher Glenn Albrecht (2011) first coined the term "psychoterratic syndromes" in 2011 to describe emergent emotional responses to climate change, including eco-anxiety, eco-grief, and solastalgia. In the past ten years, interest in the topic has grown rapidly. One review found that 80 percent of all published research on eco-anxiety has been published since 2020 (Jarrett et al, 2024). This is prompted by increasing numbers of mental health practitioners, teachers, social workers, and others caring for vulnerable individuals reporting cases of deep

concerns about climate change having debilitating effects on people's daily lives (Charlson et al. 2021).

Despite increasing attention, eco-distress and the range of emotional responses to climate change it refers to are challenging concepts to pin down. There is no clear consensus or set of standard definitions, and the concepts are currently undergoing development (Coffey et al, 2021; Clayton, 2020; Brophy et al, 2022). The scope that different authors cover when using these terms range widely, from a broad concept to more narrow definitions developed for clinical or epidemiological purposes.

In many cases 'eco-distress' and 'eco-anxiety' are used interchangeably to refer to a wide range of difficult emotional and physiological responses that people experience due to their awareness of climate change (Brophy et al, 2022). These include but are not limited to anxiety, grief, anger, despair, depression, hopelessness, and worry (Hickman et al, 2020). This broader use of the term is succinctly captured by the Royal College of Psychiatrists, who synonymously define eco-distress and eco-anxiety as:

> "The wide range of emotions and thoughts people may experience when they hear bad news about our planet and the environment" (Royal College of Psychiatrists, 2021).

Narrower definitions have been introduced when operationalised for specific research objectives. For example, some authors distinguish between 'climate' and 'eco(logical)' distress. They reason that ecological change or crises can occur independently of the climate crisis and that therefore the two must not be conflated (Clayton et al, 2017). Some papers make clear delineations between eco-distress, eco-anxiety, and eco-grief in order to study them as distinct objects of research, objecting to the use of 'eco-anxiety' as an umbrella term to refer to a broad range of emotional responses (Coffey et al. 2021). Others use terms such as 'psychoterratic syndromes' and 'eco-emotions' as umbrella concepts, under which eco-anxiety and other such terms fall (Lawrance et al, 2021; Albrecht 2011).

Greater precision in the definitions of eco-distress and eco-anxiety is often seen in papers approaching the topic from a clinical research perspective, such as examining its potential for being a diagnosable pathology or exploring practical implications for healthcare practitioners (Lawrance et al, 2022). Several authors stress that eco-anxiety in these contexts must be defined as being excessive or debilitating distress, underscoring a common theme in the literature that medicalising or pathologizing eco-anxiety should be avoided on the basis that distress is a rational and healthy response to climate change (Searle and Gow, 2010; Gifford and Gifford, 2016). Despite variation in definitions, some authors have attempted to draw out common definitional features from the literature (Helm et al, 2018). For example, Brophy et al. (2022) identified the following broad common features of eco-distress:

- It is future-oriented and anticipatory, distinguishing it from other forms of environmental distress like solastalgia.
- It is associated with feelings of uncertainty, unpredictability, uncontrollability, and being overwhelmed, accompanied by a range of emotions such as anger, frustration, despair, guilt, shame, grief.

- It should not be regarded as pathological because it is a rational and justified response that can also lead to pro-environmental behaviours and thoughts. Difficult feelings can motivate active engagement and mitigation, with some suggesting that eco-anxiety can be seen as "practical anxiety", highlighting its potentially adaptive nature (Pihkhala, 2020).

4.5.2. Measures of eco-distress

Most of the research papers we reviewed in our study use unvalidated measures to measure the prevalence of eco-distress. Most define and operationalise the concept to meet the needs of their study, particularly when aligning their work with existing measures used in psychology, such as those for anxiety (Lawrance et al. 2022; Clayton, 2020; Laronow, Soltys, and Izdebski et al, 2022). Consequently, researchers must carefully interpret how each study defines eco-distress and the scope of what is being studied.

More recently there have been some notable efforts to develop validated measures for the construct. Early studies include Searle and Gow's 12 item questionnaire to measure what they describe as climate change distress (Searle and Gow, 2010); while Reser et al (2012) developed a survey to measure climate change distress and psychological coping and adaption responses. These measures only examine the nature and extent of emotional reactions to climate change in individuals, but do not measure the relationship between these reactions and a person's emotional wellbeing (Reser et al, 2012). This distinction is important because experiencing emotional distress when learning of climate change is not necessarily unhealthy or harmful, given the possible long-term consequences of climate change in people's lives. Jarret et al. (2024)'s review of empirical research supporting eco-anxiety found a total of nine structurally validated measures that have been developed, of which four have been implemented in an empirical study outside the original work: the Climate Anxiety Scale (CAS), the Hogg Eco-Anxiety Scale (HEAS), the Climate Distress Scale (CDS), and the Climate Change Worry Scale (CCWS) – though, the latter two scales have not to date been implemented widely.

The CAS is the most frequently cited validated measure of eco-anxiety, with 24 papers implementing the scale (e.g., Larionow et al, 2022; Jarrett et al, 2024). It is a 13-item questionnaire used for assessing eco-anxiety as a psychological response to climate change, which draws on a number of existing measures for rumination, environmental identity, and anxiety (Wullenkord et al, 2021; Laronow et al, 2022).

The next most common scale is the HEAS with five studies to date employing this measure. It is similar in its construction to the CAS. However, it has a broader application in that it measures distress about indirect and direct climate change impacts, as well as more localised environmental changes such as habitat change (Hogg et al, 2021). Two additional validated measures have been published in the form of the CCWS, and the CDS, though neither explicitly link the measure of emotional response to a person's wellbeing, instead mapping responses as ranging in 'severity' from low to high (Vercammen and Lawrance, 2023; Leger-Goodes et al, 2023).

While such measures are gaining traction, their application is not widespread. Just as the clarity of definition around the concept of eco-distress can be expected to crystalise as the

body of literature expands, so too can the emergent range of measures of eco-distress be expected to gain greater validation and be more rigorously and consistently implemented across a wider range of populations in the future.

4.5.3. Prevalence and vulnerable groups – Scotland and UK

Concern about climate change is widespread in Scotland and the UK, but the prevalence of eco-distress remains unclear owing to the definitional inconsistencies previously discussed. A Scottish survey found 68% of respondents worried about climate change, with 25% reporting negative impacts on mental health (Andrews et al. 2022). A YouGov tracker in March 2024 showed 60% of Scots were concerned about climate change (YouGov, 2024). Data on public attitudes to the environment and the impact of climate change, Great Britain - Office for National Statistics (ons.gov.uk) reported 75% of UK adults, including 74% in Scotland, were worried. The study found a statistically significant generational difference, with 39 percent of people aged 16-44 feeling this way compared to 12 percent of people aged 45+. Those with existing long term health conditions were also more likely to be affected. Where validated scales are employed the prevalence of eco-distress is relatively lower. For example, a UK study employing the CAS (Whitmarsh et al, 2022) found that only 5% of participants met the threshold for experiencing moderate to high climate anxiety, despite 46.2% being very or extremely worried. Likewise, a UK study using the Climate Distress Scale (Vercammen et al. 2023) found that while 60 percent of respondents experienced eco-distress, only 10 percent experienced it such that it was associated with worse wellbeing outcomes.

4.5.3.1. Young people – Global

Surveys show that distress about climate change and environmental degradation is highly prevalent among children, adolescents, and young adults globally. Measuring the prevalence of eco-anxiety among young people, as opposed to the general population, was the most common demographic focus of the studies we reviewed (Brophy et al, 2022; Hickman et al. 2021). Key findings of a global survey of young people aged 16-25 carried out by Hickman et al (2021) include that 84 percent of respondents globally reported feelings of sadness, anxiety, anger, powerlessness, helplessness, and guilt, with 59 percent reporting being very or extremely worried.

A key finding from our review is that eco-distress is closely linked to a real or perceived lack of agency to respond to the threat posed by climate change. Notably, Hickman et al. (2021) found that eco-anxiety is closely linked to perceived government inaction on climate change. In other words, the perceived failure of governments to adequately respond to the climate crisis is associated with increased distress among individuals. Lawrance et al's (2021) study similarly highlights that young people feel powerless to affect change and feel despondent that those with the power to do so are not. Further, young people have higher exposure to information (e.g. via social media and education about climate change in schools) and so are more aware and knowledgeable about climate change and its consequences. Young people inherently have less agency to affect change (e.g. no financial independence, inability to vote in elections), contributing to a sense of hopelessness.

4.5.3.2. Young people – UK

The UK component of Hickman et al.'s (2021) global survey of people aged 16-25 showed that the climate crisis was a major cause of distress amongst young people, despite it having a relatively small impact on day-to-day functioning and quality of life of respondents. The study found that the global average for eco-distress affecting day-to-day life was 18 percent lower in the UK than the global average (46 percent). However, 28 percent reported that their feelings about climate change negatively affected their daily life and functioning in areas such as eating, concentrating, work, school, sleeping, spending time in nature, playing, having fun, and relationships. Additionally, 73 percent stated that they find the future frightening, and 80 percent believed that people have failed to take care of the planet.

This latter point is further supported by a Savanta-Comres survey commissioned by BBC Newsround that found that 58 percent of the 2000 responding children aged 8-16 were "worried about the impact that climate change will have on their lives", and that a majority felt that climate change was broadly important to them (Savanta-Comres, 2020). The survey also reported that 64 percent of children felt that people in power were not doing enough to address climate change, and that 41 percent did not trust adults to take action (Savanta-Comres, 2020).

There is limited evidence comparing the prevalence of eco-distress to other major national threats to wellbeing experienced by young people in Scotland. Lawrance et al (2021) conducted a UK study of young people aged 16-24 (N=530) looking at psychological responses to COVID-19 and climate change. Despite COVID-19 having a more pronounced reported effect on the day-to-day functioning of young people's lives, climate change was found to have a slightly more pronounced impact on their overall distress. The key distinctions were that climate change elicits feelings of guilt, personal responsibility, and a lack of agency to respond to it, whereas COVID-19 warranted a sense of loss and grief over quality of life.

4.5.3.3. Other groups - international

The body of literature suggests that people in the Global South have a higher prevalence of eco-distress (Hickman et al, 2021). Other groups that have been identified as being vulnerable to eco-distress include racialised communities, immigrants, and people with pre-existing mental health conditions (Cianconi et al, 2023). The evidence base is substantially less robust for these groups, though is concerned with how climate change compounds on existing marginalisation. Vulnerability here does not imply a greater prevalence, rather a higher level of threat posed to such groups as inequalities such as access to healthcare or agency to affect political change diminish these groups' capacity to respond and adapt to climate change (Ciarconi et al, 2023).

4.6 Research and evidence gaps

Research on the relationship between climate change and mental health, while historically understudied, is a rapidly growing field.

Hayes et al. (2017) note a range of methodological challenges in researching this topic. These include the risk of either over or underestimating the mental health impact of climate

change. This is due to the wide range of possible climate change related mental health outcomes, the challenges in understanding the effects of climate events over time, and difficulties in understanding the mechanism by which climate events produce mental health outcomes in the complex context of the wider social determinants of health (Hayes et al. 2017).

Two recent scoping reviews designed to evaluate the quality and range of evidence and identify research gaps (Hwong et al, 2022; Charlson et al. 2021) found that most studies available on this topic are survey-based, cross-sectional designs, using self-reported mental health measures to understand the effects of climate events. A smaller number of studies use health records combined with temperature data to understand the effects of temperature mental health.

They identified gaps in relation to research focused on protective factors, coping mechanisms, or resiliency in response to the mental health effects of climate change. Additionally, there is a lack of research that links population mental health outcome databases to weather databases, which they recommend filling through greater collaborations between mental health professional and data scientists to build clinically meaningful research tools that address the challenges of climate change. The reviews also point to the potentially fruitful opportunity to draw on literature from other disciplines that do not explicitly address climate change such as the extensive literature on mental health and natural disasters. While some of the reviews we have analysed attempt to do this, there is greater opportunity for inter-disciplinary collaboration on this topic, particularly in understanding the more indirect causal pathways.

The body of literature specifically discussing eco-distress is nascent, meaning that there are many gaps in the literature. A gap exists in understanding the prevalence of eco-distress in the UK specifically, not least its impacts on mental wellbeing. One study found that, as of 2020, only 11 percent of studies on the mental health impact of climate change focused on psychological responses to climate change awareness (Charlson et al, 2021).

Ambiguity and inconsistency in how eco-distress is defined is partly explained by the absence of qualitative research into eco-anxiety. Approximately 75 percent of studies on eco-anxiety are quantitative, the rest being mixed method or qualitative (Jarrett et al, 2024). Although 2021 saw an increase in the number of qualitative studies published, quantitative research still represented the majority of papers that year (Brophy et al, 2022). This means there is relatively little discussion about the nature of eco-anxiety and a lack of exploration into its qualitative causes. This is particularly important given the lack of clarity in the terms employed and the wide range of terms used.

5 Evidence on interventions addressing the mental health risks of climate change

Summary of findings from Chapter 5

This chapter addresses Research Question 3:

3. What is the evidence on effective prevention and early intervention, and on responding to mental health and wellbeing risks and impacts in a climate change context in Scotland?

Key findings:

- The evidence base for interventions is thin. Only 23 evaluated intervention types were found which address prevention, early intervention, or responses to the mental health risks of climate change. Eight of these were delivered in developing countries, and only two were based in Scotland.
- Almost half of the evaluated interventions focused on building resilience amongst the participants. The other evaluated interventions focused on capacity building, social connections, nature connection, and encouraging climate action. Capacity building interventions had a high-level of evaluation.
- Evaluations of interventions measured a wide range of outcomes. These included improved wellbeing (6), improved ability to cope (6), and relief from psychological disorders (4).
- Four other types of intervention were found. These were a) promoting public participation in decision making, b) supporting mental health practitioner development, c) climate justice and d) public communication. To date, there has been no evaluations of the interventions within these categories.

5.1 Introduction

For policymakers, the mental health risks outlined in Chapter 4 imply that actions and programmes should be designed to address the causes of poor mental health and its symptoms. This chapter focuses on public health interventions that directly address poor mental health resulting from the impacts of climate change or wider concerns. In this section we explore the broad topic of evidence on effective prevention and early intervention, and on responding to mental health and wellbeing risks and impacts in a climate change context in Scotland. We have included any intervention or programme which has been designed to help alleviate adverse mental health and wellbeing effects of climate change and have focused on those which may be applicable to Scotland.

5.1.1. Methodology

This chapter analyses mental health interventions. We took interventions to be programmes, policies, and practices aimed at supporting mental health in the context of climate change. We found 60 interventions during the shortlisting process, derived from the longlist of material which answered Research Question 3. The shortlist of 60 was analysed on several grounds including whether the intervention had been evaluated, what the evaluation found, and replicability of the intervention. ‘Evaluation’ here means any

systematic process to judge the merit, worth or significance of an intervention by combining evidence and judgement. 'Replicability' we take to mean a project has been sufficiently described, evaluated and shown to be effective in meeting its objectives, there is an understanding of *why* it worked and how it may need to be adapted to be repeated elsewhere. Appendix A describes the analytical procedures in more detail.

This chapter begins with an overview of the different types of programmes that have been delivered to support mental health in a climate context and their levels of evidence. The remainder of the chapter explores the nine different types of intervention, describing how they may lead to mental health benefits, and what these interventions look like in terms of their target groups, outcomes, and how they were delivered.

5.2 Overview of types of interventions and evidence

We found a growing number of international studies of wellbeing interventions in the context of climate change. These studies broadly agree on how to categorise mental health interventions. From reviewing their frameworks, we identified nine exclusive intervention categories which were potentially relevant to a Scottish context. These were: psychological resilience and coping; capacity building; social connection; nature connection; encouraging action; democratic participation; practitioner development; public communication, and; climate justice.

In practice, these categories were not exclusive. Ninety three percent of interventions crossed multiple categories. For example, a group therapy intervention might focus on primarily on building psychological resilience but also have a secondary focus on building social connections between participants. Encouraging action was notable in this regard. No mental health intervention had a primary purpose of encouraging action. Yet many interventions encouraged participants to take climate action through other means such as mental health toolkits, discussion club, or community gardening.

Our review identified 60 interventions. Most have been recently designed and delivered. Only 36 percent of interventions found had been evaluated. However, interventions building psychological resilience and coping skills have been delivered more than other and have and relatively frequently evaluated (9). Capacity building interventions have been delivered less frequently but the evaluations that have taken place are of higher quality than for some of the other interventions. For four intervention categories, there were no evaluations of interventions identified. Table 2 shows which intervention categories have been most frequently evaluated, and which outcomes were measured in those evaluated interventions.

Table 2 Summary of the types of interventions that have taken place, the number which have been evaluated, and the main measured outcomes for the evaluated interventions

Category of intervention	Number of separate interventions	Number of these interventions that have been evaluated	Measured outcomes in evaluated interventions					
			Relief from disorders	Reduced distress	Improved wellbeing	Coping self-efficacy	Reduced isolation	Validate emotions
Resilience and coping	24	9	2	1	2	3	1	
Capacity building	4	4	1	1	2			
Social connection	11	5				1	2	2
Nature connection	6	5	1		2	2		
Encouraging action (secondary only)[3]	16	(5)		1	1	1	1	1
Democratic participation	7	0						
Practitioner development	5	0						
Public communication	2	0						
Climate justice	1	0						
Total	60	22						

[3] No intervention was primarily focused on moving participants directly into climate action as a way of supporting wellbeing. However, 16 interventions encouraged action through other means, such as group therapy, toolkits, and discussion groups.

5.3 Intervention types with evaluated interventions

In this section we focus on intervention types that have evaluated interventions. For each type of intervention, we outline the reasoning for how this may help and the evaluated outcomes from different interventions in this group. We've also noted interventions that may be replicable or scaled up further in Scotland.

5.3.1. Psychological resilience and coping interventions

The most common form of mental health and wellbeing intervention[4] in a climate change context were those aimed at building psychological resilience and coping mechanisms. Psychological resilience is the ability to regain or remain in a healthy mental state during crises without long-term negative consequences, whilst coping mechanisms are the patterns and behaviours people use to deal with unusually stressful situations. Both resilience and coping techniques are useful both for 'bouncing back' from climate events and for dealing with climate distress day-to-day without being overwhelmed. We identified 24 separate resilience interventions of which nine were evaluated. Of the 24, 17 focused on climate distress, and six on responding to climate events.

Resilience interventions use a number of different tools and approaches to help people cope (Dooley et al, 2021), including reframing climate distress as connection, care and empathy, and cultivating positive emotions, such as optimism and realistic hope (Hickman, 2020). Similarly, resilience interventions for climate distress had a wide variety of target groups: the general population (6 interventions), teachers (4), youth (3), and activists (3). Resilience interventions around climate hazards (such as floods) were targeted at rural populations (2), those with poor mental health (2) or any resident (2).

The diversity and scale of interventions for building resilience is noteworthy. Forty percent of identified interventions primarily focused on building resilience, as well as the range of target groups and diversity of approaches. This indicates that strengthening emotional resilience, rather than moving straight into action, is the most accepted approach for mental health professionals for people facing climate change (Dooley et al, 2021).

The evaluated interventions for psychological resilience-based programmes were focused on two outcomes: developing coping mechanisms and giving relief from disorders such as anxiety and depression.

For coping mechanisms, one group therapy-based intervention, delivered following Super Typhoon Haiyan, found that participants improved in coping self-efficacy in all module domains managing unproductive thoughts and emotions and identifying personal strengths (Hechenova et al, 2018). A Skills for Life Adjustment and Resilience (SOLAR) intervention delivered after Cyclone Pam resulted in significantly decreased distress/post-traumatic stress symptoms and functional impairment after the intervention, with some effects retained at 6-month follow-up (Gibson et al, 2021).

[4] Please note, use of the term 'resilience' in this section refers to individual psychological/ emotional resilience as opposed to climate/community resilience to extreme weather events, for example.

For relief from disorders, group therapy methods appear to be effective. Rational Emotive Behavioural Therapy (REBT), a type of Cognitive Behavioural Therapy (CBT), was administered in groups to 49 participants with depression in Kogi state, Nigeria, following a series of floods. Researchers found that REBT was significantly effective in decreasing post traumatic depression among flood victims. Fatigue, feelings of hopelessness, and suicidal thoughts had been significantly reduced after being exposed to REBT (Ede et al, 2021). Flooding in the UK has been shown to be associated with higher instances of PTSD and anxiety (Jermacane, 2018). A survey in Aberdeenshire found that 71 percent of respondents reported experiencing anxiety (Andrews, 2020). The large effect size which continued at follow-up is promising for potential replication in Scotland. While REBT is currently not a standard therapeutic approach in Scotland, REBT and other talking therapies may be appropriate and fruitful avenues to explore for climate change related mental health issues.

5.3.2. Capacity building interventions

Capacity building is a programme which tries to improve a community's potential to act and respond to climate events. Whilst only four capacity building interventions were identified, each of these had been evaluated, mostly to a high standard.

The four identified capacity-building interventions in the literature covered two delivery models: training and financial aid.

We found two training programmes. First, a 3-day mental health integrated disaster preparedness intervention was delivered in a group setting in Haiti. This disaster preparation training in Haiti[5] showed reduced symptoms associated with depression, post-traumatic stress disorder, anxiety, and functional impairment, and increased peer-based help-giving and help-seeking (James et al, 2020). The second training programme was the Rural Adversity Mental Health Program (RAMHP) in Australia which offered training and support in the context of drought. The RAMHP training programme increased mental health understanding and willingness to assist others for over 90 percent of participants (Maddox, 2022).

Our search also found two financial assistance programmes. First, livestock trading grants and collective-action groups were delivered to 2300 people in Ethiopia. The livestock trading grant in Ethiopia resulted in confidence in the future and ability to recover from a crisis being much more likely to rise (Gibson et al, 2021). Second, we found a Red Cross intervention in Bangladesh which distributed an unconditional cash transfer in advance of a monsoon flood. These direct cash transfers in advance of flooding in Bangladesh appear to have been effective in improving household access to food and reducing psychosocial stress during and after the flood period (Maddox et al, 2022).

Financial assistance was offered in Bangladesh and Ethiopia, yet the impact may be in part due to both countries having GDP per capita below $3,000. These interventions were mostly

[5] The research was conducted using a randomised control trial (RCT), with two post-intervention surveys, both undertaken following a typical hurricane season with moderate associated flooding and other storm-related damage in the research communities.

funded or run by international humanitarian organisations rather than being integrated into the local system. These factors mean that, despite their high evidence level, there is some uncertainty about the replicability of capacity building interventions in Scotland, which has a high GDP per capita, and fewer outside-party delivery of interventions.

5.3.3. Social connection interventions

We found eleven initiatives which used social connection to help participants deal with mental health issues in a climate change context. Five of these have been evaluated. Social connection interventions are particularly common in the UK, where five of these interventions have been delivered or developed. All social connection interventions were and appear to prioritise two mental health related outcomes: improved social capital and validation of emotions.

First, social connection interventions can help reduce isolation and increase social capital in participants, through forming new acquaintances and resources. Examples include a cooperative enquiry into climate change in a Welsh school. This helped the participants feel less alone and more connected with group members, teachers and the school (Togneri, 2022). Social connection has been shown to protect mental health following disasters. Using a more extreme example to illustrate this, people with higher levels of social support prior to and following Hurricane Katrina had lower levels of psychological distress, even years after the event (Lowe et al, 2010).

The number of wellbeing interventions focused on building connections to others reflects the understanding that social networks are both a basic human need and a primary source of resilience (Holt-Lunstad, 2020). Social support has been found to protect against stress and is strongly associated with both physical and mental health (Leigh-Hunt et al. 2017). This is in line with the social determinants of health model that shows loneliness and social isolation increase the risk of poor mental health (Kirkbride et al, 2024).

The second major outcome from social connection interventions is validation of emotions. In group settings, people can share their feelings about the climate crisis and be heard by others who feel similarly. Climate Cafes (Box 1) are one of the most popular intervention designs to achieve both reduced isolation and validating negative feeling.

Acknowledging and validating feelings in relation to climate distress has been particularly important for young people. As highlighted in Section 4.5.3, young people often feel their concerns about the environment are ignored or belittled and have no one to talk about their worries (Atherton, 2020). Providing safe spaces to express emotions is important for avoiding isolation and emotional repression; often this will involve parents, caregivers and educators initiating conversations or actively listening (Atherton, 2020).

5.3.3.1. Climate Cafés

Climate Cafes are widespread across Scotland and, increasingly, worldwide. Somewhat confusingly, there are two main types of Climate Café with differing emphases.

First, Climate Psychology Alliance (CPA) Climate Cafes are primarily a space for talking about emotions. A typical CPA Climate Café has two facilitators. An initial round of sharing is often scaffolded by images or natural objects that participants are invited to interact with. After an initial round of reflections from each participant, the conversation is opened up and participants are invited to respond to, and reflect on, the contributions of others. Throughout the Café, the focus of discussion is on participants' thoughts and feelings about the climate and ecological crises.

A forthcoming study of CPA Climate Cafés found that prior to attending attendees had felt "helpless at times… depressed… angry" . Regarding this type of distress as unique to the climate crisis, it was regarded as impervious to existing therapies: "CBT won't fix my climate anxiety." Reflecting upon their Climate Café experience, participants noted how they had not been fully conscious of the depth and breadth of their emotional responses to the climate crisis prior to attendance.

The study showed participants had a sense of surprise at how quickly and strongly a connection developed in a new group. Attendees could "express yourself more authentically", drop the mask of a "brave face": "meeting someone who is seeing the same thing that I'm seeing and then saying, oh, that's really hard, isn't it…like 'oh thank God'". CPA Climate Cafés were seen to offer a contrast to the other climate related groups participants had attended, which often had a tonne of "we need action… there's this line of anger to it."

The second type of climate Café offered by the Climate Café® Network is more action orientated, though focused first on sharing and building connections between participants. These Climate Cafés® are defined as "informal spaces for chat [which] often inspire and inform action" and are delivered throughout Scotland and worldwide.

As informal community meetings for people to share climate-related feelings and inspire collective action, Climate Cafés® help participants to validate feelings around climate distress, increase awareness of threats to planetary health, action taken in the face of climate change, and improved social connection. One Scottish participant said, "Here are like-minded people with an equal passion and inspiring, practical answers to climate issues – both wider issues and very close to home." Another participant stated "I feel completely comfortable when stating my opinion on matters or contributing ideas as I am never alienated, I am always encouraged to just go for it."

Both CPA Climate Cafés and the Climate Café® Network are well established in Scotland. The Climate Café® Network originated in Scotland where there are 26 ongoing Cafés®. Both types of Climate Café are freely offered to all attendees. A number of tools and training offers exist to set up new cafés. Further evaluation should be commissioned to increase confidence in the outcomes from Climate Cafes and to determine which factors are critical to their success, and how this varies among population groups. Climate Cafes are already used in COP events and Community Climate Action Networks in Scotland and could be further scaled and integrated into mainstream public health, for instance, as an option in social prescription.

5.3.4. Nature connection interventions

Our review found seven interventions focused on nature connection, four of which have been evaluated. Two main types of outcomes were found: improvements to wellbeing and increased self-efficacy and coping.

Two evaluated interventions have focused on improving wellbeing among participants. Wetlands for Wellbeing in the UK has been delivered to people with poor mental health with strong results, helping participants connect to nature as a space of reflection, resourcing, and inspiration, supporting them to manage distress. Statistically significant improvements were found in mental wellbeing, anxiety, stress and emotional wellbeing, as well as social isolation, confidence to be in nature, and management of physical health (Maund et al, 2019). Another evaluated nature-based intervention addressing climate change which included a community garden hub demonstrated improvements in mental health and social connectedness for participants (Patrick et al, 2011).

Wellbeing outcomes have been strongly associated with nature connection for some time. As described in 4.3.2, climate-related loss of biodiversity represents a risk to mental health as both nature exposure and nature connection have positive impacts on mental health and wellbeing and allow humans to flourish (Passmore and Howell, 2014). Nature-based interventions have been found to reduce anxiety, reduce stress-related cortisol levels, reduce neurodevelopmental disorders, reduce severity of depression, increase cognitive function and promote social cohesion (Nabhan et al, 2020). Nature connection is also associated with improved wellbeing in general, positive moods and lower distress (Nisbet, Shaw, and Lachance, 2020).

The second outcome, self-efficacy and coping, was found in two evaluated interventions. One example of a nature-based programme delivered in Scotland, the Green Team, showed strong post-activity survey results, particularly around self-efficacy and social connection: 94 percent of young people involved in the one project increased their confidence; for another project 95 percent of young people developed positive relationships (Grant, 2021; The Green Team, 2023). Borderlands Earth Care Youth Institute, a nature-restoration project for young people project on the US-Mexico border, improved emotional strength, as well as leadership, sense of community, and social responsibility (Nabhan et al, 2020).

We found research in a small student population showing exposure to nature improving coping ability for climate distress, often through developing a sense of peace, hope, calm, ease of worries and grounding (Grant, 2021). Most nature-based interventions are delivered to marginalised people or those more susceptible to climate anxiety (such as young people from lower income households) who may have less access to nature.

However, it is notable that only one of the four evaluated interventions was explicitly addressing eco-distress. There's some evidence to suggest nature-connection interventions have perverse effects for those experiencing climate distress. Whilst studies generally agree that spending time in nature (nature exposure) is an effective strategy for coping with climate distress (Dooley et al, 2021), several studies have found that feeling *connected* to nature is associated with climate change anxiety (Curll et al, 2022). For this reason, some

programmes seek to encourage both nature-connection and optimism simultaneously (Smithsonian, 2021). Nature connection interventions also have different designs depending on the groups that are engaged. In the UK, many minorities feel excluded from rural settings and groups have been established to provide safe spaces for ethnic minorities, such as Black Girls Hike and Flock Together, a bird watching group for people of colour.

5.3.5. Interventions encouraging meaningful action

We found 16 interventions which encouraged participants to take meaningful action, five of which were evaluated. Fifteen of the 16 interventions related to climate distress. As described in the discussion of eco-anxiety in 4.5, emotions around climate change including distress are increasingly understood as rational and proportionate responses to an existential threat. Our review has found that action taken by government, groups, or individuals to combat climate change can alleviate some of these negative effects. Climate distress often involves feelings of helplessness due to the scale of the issue of climate change. Action and activism can help address these threats by helping individuals focus on what they can control, thereby promoting a sense of agency, efficacy, and competence (Schwartz et al, 2022).

It is particularly notable that all climate action interventions for mental health have action as a follow-on aim rather than encouraging participants to leap straight to solutions. Climate anxiety researcher Pikhala and psychoanalyst Randall caution against pushing clients too quickly into action, emphasising the importance of addressing emotional and identity challenges first (Dooley et al, 2021). For mental health interventions, in order to engage in action, it is vital to first provide a space for the expression of emotion.

The most common outcome of encouraging action is improved levels of empowerment, which was an expected outcome in seven out of the 16 action-based interventions. A social connection intervention in Wales used Cooperative Inquiry to improve knowledge of a group of pupils. Qualitative research found that ‘knowing about solutions’ made a difference. This knowledge was directly connected by the young people to their wellbeing and a sense of hope, highlighting the importance of envisioning alternative futures (Togneri, 2022). In Cameroon, the Ibanikom Climate Mental Health Literacy Project facilitated meetings for flood-affected communities, allowing participants to learn about the effects of climate change on mental health and co-develop local, small-scale culturally relevant integrated health and agriculture projects (Xue et al, 2024).

Another intervention, the Work That Reconnects, has been developed to help participants talk about how they feel, moving from hope and despair, build empathy and begin acting upon these feelings. The intervention is not only focused on climate change but a sense of connection to the wider ecology. Research found that participants find concrete ways of living out hope in their daily lives: one participant noted “these questions made me rethink about the legacy I will leave behind” (Hathaway, 2017). All eleven research participants in a study commented on how it is helpful as a framework for life, sharing that they use it in their relationships with family and friends, activism, and making major life decisions.

5.4 Intervention types with lower levels of evidence

We found that government and third-sector responses to climate change's effect on mental health are not limited to direct services to those effected. The disempowerment felt by many in climate distress has led to innovative new programmes to help restore a sense of agency to those effected, including through participation in decision-making, and communication. This section gives an overview of four types of intervention which are emerging as the scale of the climate crisis becomes apparent, but which to date have no evaluated programmes. We will briefly examine how interventions are theorised to support wellbeing and describe any recognised barriers to impact in Scotland.

5.4.1. Interventions promoting participation in decision-making

Citizen participation in decision-making is increasingly perceived as not only a matter of justice and democracy but also a practical necessity for transitioning into sustainability (Huttunen et al, 2022). While these interventions mainly concern wider issues than mental health, participation in decision making has been theorised to have benefits to wellbeing, particularly empowerment. We found seven wellbeing interventions which focused broadly on participation. A large number of these were in Scotland, particularly within the umbrella of the Climate Change Public Engagement Strategy.

To date, publicly available evidence remains thin and shows mixed outcomes. The Scottish Climate Assembly (2020-2022) reporting included evidence on the emotional experience of assembly members, focusing on optimism, distress and worry of members throughout the process. Findings indicated that members were less worried and more hopeful than the general population about what Scotland can do to tackle climate change and became increasingly optimistic that 'things will work out fine' over the course of the main Assembly period (Andrews et al, 2022). However, 21 percent reported their feelings about climate change were having a negative impact on their mental health. The Assembly member survey showed that feelings of worry increased, and optimism decreased. In addition, many participants reported feeling disappointed at the final meeting which reviewed the government response to their report (Andrews, 2022).

5.4.2. Practitioner development interventions

We identified five interventions aimed at increasing mental health practitioners' knowledge and skills to respond to climate related mental health issues. These typically involved workshops that facilitated discussion and training in relevant approaches to their practice. These initiatives provide training to practitioners to treat eco-anxiety not as a personal neurosis but rather as evidence of the client being connected to a greater whole (Dooley et al, 2021). Many interventions focus on grief awareness, including anticipatory loss,

disenfranchised grief, and use Worden's model of the tasks of grief[6] to successfully address eco-anxiety (Worden, 2009).

5.4.3. Climate justice awareness interventions

Climate justice is a movement that connects the climate crisis to social injustice including racial discrimination, poverty, and human rights. Many strategies in Scotland and worldwide are developing programmes to ensure that the transition to net zero is fair to all groups. However, no evaluated interventions were found which had an explicit mental health focus. Evidence suggests that educating people about climate justice can help them cope with climate anxiety and support their involvement in creating fair solutions (Davenport, 2021). Current evaluation work on Just Transition in Scotland (Tavistock Institute, 2024) has found that there will be overlap with outcomes from participative decision-making interventions, since community empowerment is a key objective to both types of intervention.

5.4.4. Public communication interventions

The final area we found for intervening in the mental health risks of climate change was public communication. Messaging on climate change needs to be viewed through the lens of building resilience and agency or it may increase levels of climate dread and denialism (Hathaway, 2017). From a mental health standpoint, communication should seek to give agency to those in distress through engaging empathy, cultivating hope and focusing on local level actions rather than provoking guilt. Scotland has delivered public engagement activities in these areas, including the Let's Do Net Zero website and toolkit, Our World, Our Impact, Climate Beacons, and Climate Ready Classrooms. Little evidence exists on the success of these or other projects in addressing climate anxiety or climate events. However, the Climate Beacons evaluation report shows results in community engagement that may relate to outcomes of interest, such as new connections made, confidence and empowerment (Hall and Coenon-Rowe, 2022).

5.5 Implications for Scotland

From the evidence review on interventions, scaling up appears most promising for interventions which promote resilience and capacity building due to the large volume of impactful and evaluated interventions in these two areas. Resilience building and coping are essential components for both climate distress and 'bouncing back' from climate change related events. Scottish policy makers can draw on a wide range of interventions with established mental health outcomes in these two categories. The strength of evidence for capacity building implies that for interventions responding to climate events, building community skills such as disaster preparedness and mental health first aid may be helpful in avoiding and mitigating direct and indirect mental health effects.

[6] These tasks being: to accept the reality of the loss, to process the pain of grief, to adjust to a world without the deceased, and to find an enduring connection with the deceased in the midst of embarking on a new life.

We also found three other types of evaluated interventions: social connection, nature connection and meaningful action. Each type is already delivered in Scotland and could possibly be scaled up and integrated with existing services and strategies. Interventions such as Climate Cafes, the Work That Reconnects, and various nature connection initiatives are already delivered in Scotland often as part of strategies including the Climate Change Public Engagement Strategy.

6 Climate action co-benefits and risks

Summary of findings from Chapter 6

This chapter addresses Research Question 4:

4. What is the evidence of co-benefits and risks, or unintended consequences, for mental health and wellbeing from climate action (both mitigation and adaptation) relevant in a Scottish context?

Key findings:

- Climate action can lead to improved mental health and wellbeing through supporting improved physical health and by addressing some of the social determinants of mental health such as financial security, and quality housing. Policymakers taking a cross-disciplinary approach to climate action and understanding the interconnected pathways of impact can achieve a win-win outcome for the climate and mental-health.
- Energy efficiency measures in homes can lead to warmer homes which may increase thermal satisfaction; improve air quality; and reduce fuel poverty, in turn leading to financial security and improved general physical health. However, with increasing temperatures and overheating risks, it is important that building regulations support proper ventilation and cooling adaptation measures.
- Active transport measures can improve mental health through increased physical activity and greater social participation. Equitable approaches to transport policy are key to ensure vulnerable groups are able to take advantage of the benefits.
- Nature-based climate solutions have the potential to improve mental health and wellbeing through increased physical activity and a greater sense of community. However, they currently risk offering most benefits for those who live in more affluent areas given that they have better access to green spaces than those in deprived areas.

6.1 Introduction

This section examines the intended or unintended co-benefits and risks of 'climate action' for mental health and wellbeing. In the context of this chapter, 'climate action' refers to policy interventions that aim to address climate change (mitigation and adaptation). Co-benefits are the range of positive side effects from climate action on mental health and wellbeing that can equal or even outweigh the importance of environmental impacts. Conversely, risks are the range of negative unintended consequences from climate action.

In this review we frame climate action as adopting one of two approaches: climate change adaptation and mitigation. Adaptation is about managing the impacts of climate change as it occurs, for example, installing flood defences (Hiscock et al, 2017). Climate change mitigation is primarily concerned with the reduction of greenhouse gas emissions, such as using renewable sources of energy (Ürge-Vorsatz, 2014). While climate action primarily serves an environmental purpose, it sits within a broader interconnected system which targets other major challenges. In Scotland, adaptation and mitigation strategy also focuses on addressing public health issues, reducing poverty and inequality, and building a stronger economy (Liski et al, 2019).

As discussed in Chapter 4, a cause of eco-distress is the (perceived) lack of action by decision makers and governmental institutions to combat climate change. The most direct method to address this cause of eco-distress is therefore to take effective climate action. Climate action on an individual, community and systems level (governments, corporations etc.) can work to help people cope with the difficult emotions surrounding climate change and help generate hopeful perspectives, improving mental health and wellbeing (Lawrance et al, 2022). Individual climate action such as reducing car use or choosing a plant-based diet can lead to a positive emotional response through acting in line with one's values. Collective climate action can strengthen solidarity and social networks which may be particularly supportive for those living in climate vulnerable areas, such as island communities in Scotland. Systems climate action and its effective communication can improve the population's trust in societal actors to help solve the climate emergency which can help reduce distress, particularly for young people (Lawrance et al, 2022).

We chose to focus on systems level climate action in our analysis. This is primarily due to there being a sufficient evidence base of relevant research to undertake our analysis for systems level climate action, but not for community or individual levels. Furthermore, putting trust in societal actors with visible climate leadership appears to be one of the most effective strategies to reduce and help prevent eco-anxiety impacting on wellbeing (Lawrance et al, 2022). Therefore, examining system level climate action may be the most useful analysis for policy makers.

6.1.1. Methodology

We reviewed 22 shortlisted sources related to the co-benefits and risks of climate action for mental health and wellbeing. While the health co-benefits or risks of climate action related to physical health are well documented, those related to mental health and wellbeing are less explored, as in most cases mental health and wellbeing are not the primary focus of the climate action so data on these outcomes is rarely collected. We found some evidence indicating risks to wellbeing, particularly when strategies do not adequately address concerns of equity, equality, and justice. However, the extent of these risks were difficult to determine due to limited evidence broken down by population demographic type (e.g., age, gender, ethnicity). We also found very limited evidence for these effects in Scotland.

From the 22 studies, we identified three main areas of climate action were most relevant for mental health and wellbeing co-benefits and risks in Scotland, which we have used as the

thematic basis for presenting our analysis: (1) housing (energy efficiency measures), (2) transport (active travel) and (3) nature-based solutions including blue-green infrastructure. Other areas such as land management (biological sequestration, peatland restoration, afforestation) and food have not been included due to less evidence of direct causal pathways between the action and mental health or wellbeing (Lawrance et al, 2022).

Most evidence we found regarding mental health and wellbeing co-benefits of climate action were related to mitigation measures. In a Scottish context, evidence related to adaptation measures was more limited. However, there was some evidence related to how managed realignment, as an adaptation measure to address coastal erosion, can pose both co-benefits and unintended negative consequences for coastal communities. See section 6.4 for discussion.

6.2 Climate action related to housing

In Scotland, the housing sector is an important area for developing climate mitigation and adaptation, with mitigation methods addressing the energy efficiency of housing providing the most relevant evidence. Energy efficiency improvement measures, such as wall and roof insulation, boiler upgrading and draught-proofing, can support a reduction in greenhouse gas emissions by decreasing the fuel needed to heat homes. Much of the literature analysing energy efficiency measures used environmental, public health, and anti-poverty lenses, which are relevant given the rise of fuel poverty and the cost-of-living crisis in Scotland. Moreover, there are strong links between energy efficiency measures and physical health improvements, particularly respiratory health. This is particularly relevant for Scotland where ill-health related to cold homes is a significant public health issue (UK Climate Risk, 2021).

The co-benefits and risks from climate action on housing are presented below through their causal mechanisms.

6.2.1. Improved thermal satisfaction

The evidence reviewed in our study presented it as an established fact that living in cold housing can contribute to poor mental health and wellbeing (Grey et al, 2017). Common mental health disorders such as anxiety and depression, as well as respiratory conditions such as asthma, have all been linked to living in cold homes. Vulnerable groups are more likely to live in poor quality housing. Vulnerable groups are also more likely to be unable to afford to turn heating on, and to spend more time in their homes (Gray et al, 2017). Energy efficiency measures can lead to warmer homes, and there is substantial evidence to suggest that improved thermal satisfaction can be linked to improved mental health (Hiscock et al, 2017). This is particularly true for those with existing chronic respiratory conditions (Thomson et al, 2013). However, there is also some evidence to suggest that energy efficiency measures could reduce thermal satisfaction through overheating, negatively impacting resident wellbeing (Hiscock et al, 2017). This risk is particularly relevant considering heatwaves and rising temperatures are an outcome of climate change in Scotland.

6.2.2. Improved air quality

Damp housing, the presence of mould, and poor indoor air quality have considerable negative impacts on overall health, including mental health (Hiscock et al, 2017). Access to warm and dry housing, especially for vulnerable groups such as children, older people and those with existing health conditions, is therefore associated with improved wellbeing (Vardoulakis et al, 2015; Bikomeye et al, 2021). Improved air quality can enhance the comfort of a home, making it easier to relax. However, if retrofitting is mismanaged and ventilation is not adequately considered, indoor air quality can worsen, potentially having unexpected negative consequences for wellbeing (Hiscock et al, 2017; Hiscock et al, 2014). By taking a more integrated approach to new-builds and retrofitting, risks associated with high indoor vapour and mould can be avoided (UK Climate Risk, 2021).

6.2.3. Potential reduction of fuel poverty

Energy efficiency measures may contribute to improved wellbeing by making heating more affordable. In Scotland, the majority of residential energy use is spent on heating homes (UK Climate Risk, 2021). Energy efficiency measures can reduce energy costs, alleviating some of the financial burden associated with fuel poverty. There is evidence to suggest that lower energy costs can reduce financial stress, benefitting mental health. Additionally, residents would have more money to spend on other necessities such as food, rent and transport (Grey et al, 2017). It can be inferred from this that energy efficiency measures could have the most impact on vulnerable groups and those in precarious financial situations.

6.2.4. Increased social interaction

Our review found evidence demonstrating the importance people place on their homes as places of comfort and relaxation (Hiscock et al, 2017). Warmer homes and improved air quality can lead to higher home satisfaction, which in turn can have a positive influence on social interaction as residents are more comfortable inviting guests to visit (Grey et al, 2017).

6.3 Climate action related to transport

Our review found evidence of the co-benefits for mental health and wellbeing of climate action regarding transport (Hiscock et al, 2017; Davis and White, 2022; ClimateXChange, 2021; Milner, Davies, and Wilkinson, 2012), including climate mitigation strategies such as individuals reducing their use of cars; policies promoting active travel (walking, wheeling, and cycling); and the prioritisation of public transport. These strategies aim to reduce greenhouse gas emissions while emphasising the health and wellbeing benefits of increased physical exercise and reduced noise and air pollution. These measures are known to provide a range of health and wellbeing benefits such as reduction in depression (Hiscock et al, 2014), reductions in obesity, diabetes, respiratory conditions, and cardiovascular disease and are shown to benefit mental health and wellbeing (Douglas et al, 2023).

In Scotland, the 20-minute neighbourhood concept supports a behavioural shift towards active travel. The idea behind it is that residents can meet their daily needs within a 20-

minute walk, cycle or wheel of their home. Daily needs may include food shopping, accessing primary healthcare services, getting to school, and using public transport for onward travel to work and leisure activities (ClimateXChange, 2021). Another mechanism for climate change mitigation found in the literature is road space reallocation. This policy involves repurposing existing motor infrastructure (roads, roadside car parking) to promote sustainable transport (e.g., cycle lanes) or for community use (e.g., greenspace) (Douglas et al., 2023).

The co-benefits and risks from climate action on transport are presented below through their causal mechanisms.

6.3.1. Increased physical activity

The literature reviewed reports strong links between increased physical activity and improved mental health and wellbeing (Penedo and Dahn, 2005; Muirie, 2017). There is evidence that 20-minute neighbourhood infrastructure can increase walking and cycling behaviour in residents by reducing the need to travel by car. This behaviour change has physical health co-benefits, such as reducing the risk of obesity, diabetes, and cardiovascular diseases.

However, there may be unintended negative consequences of promoting active travel on residents' wellbeing if policies that restrict car use are perceived as reducing independence or personal choice (Douglas et al, 2023). Moreover, in some areas, residents may unsafe walking alone or in poorly lit areas, preferring to use a car for personal safety. Feeling afraid may counteract a positive wellbeing effect and reduce people's willingness to take up active transport options (Hiscock et al, 2014).

6.3.2. Reduced social isolation and improved community relationships

Safer walking and cycling routes can build more connected communities and increase the likelihood of social interaction compared to car use. This is due to people spending more time in their local area and being more likely to interact with others living nearby when using public transport or actively traveling. There is evidence that demonstrates the positive impact this has on wellbeing, including general mood improvement (Hiscock et al, 2017). However, unless a lens of equity is used when implementing 20-minute neighbourhood and active travel infrastructure, accessibility for disabled people may be overlooked. This is particularly true for road space reallocation which can make car travel difficult (Douglas et al, 2023). Such changes may negatively impact the wellbeing of those rely on cars by reducing independence and ability to travel.

6.4 Climate action using nature-based solutions

Our review found that nature-based solutions are important climate change mitigation and adaptation strategies with co-benefits for mental health and wellbeing. This was supported by systematic literature reviews such as Hiscock et al. (2017). Nature-based solutions are 'actions to protect, sustainably manage, or restore natural ecosystems, that address societal challenges' (World Bank, 2020). While there are many types of nature-based solutions, this

report focuses on blue-green infrastructure, which provided the most relevant, high-quality evidence. Blue-green infrastructure can be defined as 'a strategically planned multifunctional network of natural and semi-natural areas and features designed and managed to deliver multiple benefits to people' (Kirby and Scott, 2023). Examples include linear greenways and paths; ground, wall and roof vegetation; urban trees and streetscapes; parks and green spaces; peri-urban and rural forests and woodlands; inland blue infrastructure regeneration (ponds, lakes, wetlands, canals, rivers); and coastal blue infrastructure regeneration. Blue-green infrastructure contributes to climate change mitigation by cooling down towns and cities (reducing the urban heat island effect) and capturing carbon. It can also help improve urban resilience to flooding by reducing stormwater runoff (Kirby and Scott, 2023).

Our review identified direct causal mechanisms tied to improved wellbeing through blue-green infrastructure, including increased physical activity, spending time in nature, and a sense of stewardship. Indirect pathways mentioned in the literature include the potential wellbeing benefits and risks of increased tourism and local business use resulting from blue-green infrastructure implementation. Different types of green infrastructure may produce different mental health and wellbeing co-benefits or risks, however the high-level analysis adopted in our approach produced insufficient evidence to offer a more granular typography of this effect. Architectural and urban design-focused green infrastructure, such as sustainable drainage solutions, cannot be covered in our analysis since there is insufficient evidence related to wellbeing co-benefits in a Scottish context. This may warrant future exploration if new evidence becomes available.

The co-benefits and risks from climate action through nature-based solutions are presented below through their causal mechanisms.

6.4.1. Increased physical activity

Regeneration of green and blue assets can lead to more local opportunities for physical activity. There is a strong link between exercise and positive mental health and wellbeing, both immediate and long-term. Being more active and increasing fitness can lead to improved physical health through reduced obesity, diabetes, and cardiovascular disease risk (Bikomeye et al, 2021). Improved self-perceived general physical health can enhance overall quality of life and general wellbeing. However, unless implementation and regeneration of blue-green infrastructure is applied equitably, it risks benefitting primarily those in higher socio-economic communities. Environmental justice studies have demonstrated that those living in more deprived areas of towns and cities have less access to high-quality greenspaces and that the residents have poorer overall physical and mental health compared to those who live closer to green environments (Baka and Mabon, 2022).

6.4.2. Spending time in nature

The implementation and regeneration of blue-green infrastructure positively impact biodiversity, encouraging local people to spend more time in nature. As described in the previous sections in 4.3.2 and 5.2.4, our review found strong evidence of links between time spent in nature and improved wellbeing including reduced stress, recovery from mental

fatigue and increased happiness (Bikomeye et al, 2021). Specific examples include studies showing the positive impact of socially prescribed visits to wetlands on patients' anxiety and depression (Kirby and Scott, 2023). Existing research demonstrates that blue-green infrastructure must have essential components in order to produce these benefits, such as tranquillity, perceived 'greenness' and a sense of safety (Baka and Mabon, 2022). There is also evidence to suggest that connecting with nature can enhance ecological awareness, which, along with wellbeing improvements, can also elicit feelings of distress (Smith et al, 2024).

6.4.3. Sense of stewardship and community

Visible efforts to improve communities through linear greenways and paths, parks and green spaces, regenerated canals and wetlands can increase residents' sense of pride and stewardship in their community. Our review found evidence supporting the idea that an improved sense of place and increased social cohesion benefits social wellbeing (Bikomeye, Rublee, and Beyer, 2021). Furthermore, good quality blue-green infrastructure can support the maintenance of collective identity and social memory (Baka and Mabon, 2022). As mentioned in section 5.4.1, the emphasis on quality infrastructure in realising these benefits is important to note. Blue-green infrastructure differentiates itself from general greenspace in its essence as a nature-based solution which is strategically planned to produce benefits for humans and the planet.

6.4.4. Managed realignment

In addition to 'blue-green' infrastructure we found some evidence that climate adaptation could also bring wellbeing benefits. Managed realignment is the restoration of wetlands through the deliberate moving inland of coastal defences (Liski et al, 2018). One study found that managed realignment could contribute to improved local population wellbeing due to the restoration of natural wetland habitat and the possibility for more activities in nature. It was also recognised that managed realignment could affect agricultural yield potential and therefore it may negatively impact farmers' mental health due to risks to their livelihood and financial security (Liski et al, 2019).

7 Conclusions and implications for policy

7.1 Conclusion

This review has aimed to address four related research topics: the evidence of climate change risks to mental health and wellbeing, the nature of eco-distress in Scotland, evidence on interventions for mental health and wellbeing in a climate change context, and the evidence of co-benefits for mental health from climate action.

7.1.1. Direct and indirect risks to mental health

The findings of the review strongly support the view that climate change is increasing risks to mental health in Scotland and will continue to do so. Based on the third UK Climate Change Risk Assessment (CCRA3) and other country specific analysis, we found that the

main relevant climate change-related hazards for Scotland are increased frequency and severity of flooding, higher temperatures, more frequent and longer droughts, and coastal changes due to sea-level rises. These hazards contribute to a range of negative mental health outcomes through the disruption of the conditions for good mental health in each domain of life. These disruptions operate through direct pathways, such as injury, trauma, and property loss because of extreme weather, and indirect pathways, such as impacts on livelihoods, social networks, and the increased risk displacement. The severity of mental health outcomes varies depending on the nature of exposure to the hazard and the circumstances of those facing them, but includes heightened risks of PTSD, suicide, depression, anxiety and general poor mental wellbeing.

There is strong evidence that the impacts of climate change on mental health are not distributed evenly but will affect some groups more than others. The three main factors that determine a group's vulnerability to poor mental health outcomes are (1) their exposure to climate change-related hazards, (2) their wider vulnerabilities to poor mental health and (3) their access to resources and support to help them recover. Climate change amplifies existing, social, economic and demographic inequalities by disrupting the positive conditions for good mental health making groups vulnerable. In Scotland, groups at heightened risk include older people, children, women, ethnic minorities, low-income individuals, those with pre-existing health and mental health conditions, coastal and island communities, and workers in agriculture and fisheries.

7.1.2. Eco-distress

We also found that climate change may have an impact on mental health through eco-distress or eco-anxiety, a psycho-social response to the awareness of the threat to the environment. Our review of evidence from this emerging field of research shows that while there is currently no consensus on the definition, some common themes are clear. These include that eco-distress is future-orientated, is associated with feelings of uncertainty, unpredictability, uncontrollability and being overwhelmed, and it particularly affects young people and vulnerable groups. The emotions from eco-distress include anger, frustration, despair, guilt, shame and grief. Crucially, the literature is generally in agreement that eco-distress is not a pathological condition. Eco-distress is considered a rational and justified response that can also lead to pro-environmental behaviours and thoughts.

In Scotland, researchers have found that up to 70% of people express distress and worry about climate change and environmental issues. However, whether this translates to a high proportion of people meeting narrower definitions of eco-distress is very much dependent on the definition employed. Where validated scales of eco-anxiety are used, this figure appears to be lower.

While there remains disagreement on measurement of these emerging constructs the data clearly demonstrates that people, particularly young people and vulnerable groups, are worried about climate change. Whether some forms of worry should be considered damaging to a person's wellbeing and what should be done about this, is less clear. We

expect to see greater clarity in how researchers understand and measure the phenomenon of eco-distress as the field matures.

7.1.3. Mental health interventions

We reviewed the evidence on mental health interventions (programmes, policies and practices) aimed at supporting mental health in the context of climate change. The evidence we found in this area was mostly thin, with only 22 out of 60 identified interventions having been evaluated. Whilst our review indicated that there are many good practices available, it remains uncertain how relevant and helpful any intervention may be to addressing mental health risks related to climate change in Scotland.

Two types of intervention had relatively strong evidence of their effectiveness. First, we found nine evaluated interventions that focused on strengthening psychological resilience and building coping mechanisms. Activities such as group therapy were found to be useful both for bouncing back after experiencing traumatic climate events and for dealing with climate distress day-to-day without being overwhelmed. Second, we found four capacity building interventions with high-quality evaluations. Despite mostly being delivered in developing countries, capacity building programmes may be a useful response to climate events in Scotland, particularly through training on disaster preparation and mental health in the community.

We found some evidence that social connection, nature connection and taking climate action could also help prevent and respond to climate change risks to mental health, particularly for climate distress. Social connection interventions such as climate cafes reduced isolation and increased social capital, and also provided a space to validate climate emotions. Nature-based interventions have been found to reduce anxiety, stress and the severity of depression. Group activities for children and young people in nature were also found to improve emotional strength and develop social skills. Programmes that encouraged climate action improved levels of empowerment, which is particularly relevant for people experiencing climate distress.

7.1.4. Co-benefits of climate action

Climate action can lead to improved mental health and wellbeing through addressing some of the social determinants of mental health such as financial security and quality housing. Policymakers taking a cross-disciplinary approach to climate action and understanding the interconnected pathways of impact can achieve a win-win outcome for the climate and mental health.

Climate action can have co-benefits and unintended consequences. In fact, our analysis found that climate action related to housing provided an important opportunity to address several cross-cutting issues in Scotland, including mental health and wellbeing. Energy efficiency measures such as improved insulation can lead to warmer homes, which may increase thermal satisfaction, improve air quality and reduce fuel poverty. Social determinants of mental health including better financial security and improved general physical health play an important role in wellbeing co-benefits of housing climate action.

However, with increasing temperatures and overheating risks posing a serious hazard in Scotland, it is important that building regulations support the installation and proper maintenance of appropriate ventilation and cooling adaptation measures when considering energy efficiency.

Social determinants of mental health were also present in our analysis of transport-related climate action. Prioritising active travel has potential wellbeing benefits through increased physical activity, reduced noise and air pollution, and improved community relationships. It is also important to take an equitable approach to transport policy to ensure vulnerable groups are able to take advantage of its benefits.

Climate action using nature-based solutions demonstrated similar opportunities for improving mental health and wellbeing through increased physical activity and a greater sense of community. However, nature-based solutions offer the most benefits for those who live in more affluent areas given that they have better access to green spaces and resources than deprived areas. Active measures to improve access for all groups within society to green spaces and natural environments can address this inequality.

7.2 Lessons for policy in Scotland

It is clear from our research that climate change represents a risk to the mental health and wellbeing of the Scottish population. In this section we discuss the main implication of our findings for policy.

7.2.1. Focus on risk areas

Mental health risks related to climate change derive from three main factors: people's exposure to or awareness of climate related hazards; their existing vulnerabilities to poor mental health; and their access to resources and support. In general, each of these factors is potentially the site of policy intervention.

- **Exposure to hazards**: A primary way to address climate change-related impact on mental health is by addressing climate change itself at a macro-level through climate action (adaptation and mitigation). By lessening the frequency and severity of hazards and managing the severity of their impacts on communities, infrastructure, and services, one can reduce its impacts on mental health outcomes. Put simply, actions will prevent disruptions to the conditions for positive mental health.
- **Existing vulnerabilities**: As our research shows, climate change acts as an amplifier of existing vulnerabilities, which are the result of social, economic and demographic factors such as poverty, inequality and social exclusion. By working at a societal level to address the main causes of vulnerability to poor mental health outcomes, you reduce individual and groups vulnerabilities to the additional stressors caused by climate change. The effects of climate change are only one factor among many that impact population mental health. Taking steps to build a healthier and more resilient population will help protect against these impacts.
- **Access to resources and support**: Finally, a key determinant of mental health outcomes is people's access to timely and appropriate support to recover from

emergencies, or navigate the disruption caused to lives and livelihoods by climate hazards. Improving the comprehensiveness and accessibility of support in relation to the main hazards (e.g., emergency services, welfare and social services, health and mental health support) is likely to reduce the negative impact of climate change on population mental health. While there is also a need for targeted and climate change-specific interventions, mainstream services have a strong role to play in protecting the population from negative outcomes.

7.2.2. Prioritise areas of urgency and vulnerability

There is a growing body of risk analysis that predicts the most common and impactful climate-related hazards in Scotland. These are flooding, increased temperatures and loss of coastal land. Risk analyses also note the growing risk offered by droughts, poor air quality, and biodiversity loss. There is also an increasing understanding of populations most at risk from these hazards, determined by their exposure to the hazards (i.e., geographical in the case of flood risk or sea-level rises) and social vulnerabilities in terms of social, economic, demographic factors, and living circumstances. With this knowledge, responses may include for example:

- **Integrating mental health awareness/response into emergency response**, as more evidence shows the negative mental health consequences of involvement in emergencies, and which groups are most vulnerable to these impacts. Incorporating a mental health lens to emergency response may help reduce the negative mental health impacts. Targeted support for vulnerable people caught up in climate-related emergencies may reduce the prevalence, duration and severity of poor mental health outcomes. This should involve developing cross-sector plans for emergency response prior to emergencies that integrates mental health awareness and support, combined with early identification of mental health concerns and intervention in the event of a climate-related emergency.
- **Specific action about temperature for the most vulnerable**: In addition to public health information provision aimed at increasing heat awareness and reducing the impact of temperature on population mental health, there may be value in identifying people at most risk of poor outcomes via their contact with services. This may require the provision of training and awareness raising for professionals. It is also important to ensure that settings with high proportions of vulnerable people such as healthcare and care settings are equipped to manage high temperatures.
- **Support for groups whose livelihoods are impacted by climate change and climate action**: Our research identifies groups whose livelihoods may be affected by climate change in the long run, such as agricultural and fisheries workers, those who work in the tourism industry and groups who work in high-emissions industries such as oil and gas whose livelihoods may be affected by the planned transition to net zero. Policymakers should consider measures to mitigate negative mental health and wellbeing outcomes from these changes through, for example, the provision of alternative employment and training opportunities, welfare transfers and other forms of support.

- **Managed displacement:** As the effects of climate change advance, it is increasingly likely that communities will be displaced. Our research found that the way this process is managed – whether it is planned and orderly, or unplanned and in response to an emergency – can have a major bearing on mental health and wellbeing. This suggests the importance of long-term planning to identify the most vulnerable communities to work with to manage future displacement.

7.2.3. Reverse disempowerment though building connection and prompting action

A key challenge for policy is to understand climate emotions not only as problems but also as levers and solutions. Emotions are often what lead people to act: “ecological anxiety and grief, although uncomfortable, are in fact the crucible through which humanity must pass to harness the energy and conviction needed for the lifesaving changes now required." (Cunsolo et al, 2020). In short, policy can use care and emotion as assets.

While eco-anxiety affects people from all demographics, young people are particularly exposed to it and it is important that they are supported to help mitigate this. Early evidence suggests that eco-anxiety is lessened where people are empowered to act in their lives, communities and political systems.

One of the most effective areas for action is to identify affected groups and invest in interventions that empower participants and give agency. In practice, direct climate action and preventing/addressing mental health risks are often two sides of the same coin. Addressing helplessness supports a sense of agency and can often trigger people and groups into action. The way people think and feel about climate change influences climate action, and climate action in turn changes emotions related to the environment (Lawrance et al, 2022). This implies that increasing climate agency and action has the potential to reduce the impact of climate distress on mental health and wellbeing, while also improving the climate itself (Lawrance et al, 2022).

7.2.4. Take visible actions

As described above, a key pillar of any response to climate change-related mental health issues is robust, ambitious climate action on mitigation and adaptation. In order to address people’s rational and legitimate anxieties about the future, they need to feel that proportionate action is being taken to address the threats and local, national and supra-national levels. Our review shows that eco-anxiety is linked to the perception of inaction on climate change by government and other actors. While this is a key condition to manage the mental consequences of climate change, action should be coupled with clear and transparent communication.

7.2.5. Public communication about climate change and climate action

The final area found for intervening in the mental health risks of climate change was public communication. Messaging on climate change needs to be viewed through the lens of building resilience and agency or it may increase levels of climate dread and denialism (Hathaway, 2017). For many experiencing eco-distress, the severity of the ecological crisis is such that it is no longer certain that future generations will arrive and thrive. This creates

disorientation. Attempts to shock people with facts or using fear, guilt, or shame to motivate ecological action produce 'defensive rigidity' (Hathaway, 2017).

For many who read shocking news on the climate, full awareness of the crisis may be painful. Psychic distress can be reduced by ''turning down the volume'' instead of acting (Sewall, 1995). Danger signals, which should demand attention and lead to collective action, instead "make us want to pull down the blinds and busy ourselves with other things" (Macy and Brown, 1998). From a mental health standpoint, communication should seek to give agency to those in distress through engaging empathy, cultivating hope and focusing on local level actions rather than provoking guilt.

7.2.6. Select areas for action with existing resources in mind

The scale of climate worry and the necessity for climate action mean that at national, regional and local levels, collaborative efforts should be developed to address the mental health implications of climate change through concrete actions by all key agencies including health and mental health services, and local authorities (Hayes et al, 2018). At present, global studies indicate mental health resources available to intervene specifically in mental health issues arising from climate change are inadequate, insufficient and inequitably distributed (Hayes et al, 2018; Lawrance et al, 2022); As temperatures and climate events increase, investment in effective interventions and climate actions, such as in transport and housing, will be necessary to improve wellbeing of residents in Scotland to cultivate hope and prompt individual and collective action. However, since public finances in Scotland and elsewhere are tight, it is important to build upon existing resources and systems and avoid building a parallel suite of actions:

- The authors recognise that addressing inequalities of access and care are already a priority in the long-term mental health strategy (Mental Health and Wellbeing Strategy) and the latest delivery plan (2023-2025), and recommend that climate change and its impacts be considered in their implementation.
- We found many areas of intervention and adaptation that are either already delivered in Scotland or similar actions are taking place. These include nature-based solutions, social connection interventions and nature connection interventions.

7.2.7. Support monitoring of prevalence and evaluation of interventions and adaptations

Evidence on the prevalence and distribution of mental health impacts of climate change in Scotland is inconsistent with substantial gaps. We suggest more systematic monitoring of key indicators to best target support towards the communities with the greatest need. For example, consider including eco-distress as an item on an existing or new longitudinal survey of the population in Scotland.

It is notable that many interventions and adaptations were delivered with very little attention to measuring the mental health impact on participants. This has led to a limited evidence base on what works to address the mental health and wellbeing impact of climate change, despite many promising and worthy actions in this area. As a result, the scope to have fully evidence-informed confident policy decisions for addressing mental health risks in

this area or to see which outcomes are produced (and can be reproduced) for vulnerable groups in Scotland is also limited.

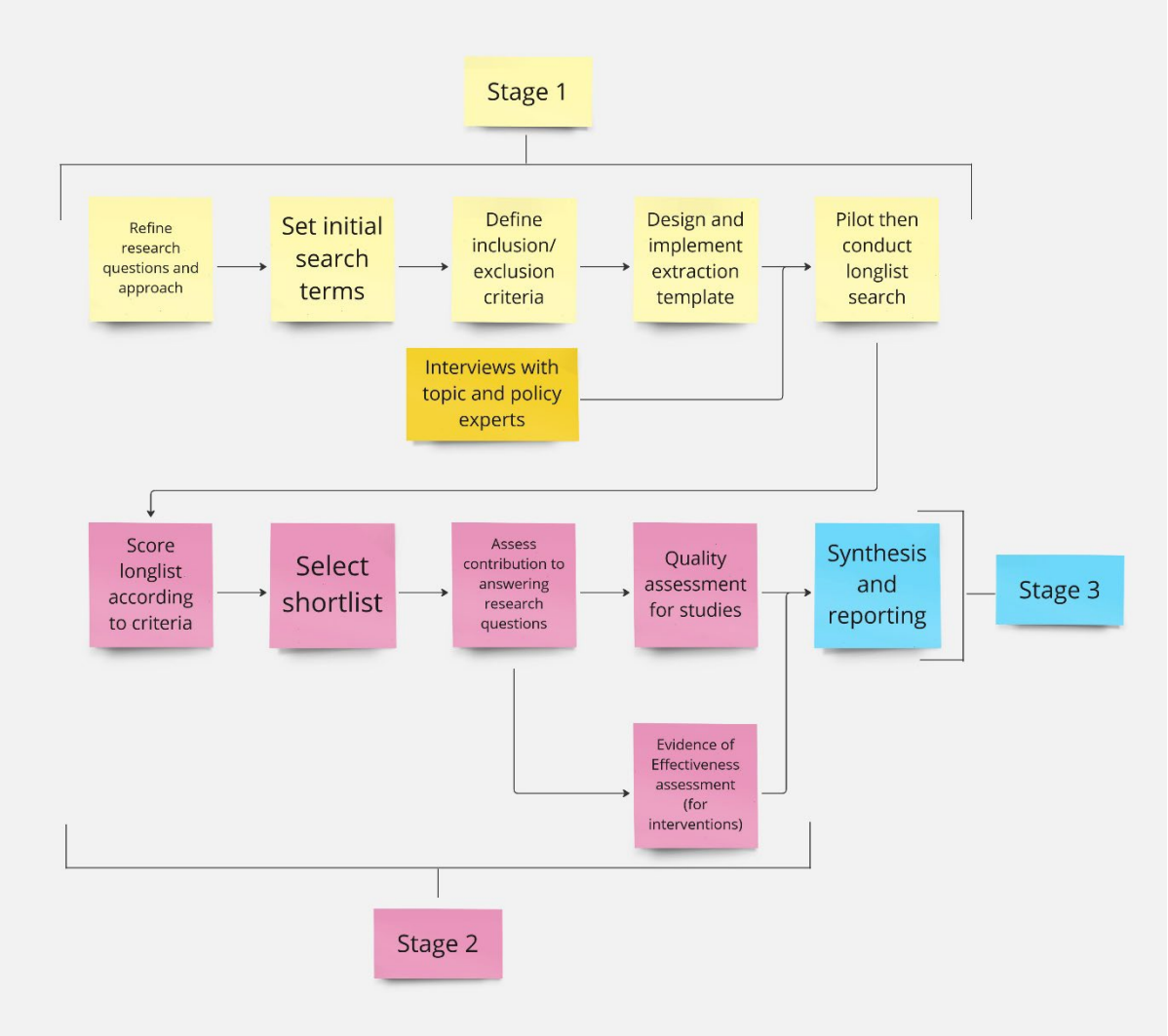
The evidence base could be improved by the adoption of a more holistic vision of climate action, taking a system-wide view to include physical health and mental health not as co-benefits but primary benefits. Further, when commissioning infrastructure, adaptations or interventions, we recommend the inclusion of funding for monitoring and evaluation or access to evaluation resources that have at least some focus on the mental health impact on participants. Given the growing incidence of climate events and climate distress, building a knowledge base now will help policymakers make informed decisions to address the wellbeing impact of climate change in Scotland.

8 Appendix A: Methodology for systematic evidence review

8.1 Process overview

The systematic evidence review was conducted in three sequential stages: (1) scoping and collation and assessment of longlist; (2) collation and assessment of shortlist; and (3) synthesis and reporting. This document provides an overview of these stages and the procedures that were applied.

Figure 2 Workflow for the evidence review



Our approach to this review was designed to produce strongly evidenced answers to four research questions which are collectively targeted at understanding the relationship between climate change and mental health, and how interventions may affect this relationship.

These research questions can be clustered according to whether they relate primarily to population studies or interventions.

8.1.1. Population study based and conceptual questions:

4. What is the evidence of climate related risks and impacts to mental health and wellbeing in Scotland, and how these might differentially affect population groups?
5. How is 'eco-distress' (including 'eco-anxiety') currently defined, what is the current/potential prevalence in Scotland and how might this differentially affect population groups?

In general, these questions were answered by reviewing general population studies (for instance, research addressing how people feel because of climate change) or conceptual studies (for instance, defining relevant concepts or identifying types of causal relationship).

8.1.2. Intervention based questions:

6. What is the evidence on effective prevention and early intervention, and on responding to mental health and wellbeing risks and impacts in a climate change context in Scotland?
7. What is the evidence of co-benefits and risks, or unintended consequences, for mental health and wellbeing from climate action (both mitigation and adaptation) relevant in a Scottish context?

These questions were mainly addressed through analysis of intervention studies (for instance, studies of how people feel following climate change interventions or after a climate adaptation has been delivered).

Given the potential breadth of these questions and the timeline in which to answer them, the study included four interviews with experts who provided an informed overview of the topic areas, including working definitions of key terms, Scotland-specific insights to the topics, and key studies and interventions. With the help of the project steering group and our own searches we identified individuals with expertise in either/ both academic research in relevant fields to the research questions (i.e., mental health and climate change), and relevant Scottish Government policy and practice.

8.2 Stage 1: Collating and assessment of a 'long list' of items

The first stage in the evidence review entailed searching and collating relevant material using search engines and identifying other sources to create a longlist of potentially relevant documents. This involved searching, collating, and defining items for review and entering these into an extraction spreadsheet. The items were drawn from two sources:

8. Items results from search engine searches to identify materials.
9. Items identified through 'snowballing' (recommendations from the Core Team; external experts; other experts; references from other documents)

The documents selected were then assessed and filtered to produce a shortlist. Many of the documents on the longlist were not directly relevant to answer the research questions, therefore were excluded from the shortlist. However, many covered topics tangentially related to mental health and climate change, such as climate migration and job losses, and so were retained in the longlist, shared, and referred to in reporting where relevant to the broader topic or when indicating areas for further research .

8.2.1. Data sources

The searches were performed on a variety of platforms to ensure that two types of sources were identified: i) 'official' published literature, e.g., books; peer reviewed journal articles; formal reports and ii) 'grey' literature, e.g. website material; intervention descriptions; statistics; company data; government policies and actions. Searching was confined to the period 2015-present unless key 'landmark' texts (that have very high levels of citations within the field or are considered to provide key theoretical developments to the field such as coining key terms) and surveys were identified by stakeholders or in other publications that had been published earlier. This search concentrated on the peer reviewed 'academic' and practice literature, mapping concepts, theories, policies, and practices with regard to climate change and mental health.

The sources for materials are set out below.

- Academic search engines (semanticscholar.org and Google Scholar)
- Generic search engines for grey literature (Google)
- Government and other public body websites e.g. https://www.gov.scot/publications/ ; http://www.healthscotland.scot/publications
- References of relevant documents, documents referred to by experts

8.2.2. Search terms

The search terms were structured to answer the four key research questions we needed to cover. This initial list was subject to iteration depending on the search results.

Table 3 Search Terms

Identification of studies		**Identification of interventions**	
Risks	Eco-distress	Prevention/ intervention	Climate action
Wellbeing+risk+"climate chang*"	Eco-anxiet*+defin*	"Mental health"+"climate chang*"	Citizen+"climate action"
"Mental health"+risk+"climate chang*"	"Ecological grief"	"Wellbeing"+"climate chang*"	"Green prescription"
Extent+eco-distress	"Environmental psych*"	Eco-anxiety+treat*	"Climate mitigat*"+wellbeing
Extent+eco-anxiety	"Conservation psych*"	Eco-distress+treat*	"Climate adapt*"+wellbeing

Direct+eco-distress	"Solastalgia"	Eco-distress+"early interv*"	"Public climate action"+wellbeing
Indirect+eco-distress	"Determinants of health"+"climate change"	Eco-distress+"prevent*"	"Just transition"+"Mental health"
Vicarious+eco-distress	Groups+eco-distress	All above +Scotland	"Just transition"+Wellbeing
Flooding+"mental health"	Vulnerable+eco-distress		All above +Scotland
Snow+disruption+"mental health"	All above +Scotland		
Heatwaves+"mental health"			
All above +Scotland			

8.2.3. Entering items in extraction spreadsheet

Each item identified was logged in an excel spreadsheet, one per row, using the following descriptors (column headings):

- Item number – for researcher reference
- Title – of book; article etc.
- Type – book, article, report etc.
- Source – where obtained from
- Authors
- Date – date published
- URL – if exists (data consulted)
- Focus – Short description of which research question(s) it addresses or the focus of the study
- Summary - A brief one- or two-line summary description of the item, e.g. using an 'abstract' of a report or article
- Who – the researcher who inputted the item.

Table 4 Snapshot of longlist extraction template: basic information

Item number	Title	Type	Source	Authors	Date	URL	Focus	Summary	Who
1	Mental health and psychosocial interventions in the context of climate change: a scoping review	Journal article	Author search	Xue S, Massazza A, Akhter-Kahn S	2024	https://www.nature.com/articles/s44184-024-00054-1	Key work for intervention mapping (RQ3)	37 unique interventions or packages of interventions were identified. The interventions act at the levels of microsystem, mesosystem, exosystem, and macrosystem through diverse mechanisms.	DD

8.3 Stage 2: collation and assessment of a 'short list' of items

8.3.1. Inclusion/exclusion criteria

The searching process generated 238 items that were potentially of value. Due to time constraints, only items that were likely to score '1' on domain relevance were included on the longlist. These items had to be separated into the four research areas and assessed for their rigour, relevance and value to the study. This second stage therefore entailed reviewing the material collected though stage 1 in order to select a shortlist of the most relevant items. The checklist below provided a simple way for the research team to rank relevance and consists of applying seven assessment criteria to each item. Table 4 presents the checklist the research team used which was completed by scoring each of the boxes for which the item meets the criteria to arrive at a total 'score'. In order for the shortlist to be relevant to Scotland and include systematic reviews, the two relevant criteria were given double weighting.

Table 5 Inclusion-Exclusion criteria for Data Audit

Criteria	Question	Tick box
1.Domain relevance	Does the item directly cover climate change AND mental health/wellbeing?	o
2. Recency	Is the item up to date (published after 2015)?	o
3. Research relevance	Does the evidence concern Scotland? (score 2 for Scotland, 1 for UK) Does this item address vulnerable/target groups? Does this item address known gaps in our knowledge? Is this item directly relevant to answering a research question? Does this item include high quality primary evidence?[7] Is this item a systematic or scoping review which reviews several studies in one item? (score 2 if so)	o o o o o o
SCORE		0-10

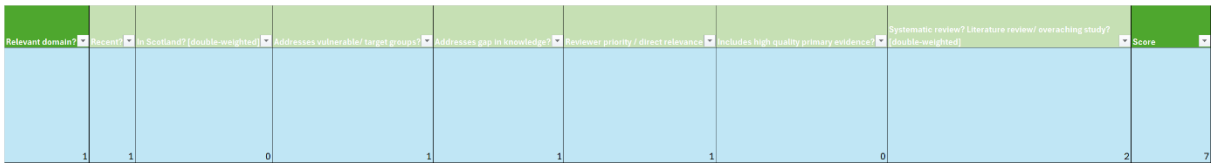
The shortlist selection used the checklist as follows:

- If Criterion 1 not ticked (Domain relevance) then the item was discarded. This includes items relating to potentially indirect effects of climate change, such as the wellbeing impact of losing a job, the impact of migration, that did not explicitly refer to climate change as a cause.
- Make judgement on selection of the remaining items. Firstly, look at the total score. The higher the score, the stronger the case for selecting a particular item for

[7] Evidence quality was assessed using the wording in question 3 for Cluster C, in 8.4.3 below, that is, whether the research was based on an appropriate / well-articulated and justified research approach that is commensurate with the intervention, which could be qualitative, quantitative or mixed methods.

subsequent analysis. Secondly, look at the 'relevance' scores for the items, particularly on whether the study concerned Scotland. The higher the relevance scores the stronger the case for selecting a particular item for subsequent analysis. Finally, check the summaries for the items from the extraction sheet and assess the extent to which they are useful for the study.

Table 6 Snapshot of shortlist extraction template: Inclusion rating



Relevant domain?	Recent?	In Scotland? [double-weighted]	Addresses vulnerable/ target groups?	Addresses gap in knowledge?	Reviewer priority / direct relevance	Includes high quality primary evidence?	Systematic review? Literature review/ overaching study? [double-weighted]	Score
1	1	0	1	1	1	0	2	7

Many items fulfilled several criteria. All items were relevant to at least one research question and only 13 percent were not published since 2015. Close to half (45 percent) of items were scoping or systematic reviews. Fourteen percent directly concerned Scotland since search terms specifying 'Scotland' were included in all searches.

Table 7 Item counts for the shortlisting criteria

Criteria	Number of items fulfilling criteria	Proportion of items which fulfilled criteria
Relevant domain	238	100 percent
Recent	206	87 percent
Concerns Scotland	34	14 percent
Addresses vulnerable/ target groups	120	50 percent
Addresses gap in knowledge	163	68 percent
Direct relevance to a research question	127	53 percent
Includes high quality primary evidence	101	42 percent
Systematic or scoping review	107	45 percent

Table 7 shows that nearly 75 percent of items scored five or above and under 5 percent scored 8 or above. As over 100 items scored between 6 and 10, these high scoring items were the focus of analysis in the analysis and synthesis stage. This scoring system was not infallible, however, and some items were selected from the longlist with lower scores where appropriate. In addition, other items not in the longlist were also added to the analysis where gaps in the literature were found during the analysis stage.

Table 8 Scores of items in the longlist

Score	Item count	Proportion of items
10	1	0.4 percent
9	2	0.8 percent
8	7	3.0 percent
7	45	19.0 percent
6	54	22.8 percent
5	68	28.7 percent
4	31	13.1 percent

3	17	7.2 percent
2	12	5.1 percent
1	1	0.4 percent

8.4 Stage 3: Analysing selected items

Using the results of the shortlisting process, we analysed each item selected in the shortlist and summarised the results of the analysis. The approach taken to answering the research questions differed depending on the nature of the research question.

8.4.1. Analysis for research questions 1 and 2

Content analysis of the material related to research questions 1[8] and 2[9] followed the 'inspection' method. This entails scanning each item of material manually, creating a classification framework and coding constructs to map the occurrence of particular items, and the relationships between them for each research question. This classification frame and set of constructs were then modified and added to as the analysis develops.

The framework is divided into three sections.

Section 1 provides details on the item (name; type of material; source; summary of the content). This was imported from the extraction template.

Section 2 provides a framework for analysing the item. The initial classification framework is a 'first baseline' for the content analysis. Each item was analysed across three dimensions which underwent iteration depending on the results of the exercise:

- A Thematic dimension (column 1), reflecting the key themes and research objectives of the study, using the language of the research questions. For example, determinants of health; unintended effects; prevention.
- Each theme is broken down into a number of sub-themes - 'constructs' - that should be searched for within each item being analysed. These were initially developed following the shortlisting process and undergo further iteration throughout the analysis. For example, exacerbation of health conditions, prevalence of conditions, community-based interventions etc.
- Codes and examples or descriptors of how each construct is treated (described) in the material being analysed should be entered into Column 3. This could include direct quotations from the text/material to help illustrate the study research questions. For example, a paragraph of text on the wellbeing effects of being flooded.

[8] 1. What is the evidence of climate related risks and impacts to mental health and wellbeing in Scotland, and how these might differentially affect population groups?

[9] 2. How is 'eco-distress' (including 'eco-anxiety') currently defined, what is the current/potential prevalence in Scotland and how might this differentially affect population groups?

In Section 3 additional themes, constructs, and descriptors were added as the analysis developed.

We highlighted evidence particularly relevant to Scotland, particularly research examining Scottish or UK populations; relating to common climate change hazards in Scotland (e.g., flooding); or from similar climatic, geographical, or social/governmental contexts.

A 2021 scoping review identified 120 original research studies that examined mental health and climate change. The earliest study identified was published in 2007 with the review finding an increasing trend in the number of studies on this topic each year up to the present (Charlson et al, 2021). As the number of original research studies has increased, there has been a growing number of literature and evidence reviews that summarise the overall state of the field now (Lawrance et al, 2022; Charlson et al, 2021; Cianconi, Betro, and Janiri, 2020; Hayes et al, 2018; Manning and Clayton, 2018). For this reason, we took the decision to focus our analysis on the most recent and highly cited literature and evidence reviews and those with the most robust review methodologies, for this we following adapted Rapid Evidence Assessment protocols from DfID (2015), research quality assessment for each shortlisted study was related to four criteria: conceptual framing, methodological transparency, validity, and relevance. We then supplemented review findings with reference to original studies or additional evidence where useful.

8.4.2. Analysis for research question 3

For answering research question 3[10] the analytical process initially paid close attention to the core dimensions of Realist Synthesis:

- Context (where the studies/interventions were conducted, what part context played in the results for example via geography specific effects)
- Mechanisms that underpinned the effects of interventions (for instance, experiencing a greater sense of agency through direct environmental work)
- Outcomes (which aspects of mental health, other determinants of health are covered)

Individual interventions were identified from the shortlist for research question 3. Systematic reviews and other scoping reviews were then mapped in terms of how they categorised relevant interventions. Areas of overlap were identified and some intervention types were insufficient data were not included in the analysis. This resulted in eight types of intervention being included in the review: Capacity building, Climate justice, Communication, Nature connection, Participation, Practitioner development, Resilience and coping, and Social Connection.

Interventions were then input into a spreadsheet with the following criteria using descriptive text:

- Name

[10] What is the evidence on effective prevention and early intervention, and on responding to mental health and wellbeing risks and impacts in a climate change context in Scotland?

- Level of action
- Location
- Study design
- Climate stressor
- Target population
- Intervention details
- Inclusion of co-design
- Expected mental health outcome (measure)
- Evaluation results

From this, further analysis was conducted on the qualitative data to make a simpler set of codes from the descriptive data. These topics are listed below along with the input options [in square brackets]:

- Location code [Developed country, Global South, UK or Scotland]
- Evidence effectiveness cluster [A, B or C – see below for more details]
- Climate distress [Yes or no]
- Primary subgroup [Any, Indigenous, Low income, Minorities, Poor mental health, Potential activists, Practitioners, Rural, Teachers, Vulnerable, or Youth]
- Primary outcome [Relief from disorders, Reduce distress, Improved wellbeing, Empowerment, Coping self-efficacy, Social capital, Validate emotions, or Optimism]
- Secondary outcome [same list as primary outcomes]
- Primary mechanism [Capacity building, Climate justice, Communication, Nature connection, Participation, Practitioner development, Resilience and coping, and Social connection]
- Secondary mechanism [same list as primary mechanism]

The framework used for assessment of quality of evidence for the interventions is outlined below.

8.4.3. Evidence of Effectiveness Assessment for Interventions

To ensure the appraisal process measures strength of evidence, the research team assessed each identified initiative using a bespoke Standards of Evidence framework we developed for the Medici project called the Evidence Effectiveness Framework. The framework has tight criteria and clusters initiatives into three categories: Cluster A: Innovative Interventions, Cluster B: Effective Interventions, and Cluster C: Replicable Interventions. These clusters and the inclusion criteria are outlined below.

8.4.3.1. Cluster A: Innovative Interventions

Cluster A has a low threshold for inclusion as it is for new, innovative interventions which are prepared for further roll out. This is where many interventions were assigned, since interventions related to eco-distress are likely to be relatively new.

We do not expect new interventions to have been subject to rigorous evaluations. However, a promising intervention should be as prepared as possible through research, specification of the intervention logic, piloting and plans for evaluation.

This cluster includes interventions which have:

- Recently begun delivery
- Have defined and designed their intervention with care
- Are likely to have a positive impact if delivered at scale

Assessment questions

1. Has any research been conducted on this intervention type by the originating organisation?
    - Yes / no
2. Has their intervention been piloted by the originating organisation?
    - Yes / no
3. Is there evidence that the intervention has a defined theory or a Theory of Change?
    - Yes / no
4. Is there an evidence plan to determine whether the intervention makes a difference?
    - Yes / no
5. When was the intervention first delivered?
    - Year/month
6. To what extent can this intervention be considered to be innovative?
    - Likert scale 1-5 from not innovative at all to highly innovative

Threshold for inclusion in Cluster A

Projects must achieve the following to be included in Cluster A:

- Questions 1, 2, 3 & 4 must be 'yes' (or don't know) AND
- Question 5 must be under 5 years ago
- Question 6 must be a '3' or higher.

8.4.3.2. Cluster B: Effective interventions

Cluster B relates to whether the intervention has been shown a positive effect on its target group. This implies a specific evaluation of the project has been implemented, that the evaluation showed a positive effect on relevant outcomes, and that the data which shows this positive effect has been generated using an appropriate methodology.

The questions on methodological fit assume that the intervention logic or theory has been articulated and the methodology is transparent. The question can be answered with respect to which outcomes were measured, how they were measured, and whether (quasi-) experimental methods would be logistically/ethically inappropriate.

This cluster included interventions which have:

- Received one or more evaluation with positive outcomes

- Been evaluated using appropriate methods that support confident conclusions
- Include a well-defined set of outcomes which fits their change model.

Assessment questions

1. Through the data collected and analysed we have seen there is change.
    - Yes / no
2. Is / are the outcome evaluation(s) based on an appropriate / well-articulated and justified evaluation approach that is commensurate with the intervention? This could be either "qual" and/or "quant".
    - Yes / no
3. How well has the study has been implemented / methodological issues (like sample sizes) been considered to allow rigorous conclusions to be drawn?
    - Likert scale of 1 - 5

Threshold for inclusion in Cluster B

An intervention was included in Cluster B if it:

- Answers 'yes' to question 1 and 2 AND
- Scores 3 out of 5 or above for question 3.

8.4.3.3. Cluster C: Replicable interventions

This is the final cluster in the evidence of effectiveness rating system. It is for interventions that already have a strong evidence base behind them that has been generated by a number of evaluations which may also have been implemented in different locations or by applying the intervention with different target groups.

This cluster is differentiated from Cluster B as the evaluations should provide a higher degree of confidence that the intervention has caused or contributed towards the change observed. The evidence provided may be qualitative or quantitative and ideally, combine the two. The chosen methods need to be embedded in, and appropriate to, a well justified evaluation approach and implemented to provide the best data possible.

This cluster included interventions which have:

- Received more than one evaluation with positive outcomes (without replication but with increasing rigour)
- Been replicated and evaluated in the replication destination
- Both of the above.

We have included flexibility as to whether the cluster requires interventions to have been replicated as we feel that there is otherwise too great a distance between the requirements for cluster B and C.

Assessment questions

1. Does the project have a Theory of Change and if so, does this theory of change include evidence based / realistic outcomes that have been shown to materialise (for the target group / beneficiaries)?

- Yes / no

2. Are the outcome evaluations based on an appropriate / well-articulated and justified evaluation approach that is commensurate with the intervention? This could be either "qual" and/or "quant".
   - Yes / no
3. How well have the studies been implemented / methodological issues (like sample sizes) been considered to allow rigorous conclusions to be drawn?
   - Likert scale of 1 - 5
4. Has more than one evaluation of this intervention been conducted by an independent evaluator? These evaluations could be in one location or multiple locations.
   - Yes / no

Threshold for inclusion

Projects must achieve the following to be included in Cluster C:

- Questions 1, 2 & 4 must be 'yes' AND
- Question 3 must be a '3' or higher.

The analysis resulted in 60 interventions being categorised

Table 9 Count of evidence effectiveness categorisation

Evidence Effectiveness Cluster	Count of interventions	Proportion of interventions
A - Innovative interventions	35	61 percent
B - Effective interventions	14	25 percent
C - Replicable Interventions	8	14 percent

The full list of interventions can be found in Appendix D.

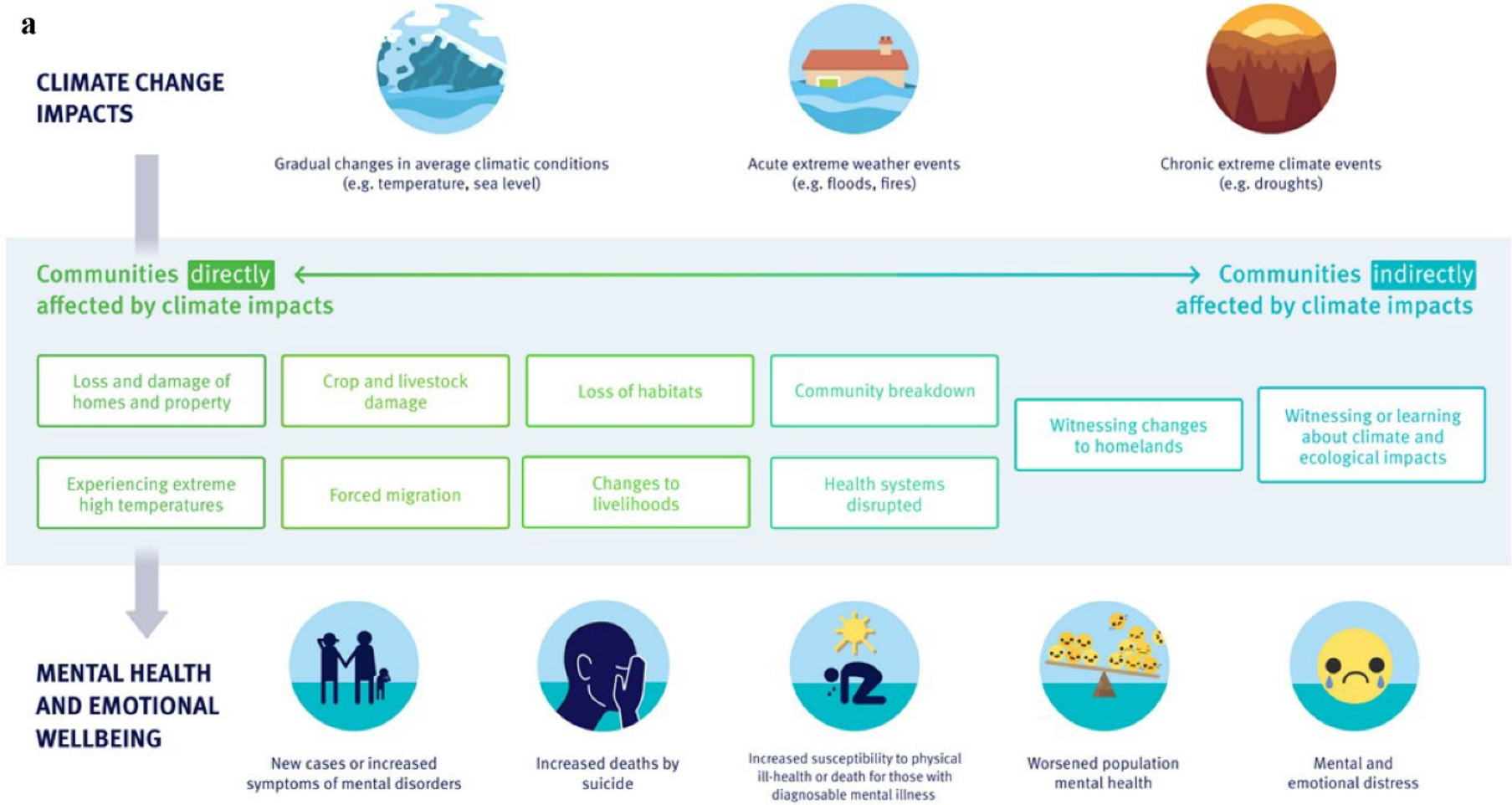
8.4.4. Analysis for research question 4

As stated in Chapter 6, analysis of research question 4[11] on the co-benefits of climate adaptation and mitigation largely followed the same process as the three sections outlined for research questions 1 and 2: identifying themes, sub-themes and key extracts from studies, then using this as a basis for further analysis. This resulted in 22 high quality sources being reviewed which related to the co-benefits and risks of climate action for mental health and wellbeing.

[11] What is the evidence of co-benefits and risks, or unintended consequences, for mental health and wellbeing from climate action (both mitigation and adaptation) relevant in a Scottish context?

9 Appendix B: Causal pathways between climate change and mental health

Figure Illustrates Lawrance et al (2022)'s idea of a continuum of casual pathways between climate change and mental health (from direct to indirect), starting with the main hazards at the top of the diagram leading through to the main mental health outcomes at the bottom via many possible casual pathways.



10 Appendix C: Shortlisted items from the Realist Synthesis Review

Item number	*Reference*	*Summary*	*Score*	*RQ1*	*RQ2*	*RQ3*
191	Douglas, M. J., Teuton, J., Macdonald, A., Whyte, B., & Davis, A. L. (2023). Road space reallocation in Scotland: A health impact assessment. Journal of Transport & Health, 30, 101625.	We conducted a health impact assessment to identify and assess the potential impacts of road space reallocation on health and health inequalities in Scotland. This involved a facilitated scoping workshop to identify potential impacts, collation of routine data, interviews with 13 key informants and a rapid review of research literature.	10			x
152	Fazey, I., Carmen, E., Rao-Williams, J., Hodgson, A., Fraser, J., Cox, L., Scott, D., Tabor, P., Robeson, D., Searle, B., Lyon, C., Kenter, J. O., & Murray, B. (2017). Community Resilience to Climate Change: Outcomes of the Scottish Borders Climate Resilient Communities Project. University of Dundee	This report presents findings from an action research project conducted in the Scottish Borders between May 2015 and September 2016. The project aimed to: 1) Support a local process of community change through building partnerships, learning and capacity building; and 2) Understand the critical factors involved in facilitating the development of community resilience to climate change to draw out key levers for change nationally.	9	x		x
266	Curl, A., & Kearns, A. (2017). Housing improvements, fuel payment difficulties and mental health in deprived communities. International Journal of Housing Policy, 17(3), 417–443. https://doi.org/10.1080/14616718.2016.1248526	This paper examines the effect of warmth interventions on self-reported difficulties affording fuel bills and mental health, using a longitudinal sample in Glasgow, UK	9			x
149	Houston, D., Werritty, A., Ball, T., & Black, A. (2021). Environmental vulnerability and resilience: Social differentiation in short- and long-term flood impacts. Transactions of the Institute of British Geographers, 46(1), 102-119.	Survey of representative samples (n = 593) of households up to 12 years after they were flooded, one of the first to provide detailed analysis of social differentiation in long-term flood impacts. Social differentiation in flood impacts is relatively small soon after a flood, but widens over time, with socially disadvantaged groups displaying less recovery.	8	x	x	

156	Tieges, Z., McGregor, D., Georgiou, M., Smith, N., Saunders, J., Millar, R., ... & Chastin, S. (2020). The impact of regeneration and climate adaptations of urban green–blue assets on all-cause mortality: a 17-year longitudinal study. International journal of environmental research and public health, 17(12), 4577.	The present observational study used a unique 17-year longitudinal natural experiment of canal regeneration from complete closure and dereliction in North Glasgow in Scotland, U.K. to explore the impact of green and blue canal assets on all-cause mortality as a widely used indicator of general health and health inequalities.	8		x
162	Salvador Costa, M. J., Leitão, A., Silva, R., Monteiro, V., & Melo, P. (2022). Climate change prevention through community actions and empowerment: a scoping review. International journal of environmental research and public health, 19(22), 14645.	As society tries to tackle climate change around the globe, communities need to reduce its impact on human health. The purpose of this review is to identify key stakeholders involved in mitigating and adapting to climate change, as well as the type and characteristics of community empowerment actions implemented so far to address the problem.	8	x	
197	Jill Muirie (2017) Active travel in Glasgow: what we've learned so far. Report for the Glasgow Centre for Population Health	This report follows the synthesis of ten years of GCPH evidence published in October 2014 which emphasised, in line with international evidence, the importance of economic, environmental and social factors on health.	8		x
227	Paavola, J. (2017). Health impacts of climate change and health and social inequalities in the UK. Environmental Health, 16, 61-68.	This article examines how social and health inequalities shape the health impacts of climate change in the UK, and what the implications are for climate change adaptation and health care provision. Exposure to heat and cold, air pollution, pollen, food safety risks, disruptions to access to and functioning of health services and facilities, emerging infections and flooding are examined as the key impacts of climate change influencing health outcomes. Age, pre-existing medical conditions and social deprivation are found to be the key (but not only) factors that make people vulnerable and to experience more adverse health outcomes related to climate change impacts.	8	x	

231	Dunnell, K., Farager, R., Haberman, S., Leon, D., Price, D. & Sloman, D. (2022). The current and future effects of climate change on health in the UK. Longevity Science Panel.	UK focus on health effects of Climate Change	7.5	x	x
2	Hayes, K., Blashki, G., Wiseman, J., Burke, S., & Reifels, L. (2018). Climate change and mental health: risks, impacts and priority actions. International journal of mental health systems, 12, 1-12.	This article provides an overview of the current and projected climate change risks and impacts to mental health and provides recommendations for priority actions to address the mental health consequences of climate change.	7	x	x
3	Hayes, K., Berry, P. and Ebi, K.L., 2019. Factors influencing the mental health consequences of climate change in Canada. International journal of environmental research and public health, 16(9), p.1583.	A scoping review of literature published during 2000–2017 explored risks, impacts, and vulnerabilities related to climate change and mental health.	7	x	x
5	Charlson, F., Ali, S., Benmarhnia, T., Pearl, M., Massazza, A., Augustinavicius, J., & Scott, J. G. (2021). Climate change and mental health: a scoping review. International journal of environmental research and public health, 18(9), 4486.	This scoping review aims to assess the available literature related to climate change and mental health across the World Health Organisation's (WHO) five global research priorities for protecting human health from climate change.	7	x	x
24	World Health Organization. (2021). COP26 special report on climate change and health: the health argument for climate action.	The 10 recommendations in the COP26 Special Report on Climate Change and Health propose a set of priority actions from the global health community to governments and policy makers. The recommendations were developed in consultation with over 150 organizations and 400 experts and health professionals.	7	x	

26	Berry, H. L., Waite, T. D., Dear, K. B., Capon, A. G., & Murray, V. (2018). The case for systems thinking about climate change and mental health. Nature climate change, 8(4), 282-290.	The authors outline current thinking about climate change and mental health, and discuss crucial limitations in modern epidemiology for examining this issue. A systems approach, complemented by a new style of research thinking and leadership, can help align the needs of this emerging field with existing and research policy agendas.	7	x	x
28	Hickman, C., Marks, E., Pihkala, P., Clayton, S., Lewandowski, R. E., Mayall, E. E., ... & Van Susteren, L. (2021). Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. The Lancet Planetary Health, 5(12), e863-e873.	We surveyed 10 000 children and young people (aged 16–25 years) in ten countries (Australia, Brazil, Finland, France, India, Nigeria, Philippines, Portugal, the UK, and the USA; 1000 participants per country).Data were collected on participants' thoughts and feelings about climate change, and government responses to climate change.	7	x	x
47	Ma, T., Moore, J., & Cleary, A. (2022). Climate change impacts on the mental health and wellbeing of young people: A scoping review of risk and protective factors. Social Science & Medicine, 301, 114888.	The article reviews evidence on the scope and nature of the climate change challenge; reviews how these impacts manifest themselves in insecurity at diverse scales; and examines evidence on the political economy of adaptation responses to these impacts.	7	x	
56	Dooley, L., Sheats, J., Hamilton, O., Chapman, D., & Karlin, B. (2021). Climate change and youth mental health: Psychological impacts, resilience resources, and future directions. Los Angeles, CA: See Change Institute.	this report: (1) synthesizes a decade of research on climate and mental health with a focus on youth and BIPOC, (2) shares a framework of the key components of climate resilience / anxiety interventions, and (3) highlights promising approaches in schools, families, communities, and clinical settings for climate anxiety support. synthesized over a decade of research and theory on climate change and mental health, with a focus on youth and BIPOC groups.	7		x

84	Elaine C Flores, Laura J Brown, Ritsuko Kakuma, Julian Eaton and Alan D Dangour. Mental health and wellbeing outcomes of climate change mitigation and adaptation strategies: a systematic review 2023 IOP Publishing Ltd Environmental Research Letters, Volume 19, Number 1	We included controlled, quasi-experimental, pilot, and focussed case studies reporting mental health or wellbeing outcomes assessments of climate change mitigation and adaptation strategies.	7		x
101	Kirby, M., & Scott,. AJ. (2023). Green Blue Infrastructure Impacts on Health and Wellbeing; A Rapid Evidence Assessment: CAPE, University College London.	This rapid evidence assessment assesses current knowledge in the academic literature concerning the impacts of Green Blue Infrastructure on people's health and wellbeing in the UK, and the implications therein for policy and practice and its use in Parliamentary work.	7		x
102	Grey, C.N.B., Jiang, S., Nascimento, C. et al. The short-term health and psychosocial impacts of domestic energy efficiency investments in low-income areas: a controlled before and after study. BMC Public Health 17, 140 (2017).	This study examined the relationship between energy efficiency investments to homes in low-income areas and mental and physical health of residents, as well as a number of psychosocial outcomes likely to be part of the complex relationship between energy efficiency measures and health outcomes.	7		x
110	Sanna Markkanen & Annela Anger-Kraavi (2019) Social impacts of climate change mitigation policies and their implications for inequality, Climate Policy, 19:7, 827-844,	This paper synthesizes evidence from the existing literature on social co-impacts of climate change mitigation policy and their implications for inequality.	7		x
113	Miller ME, Nwosu CO, Nyamwanza AM, Jacobs PT. Assessing Psychosocial Health Impacts of Climate Adaptation: A Critical Review. NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy. 2023;33(1):37-50.	This critical review seeks to contribute towards closing this gap through a synthesis of current literature on the psychosocial health outcomes of climate adaptation actions.	7	x	x

121	Hayward, G., & Ayeb-Karlsson, S. (2021). 'Seeing with Empty Eyes': a systems approach to understand climate change and mental health in Bangladesh. Climatic Change, 165(1), 29.	hree databases were searched for English primary qualitative studies published between 2000 and 2020. Out of 1202 publications, 40 met the inclusion criteria. This systematic review applies a systems approach to further understand Bangladesh's 'climate-wellbeing' network. The literature indicates diverse factors linking environmental stress and mental ill-health including four key themes: (1) post-hazard mental health risks, (2) human (im)mobility, (3) social tension and conflict, and (4) livelihood loss and economic hardship. This systems analysis also revealed that people's mental wellbeing is strongly mediated by socio-economic status and gender.	7	x	
134	Vergunst, F., & Berry, H. L. (2022). Climate change and children's mental health: a developmental perspective. Clinical Psychological Science, 10(4), 767-785.	Drawing on a developmental life-course perspective, we show that climate-change-related threats can additively, interactively, and cumulatively increase psychopathology risk from conception onward; that these effects are already occurring; and that they constitute an important threat to healthy human development worldwide.	7	x	x
138	Thoma, M. V., Rohleder, N., & Rohner, S. L. (2021). Clinical ecopsychology: the mental health impacts and underlying pathways of the climate and environmental crisis. Frontiers in psychiatry, 12, 675936.	This synergy of literature provides a current summary of the adverse mental health impacts of the climate and environmental crisis from the perspective of Clinical Psychology. Furthermore, it presents potential underlying processes, including biological, emotional, cognitive, behavioral, and social pathways.	7	x	x
146	Cianconi, P., Hanife, B., Grillo, F., Lesmana, C. B. J., & Janiri, L. (2023). Eco-emotions and Psychoterratic syndromes: reshaping mental health assessment under climate change. The Yale Journal of Biology and Medicine, 96(2), 211.	Paper focusses on what it describes as emergent 'eco-emotions' and 'psychoterratic syndromes', i.e. psychological categories resultant from the existential (mortal/cultural/societal/personal) threat posed by climate/ecological crises. Owing to this clinical angle, it further distinguishes between phsychological distress resulting in 'positive outcomes' (i.e. pro-environmental behaviours/actions) and those which result in psychotherapy - a means of stressing that eco-anxiety should not be pathologised, while acknowledging that eco-anxiety can result in outcomes that require theraputic interventions that have been considered in light of eco-anxiety as a distinct category.	7	x	x

148	Brophy, H., Olson, J., & Paul, P. (2023). Eco-anxiety in youth: An integrative literature review. International journal of mental health nursing, 32(3), 633-661.	This literature review aimed to summarize the relevant works on eco-anxiety in young people, provide a critique of the literature, identify gaps, and discuss the relevance to nursing practice.	7	x	x	
150	Werritty, A., Houston, D., Ball, T., Tavendale, A., & Black, A. (2007). Exploring the social impacts of flood risk and flooding in Scotland.	This report presents the findings of a social research project, the aim of which was to assess the range of impacts that experience of recent flooding in Scotland has had on people, their attitudes and behaviours; and to establish "what works" with particular popluation groups and locations in relation to flood prevention campaigns and flood warning/dissemination systems.	7		x	
154	Liski, A.H., Ambros, P., Metzger, M.J. et al. Governance and stakeholder perspectives of managed re-alignment: adapting to sea level rise in the Inner Forth estuary, Scotland. Reg Environ Change 19, 2231–2243 (2019).	We interviewed 16 local organisations, landowners and farmers and held workshops with 109 citizens living the Inner Forth estuary in eastern Scotland, to examine how managed realignment is supported by stakeholder attitudes and their engagement.	7			x
157	Lawrance, E. L., Jennings, N., Kioupi, V., Thompson, R., Diffey, J., & Vercammen, A. (2022). Psychological responses, mental health, and sense of agency for the dual challenges of climate change and the COVID-19 pandemic in young people in the UK: an online survey study. The Lancet Planetary Health, 6(9), e726-e738.	The COVID-19 pandemic and climate change are affecting the wellbeing of UK young people in distinct ways, with implications for health service, policy, and research responses. There is a need for mental health practitioners, policy makers, and other societal actors to account for the complex relationship between climate agency, distress, and mental wellbeing in young people.	7	x	x	
161	Majekodunmi, M., Emmanuel, R., & Jafry, T. (2020). A spatial exploration of deprivation and green infrastructure ecosystem services within Glasgow city. Urban Forestry & Urban Greening, 52, 126698.	We map potential of ecosystem services within urban areas to provide cooling and increase resilience to surface flooding and highlight the geographical mismatch between social deprivation and the preponderance of these ecosystem services. We explore the implications for a ‘climate just transition’ using GI as a performance indicator. (Glasgow)	7	x		x

201	Hannon, M. J., Cairns, I., Combe, M., Cooper, E., Davidson, M., Kerr, F., McDonnell, A., Phillips, P., Potts, T., Reay, D., Roberts, J., Wharmby, C. Carbon Offsetting and Communities: Can Nature-Based Voluntary Carbon Offsetting Benefit Scottish Communities?, Workshop Report University of Strathclyde, Glasgow, https://doi.org/10.17868/strath.00083777	This briefing note captures the outputs of a workshop, involving team members and guest speakers, from the University of Strathclyde led project: Carbon Offsetting and Communities: co-developing alternative place-based voluntary offsets in Scotland.	7	x		
213	N. Kabisch et al. (2017), Nature-based Solutions to Climate Change Adaptation in Urban Areas, Theory and Practice of Urban Sustainability Transitions, DOI 10.1007/978-3-319-56091-5_1	This book brings together experts from science, policy and practice to provide an overview of our current state of knowledge on the effectiveness and implementation of nature-based solutions and their potential to the provision of ecosystem services, for climate	7			x
224	Budziszewska, M., & Kałwak, W. (2022). Climate depression. Critical analysis of the concept. Psychiatr. Pol, 56(1), 171-182.	The aim of this paper is to discuss the challenge posed to mental health by climate change. Our inquiry is based on literature review and original qualitative studies. The data are collected from both desk research and in-depth interviews with participants belonging to following groups: high school and university students, young parents, activists, and psychotherapy patients. This paper also offers the critical review of contemporary terminology used for mental health problems and emotions appearing in the context of climate change, as well as the history of scientific interest in the issue at hand	7		x	

228	Lee, H., Kim, H., & Pehlivan, N. (2023). Heat exposure and mental health in the context of climate change. In Heat Exposure and Human Health in the Context of Climate Change (pp. 155-187). Elsevier.	This investigation aims to determine the impacts of heat exposure on mental health, in a climate change context, by reviewing the literature systematically to contribute to establishing appropriate public health policies and interventions for mental health. Findings are classified into five categories as diagnosed mental disorders and illnesses, suicides, violence, subjective wellbeing, and other outcomes. The mental health outcomes affected by heat exposure consisted of mortality due to mental illnesses, hospitalizations, emergency department or outpatient visits, aggravation of symptoms, incidence of mental disorders, dementia, suicide, and violence including assault and crime.	7	x	
4	Palinkas, L. A., & Wong, M. (2020). Global climate change and mental health. Current opinion in psychology, 32, 12-16.	Poor mental health is associated with three different forms of climate-related events. Depression, anxiety, and post-traumatic stress are the most common impacts. Impacts represent both direct and indirect consequences of global climate change. Children and residents of low and middle-income countries are especially vulnerable. Understanding impact scope and scale is critical for prevention and treatment.	6	x	
23	Coffey, Y., Bhullar, N., Durkin, J., Islam, M. S., & Usher, K. (2021). Understanding eco-anxiety: A systematic scoping review of current literature and identified knowledge gaps. The Journal of Climate Change and Health, 3, 100047.	Scoping review aims to understand 1. how eco-anxiety was operationalized in the existing literature, and 2. the key characteristics of eco-anxiety. Specifically, it seeks to address some conceptual nuance that is overlooked Hence, it focusses on eco-anxiety, not simply as a byword for negative emotions stemming from climate change, but on anxiety as a trauma response to climate change.	6		x
27	Cianconi, P., Betrò, S., & Janiri, L. (2020). The impact of climate change on mental health: a systematic descriptive review. Frontiers in psychiatry, 11, 490206.	163 items were selected. We looked for the association between classical psychiatric disorders such as anxiety schizophrenia, mood disorder and depression, suicide, aggressive behaviors, despair for the loss of usual landscape, and phenomena related to climate change and extreme weather.	6	x	

45	Ma, T., Moore, J., & Cleary, A. (2022). Climate change impacts on the mental health and wellbeing of young people: A scoping review of risk and protective factors. Social Science & Medicine, 301, 114888.	This review scopes the current research on what and how RFs and PFs are related to the mental health impacts of both direct and indirect exposure to climate change for young people. RFs and PFs were reviewed through the lens of ecological system theory.	6	x		
63	Ojala, M., Cunsolo, A., Ogunbode, C. A., & Middleton, J. (2021). Anxiety, worry, and grief in a time of environmental and climate crisis: A narrative review. Annual review of environment and resources, 46(1), 35-58.	Climate change worry, eco-anxiety, and ecological grief are concepts that have emerged in the media, public discourse, and research in recent years. However, there is not much literature examining and summarizing the ways in which these emotions are expressed, to what processes they are related, and how they are distributed. This study finds that negative emotions regarding environmental problems are normal, and often constructive, responses. Yet, given the nature, range, and extent of these emotions, it is important to identify diverse place-based and culturally relevant strategies to help people cope.	6		x	
78	Bikomeye JC, Rublee CS, Beyer KMM. Positive Externalities of Climate Change Mitigation and Adaptation for Human Health: A Review and Conceptual Framework for Public Health Research. Int J Environ Res Public Health. 2021 Mar 3;18(5):2481.	We briefly summarize the burden of climate change on global public health, describe important mitigation and adaptation strategies, and present key health benefits by giving context specific examples from high, middle, and low-income settings. We then provide a conceptual framework to inform future global public health research	6			x
100	Anastasia Baka & Leslie Mabon (2022) Assessing equality in neighbourhood availability of quality greenspace in Glasgow, Scotland, United Kingdom, Landscape Research, 47:5, 584-597	We assess the relationship between neighbourhood-level deprivation and local greenspace quality in Glasgow, Scotland...unlock the health, wellbeing and resilience benefits that good quality greenspace can provide.	6			x

106	Aylward, B., Cunsolo, A., Vriezen, R., & Harper, S. L. (2022). Climate change is impacting mental health in North America: A systematic scoping review of the hazards, exposures, vulnerabilities, risks and responses. International Review of Psychiatry, 34(1), 34-50.	This scoping review systematically examined the nature, range and extent of published research in North America that investigates climate-mental health interactions.	6	x
132	Comtesse, H., Ertl, V., Hengst, S. M., Rosner, R., & Smid, G. E. (2021). Ecological grief as a response to environmental change: a mental health risk or functional response?. International journal of environmental research and public health, 18(2), 734.	In this study, we examined how negative climate-related emotions relate to sleep and mental health among a diverse non-representative sample of individuals recruited from 25 countries, as well as a Norwegian nationally-representative sample. Overall, we found that negative climate-related emotions are positively associated with insomnia symptoms and negatively related to self-rated mental health in most countries.	6	x
137	Tang, K. H. D. (2021). Climate change and its impacts on mental wellbeing. Glob Acad J Humanit Soc Sci, 3(4), 144-151.	This review aims to examine the impacts of climate change on people's mental wellbeing . To achieve the aim, relevant peer-reviewed scholarly articles published between 2000 and 2021. climate change could affect mental health in multiple ways including the experience of mild stress, distress, sleep disturbances, depression and anxiety. Extreme weather events posing risks to life could trigger post-traumatic stress disorder, depression, anxiety, substance abuse and even suicidal thoughts, in addition to disrupting social support and networks. Gradual climate change yields less dramatic impacts on mental wellbeing. Global warming is associated with transient mental disorders, episodic mood disorders and higher inclination towards aggression while rising sea level stirs fears and worries of inundation, safety and food security. Melting ice changes landscape and triggers solastalgia besides loss of individual identity.	6	x

212	Irena Leisbet Ceridwen Connon, Extreme weather, complex spaces and diverse rural places: An intra-community scale analysis of responses to storm events in rural Scotland, UK, Journal of Rural Studies, Volume 54, 2017, Pages 111-125, ISSN 0743-0167	The article makes the claim that policies and practices of Disaster Risk Reduction, including the Scottish Community Resilience initiatives, need to focus more on the intra-community scale in rural settings in order to better protect residents from the risks that extreme weather poses to human wellbeing.	6	x	
223	Mullins, J., & White, C. (2018). Temperature, climate change, and mental health: Evidence from the spectrum of mental health outcomes. Working Papers 1801. Polytechnic State University, Department of Economics, California.	We find that higher temperatures increase emergency department visits for mental illness, suicides, and self-reported days of poor mental health. Specifically, cold temperatures reduce negative mental health outcomes while hot temperatures increase them. Our estimates reveal no evidence of adaptation, instead the temperature relationship is stable across time, baseline climate, air conditioning penetration rates, accessibility of mental health services, and other factors. The character of the results suggests that temperature affects mental health very differently than physical health, and more similarly to other psychological and behavioral outcomes.	6	x	
264	Roe JJ, Thompson CW, Aspinall PA, Brewer MJ, Duff EI, Miller D, Mitchell R, Clow A. Green space and stress: evidence from cortisol measures in deprived urban communities. Int J Environ Res Public Health. 2013 Sep 2;10(9):4086-103. doi: 10.3390/ijerph10094086. PMID: 24002726; PMCID: PMC3799530.	This study extends an earlier exploratory study showing that more green space in deprived urban neighbourhoods in Scotland is linked to lower levels of perceived stress and improved physiological stress as measured by diurnal patterns of cortisol secretion.	6		x
267	Houlden V, Weich S, Porto de Albuquerque J, Jarvis S, Rees K (2018) The relationship between greenspace and the mental wellbeing of adults: A systematic review. PLoS ONE 13(9): e0203000.	A systematic review of the evidence for associations between greenspace and mental wellbeing, stratified by the different ways in which greenspace has been conceptualised in quantitative research.	6		x

17	Hiscock R, Mudu P, Braubach M, Martuzzi M, Perez L, Sabel C. Wellbeing Impacts of City Policies for Reducing Greenhouse Gas Emissions. International Journal of Environmental Research and Public Health. 2014; 11(12):12312-12345.	Based on survey data (n = 763) from Suzhou, this study used Generalized Estimation Equation approach to model external conditions associated with wellbeing. Then, semi-quantitative analyses were conducted to provide a first indication to whether local climate change policies promote or conflict with wellbeing through altering these conditions.	5			x
21	Hiscock, R., Asikainen, A., Tuomisto, J., Jantunen, M., Pärjälä, E., & Sabel, C. E. (2017). City scale climate change policies: Do they matter for wellbeing?. Preventive medicine reports, 6, 265-270.	It is increasingly realised that enacting climate adaptation policies will have unintended implications for public health, but there has been less focus on their implications for wellbeing. Survey designed to measure living conditions and levels of wellbeing in Kuopio, Finland.	5			x
22	Hiscock R, Mudu P, Braubach M, Martuzzi M, Perez L, Sabel C. Wellbeing Impacts of City Policies for Reducing Greenhouse Gas Emissions. International Journal of Environmental Research and Public Health. 2014; 11(12):12312-12345.	We illustrate how wellbeing can be divided into objective and subjective aspects which can be measured quantitatively; our review of measures informs the development of a theoretical model linking wellbeing to policies which cities use to reduce greenhouse gas emissions.	5			x
35	Berry, H. L., Bowen, K., & Kjellstrom, T. (2010). Climate change and mental health: a causal pathways framework. International journal of public health, 55, 123-132.	We propose an explanatory framework to enhance consideration of how these effects may operate and to encourage debate about this important aspect of the health impacts of climate change.	5	x		
40	Lawrance, E. L., Thompson, R., Newberry Le Vay, J., Page, L., & Jennings, N. (2022). The impact of climate change on mental health and emotional wellbeing: a narrative review of current evidence, and its implications. International Review of Psychiatry, 34(5), 443-498.	This article explores the relationship between climate change and mental health, emphasising the need for a comprehensive understanding of the impacts on human wellbeing. The review highlights the urgent need to address the mental health impacts of climate change, emphasizsng the interconnected nature of mental health with environmental conditions. It calls for effective interventions and actions to mitigate the adverse effects of climate change on mental health and wellbeing, advocating for a holistic approach that considers various	5	x	x	

		factors influencing mental health in the context of a changing climate.		
43	Clayton, S., Manning, C., Krygsman, K., & Speiser, M. (2017). Mental health and our changing climate: Impacts, implications, and guidance.	This is an updated and expanded version of our 2014 report, Beyond Storms & This updated report is intended to further inform and empower health and medical professionals, community and elected leaders, and the public.	5	x
44	Manning, C., & Clayton, S. (2018). Threats to mental health and wellbeing associated with climate change. In Psychology and climate change (pp. 217-244). Academic Press.	The mental health effects of climate change are multifaceted, including post-traumatic stress disorder, depression and suicide, and anxiety. Research has consistently demonstrated that specific risk factors (e.g., gender, socioeconomic status and education, pre-existing mental health symptomatology), are associated with increased vulnerability to mental health conditions post-disaster.	5	x
46	Hrabok, M., Delorme, A., & Agyapong, V. I. (2020). Threats to mental health and well-being associated with climate change. Journal of Anxiety Disorders, 76, 102295.	This paper aims to describe the impact of climate change on mental health conditions, including risk and protective factors related to the expression of mental health conditions post-disaster, as well as a discussion of our local experience with a devastating wildfire to our region within Canada.	5	x
50	Kjellstrom, T., & McMichael, A. J. (2013). Climate change threats to population health and well-being: the imperative of protective solutions that will last. Global health action, 6(1), 20816	This article highlights links between climate change and non-communicable health problems, a major concern for global health beyond 2015.	5	x

52	Chersich, M. F., Wright, C. Y., Venter, F., Rees, H., Scorgie, F., & Erasmus, B. (2018). Impacts of climate change on health and wellbeing in South Africa. International journal of environmental research and public health, 15(9), 1884.	We systematically reviewed the literature by searching PubMed and Web of Science. Of the 820 papers screened, 34 were identified that assessed the impacts of climate change on health in the country. Most papers covered effects of heat on health or on infectious diseases (20/34; 59%).	5	x
68	Middleton, J., Cunsolo, A., Jones-Bitton, A., Wright, C. J., & Harper, S. L. (2020). Indigenous mental health in a changing climate: a systematic scoping review of the global literature. Environmental Research Letters, 15(5), 053001.	Thus, the goal of this study was to examine the extent, range, and nature of published research investigating the ways in which global Indigenous mental health is impacted by meteorological, seasonal, and climatic changes. Following a systematic scoping review protocol, three electronic databases were searched.	5	x
71	Charlson, F., Ali, S., Augustinavicius, J., Benmarhnia, T., Birch, S., Clayton, S., ... & Massazza, A. (2022). Global priorities for climate change and mental health research. Environment international, 158, 106984.	Twenty-two experts participated from across low- and middle-income countries (n = 4) and high-income countries (n = 18). Our process identified ten key priorities for progressing research on mental health and climate change.	5	x
104	Obradovich, N., Migliorini, R., Paulus, M. P., & Rahwan, I. (2018). Empirical evidence of mental health risks posed by climate change. Proceedings of the National Academy of Sciences, 115(43), 10953-10958.	Here, we show that short-term exposure to more extreme weather, multiyear warming, and tropical cyclone exposure each associate with worsened mental health	5	x
122	Clayton, S. (2018). Mental health risk and resilience among climate scientists. Nature Climate Change, 8(4), 260-261.	Awareness of the threats to mental health posed by climate change leads to questions about the potential impacts on climate scientists because they are immersed in depressing information and may face apathy, denial and even hostility from others. But they also have sources of resilience.	5	x

135	Sharpe, I., & Davison, C. M. (2021). Climate change, climate-related disasters and mental disorder in low-and middle-income countries: a scoping review. BMJ open, 11(10), e051908.	We used the scoping review methodology to determine how exposure to climate change and climate-related disasters influences the presence of mental disorders among those living in LMICs. We also aimed to recognise existing gaps in this area of literature.	5	x	
147	Seritan, A., Asghar-Ali, A. A., Cooper, R., & Hatcher, A. (2023). The time is now: Climate change and aging adults' mental health. The American Journal of Geriatric Psychiatry, 31(3), S21.	Review age-specific and socio-economic-cultural determinants which increase the risk of adverse outcomes for this vulnerable population (older people). We will discuss the prevalence and phenomenology of psychiatric conditions that can occur in aging adults exposed to heat waves and/or natural disasters.	5	x	
158	Jackson, L., & Devadason, C. A. (2019). Climate Change, Flooding and Mental Health. New York: The Rockefeller Foundation.	This review aims to fill an important gap in understanding of the potential key risk factors affecting farmers' mental health around the world.	5	x	
170	Trenbirth, H., & Dutton, A. (2019). UK natural capital: peatlands. London, UK: Office for National Statistics.	Peatlands occupy around 12% of the UK land area. This dramatic landscape provides over a quarter of the UK's drinking water and stores a significant amount of carbon making it an important habitat for providing both provisioning and regulating ecosystem services in the UK. Peatlands are also a major tourist destination and provide cultural history contributing significantly to the UK's cultural ecosystem service.	5		x
265	Beyer KM, Kaltenbach A, Szabo A, Bogar S, Nieto FJ, Malecki KM. Exposure to neighborhood green space and mental health: evidence from the survey of the health of Wisconsin. Int J Environ Res Public Health. 2014 Mar 21;11(3):3453-72. doi: 10.3390/ijerph110303453. PMID: 24662966; PMCID: PMC3987044.	This study contributes a population-level perspective from the United States to examine the relationship between environmental green space and mental health outcomes in a study area that includes a spectrum of urban to rural environments.	5		x

54	Tiatia-Seath, J., Tupou, T., & Fookes, I. (2020). Climate Change, Mental Health, and Well-Being for Pacific Peoples. The Contemporary Pacific, 32(2), 400-430.	This article analyzes existing research on climate change and its impact on mental health and wellbeing, primarily among Pacific Islanders. To compensate for a lack of research in this area, the article also addresses some of the projected mental health implications resulting from disasters linked to climate change, such as flooding, hurricanes, and cyclones.	4	x	
64	Pihkala, P. Toward a Taxonomy of Climate Emotions. Front. Clim. 2022, 3, 738154.	This article conducts a preliminary exploration of the taxonomy of climate emotions, based on literature reviews and philosophical discussion.	4		x
133	Willox, C., Harper, L., Ford, D., Edge, L., Landman, K., Houle, K., ... & Wolfrey, C. (2013). Climate change and mental health: an exploratory case study from Rigolet, Nunatsiavut, Canada. Climatic Change, 121(2), 255-270.	Through a multi-year, community-led, exploratory case study conducted in Rigolet, Nunatsiavut, Labrador, Canada, this research qualitatively explores the impacts of climate change on mental health and wellbeing in an Inuit context. Drawing from 67 in-depth interviews conducted between January 2010 and October 2010	4	x	
241	Thomas, F., Sabel, C. E., Morton, K., Hiscock, R., & Depledge, M. H. (2014). Extended impacts of climate change on health and wellbeing. Environmental Science & Policy, 44, 271-278.	Here we propose that greater insight and understanding of the health-related impacts of climate change can be gained by integrating the positivist approaches used in public health and epidemiology, with holistic social science perspectives on health in which the concept of 'wellbeing' is more explicitly recognised. Such an approach enables us to acknowledge and explore a wide range of more subtle, yet important health-related outcomes of climate change.	4	x	
42	Huebner, G., (2021), Climate Change and Mental Health. Web article: https://www.ucl.ac.uk/bartlett/news/2021/jul/climate-change-and-mental-health	Overview of topic with references	3	x	
51	Sachs, J. D. (2014). Climate change and intergenerational well-being. The Oxford handbook of the macroeconomics of global warming, 248-259.	Theoretical macro-economic work on wellbeing in a Climate Change context	2	x	

11 Appendix D: Interventions included in Chapter 5

Intervention name	*Location*	*Climate distress focus*	*Primary sub group*	*Intervention details*	*Primary outcome*	*Evidence effectiveness cluster*	*Evaluation results*	*Primary mechanism*
Livestock trading grants and collective-action groups	Global south	No	Rural	(1) Step-wise capacity-building interventions (59 collective-action groups with total membership of 2300) (2) Livestock trading grant	Improved general wellbeing or mental health	C	Capacity-building package plus trading grant improved personal/household wellbeing attributes in both Districts in comparison to control group. Link	Capacity
Rational Emotive Behavioural Therapy in Lagos	Global south	No	Poor mental health	REBT (20 sessions; 50 minutes each) delivered in a group setting by therapists with PhD in career/mental health	Relief from disorders e.g. anxiety/depression/ PTSD	C	Intervention group had significantly decreased depression symptoms in comparison to waitlist control group. Link	Resilience
Skills for Life Adjustment and Resilience (SOLAR) program	Global south	No	Poor mental health	Program delivered in a group setting (up to 10 participants per group) over 5 consecutive days, delivered by trained non- specialist facilitators or ”coaches”	Relief from disorders e.g. anxiety/depression/ PTSD	C	Participants had significantly decreased distress/post-traumatic stress symptoms and functional impairment after the intervention, with some effects retained at 6-month follow-up. Link	Resilience
Bangladesh flooding grants	Global south	No	Low income	Red Cross Red Crescent Project distributed flood-forecast-based unconditional cash transfer (USD 60 equivalent)	Reduce general psychological distress/stress	C	Intervention group was less likely to experience psychological distress after the flood or feel anxious/depressed in the last seven days before the survey. Link	Capacity

Intervention name	*Location*	*Climate distress focus*	*Primary sub group*	*Intervention details*	*Primary outcome*	*Evidence effectiveness cluster*	*Evaluation results*	*Primary mechanism*
Katatagan health intervention	Global south	No	Any	Locally adapted "Katatagan" resilience intervention delivered in a group setting (5–7 participants per group) over 2 days as part of multi-day mission trips that provide medical/ dental and social services	Improved coping self-efficacy	C	Participants improved in coping self-efficacy in all module domains managing unproductive thoughts and emotions and identifying personal strengths. Link	Resilience
Katatagan anxiety intervention	Global south	No	Any	Locally adapted "Katatagan" resilience intervention delivered in a group setting (8 participants per group) by trained paraprofessionals	Improved coping self-efficacy	C	Intervention group had reduced anxiety scores and increased individual resilience 7–8 months post-intervention in comparison to control group; improvement in adaptive coping was less sustained. Link	Resilience
Haitian disaster preparedness	Global south	No	Vulnerable	3-day mental health integrated disaster preparedness intervention in a group setting (up to 20 participants per group) delivered by trained Haitian lay mental health workers	Relief from disorders e.g. anxiety/depression/ PTSD	C	Intervention group had decreased mental health symptoms and functional impairment from baseline; and exhibited a trend in increase in social cohesion. Link	Capacity
Carbon Conversations	UK	Yes	Any	Guided group sessions (typically 6 sessions with 6–8 individuals per	Validation of emotions	B	Participants reported feeling less scared, less powerless, and more empowered (greatest perceived benefit	Social

Intervention name	Location	Climate distress focus	Primary sub group	Intervention details	Primary outcome	Evidence effectiveness cluster	Evaluation results	Primary mechanism
				group, moderated by 2 trained volunteer facilitators) with themes set out in the handbook; created by Rosemary Randall and Andy Brown			among those with interest in climate change but has not engaged deeply in addressing carbon footprint). Link	
Rural Adversity Mental Health Program	Developed	No	Rural	Various; dedicated full- time drought mental health workers; farmer with lived experience/ RAMHP based on DMHAP with new components targeting aboriginal communities, older farmers, youth, women and substance use	Improved general wellbeing or mental health	B	The RAMHP training programme increased mental health understanding and willingness to assist others for over 90 percent of participants. Link 1 Link2	Capacity
Sonoma Wildfire Mental Health Collaborative	Developed	No	Rural	(1) Free trauma-informed yoga and meditation classes facilitated by trained yoga instructors, and (2) SPR training to counsellors and paraprofessionals	Improved general wellbeing or mental health	B	Most participants (84%) reported feeling better after class; repeat attendees reported feeling better for the rest of the week (32%), "lasting effects at reducing heightened response to ongoing stressors and episodic triggers". Limited data to conclude SPR was associated with any mental health improvement. Link	Resilience
Environmental Health Clinic	Developed	Yes	Potential activists	Structured problem-based coping	Reduce general psychological distress/stress	B	Helped convert people's anxiety and concern about environmental issues into	Resilience

Intervention name	Location	Climate distress focus	Primary sub group	Intervention details	Primary outcome	Evidence effectiveness cluster	Evaluation results	Primary mechanism
							specific, measurable, and significant actions. Link	
Borderlands Earth Care Youth Institute	Developed	Yes	Low income	Borderlands Earth Care Youth Institute (hands-on nature restoration work); essays and reflections on land ethics and nature	Improved coping self-efficacy	C	Program evaluation demonstrated positive effects of the program including improved emotional strength, as well as leadership, sense of community, and social responsibility. Link 1 Link2 Link 3	Nature
Addressing Climate Change impacts through Health Clinics	Developed	Yes	Vulnerable	Community garden hub and many associated programs, including community kitchen, market, school gardening and agricultural courses, tree-planting workshops, and sensory garden for hospital patients and aged-care residents	Improved general wellbeing or mental health	B	Internal program evaluation demonstrated improvements in mental health and social connectedness for participants. Link	Nature
Climate Change and Health Adaptation Program	Developed	Yes	Indigenous	On-the-land activities at fish camp for youth to connect with indigenous traditional knowledge facilitated by local community members including Selkirk Elders; participatory research	Improved general wellbeing or mental health	B	Evidence presented showing how programme mitigated and adapted to the health impacts of climate change to demonstrate climate change resiliency within Indigenous communities. Link	Nature

Intervention name	Location	Climate distress focus	Primary sub group	Intervention details	Primary outcome	Evidence effectiveness cluster	Evaluation results	Primary mechanism
				documenting climate impact				
All We Can Save	Developed	Yes	Any	Self-organized groups for reading the book "All We Can Save" over 10 sessions (recommended 6–10 people per group); founded by Katherine Wilkinson and Ayana Johnson	Reduced isolation/increased social capital	B	A survey for past participants is available to fill out on the organization website; results are not public. Link	Resilience
Climate Cares guided journal	Developed	Yes	Youth	Physical journal with 4-weeks of guided activity content to support a person's "mental wellbeing and effectiveness in acting on environmental issues"; developed by Climate Cares	Improved general wellbeing or mental health	B	Positive qualitative comments from 40 youth who received the journal in a pilot study. Link	Resilience
Climate Café®	Scotland	Yes	Any	Informal community meetings for people to share climate-related feelings and inspire collective action	Validation of emotions	B	Evidence that cafes help participants to validate feelings around climate distress, increase awareness of threats to planetary health, action taken in the face of climate change, and improved social connection. Link	Social
Climate Psychology Alliance's Climate Cafes	Scotland	Yes	Any	Climate Cafes are a space for talking about emotions. Throughout the Café, the focus of discussion is on	Reduce general psychological distress/stress	B	Participants noted how they had not been fully conscious of the depth and breadth of their emotional responses to the climate crisis prior to attendance	

Intervention name	Location	Climate distress focus	Primary sub group	Intervention details	Primary outcome	Evidence effectiveness cluster	Evaluation results	Primary mechanism
				participants' thoughts and feelings about the climate and ecological crises.			Link 1 Link 2	
Ibanikom Climate Mental Health Literacy Project	Global south	Yes	Youth	A mental health literacy program built on Ibanikom ancestral and cultural identity and knowledge that involved meetings twice a week for 6 months; participants learned about the psycho-effects of climate change and co-developed local small-scale integrated health and agriculture projects that are ecologically sound	Improved coping self-efficacy	B	One-year internal evaluation results indicative of community having increased awareness of climate disasters and mental preparedness of flood effects. Link	Social
Scotland's Climate Assembly	Scotland	No	Any	Scotland's Climate Assembly took place between November 2020 and March 2021. Its purpose was to consider and make recommendations on the question: "How should Scotland change to tackle the climate emergency in an effective and	Increased hope/optimism	B	Members were less worried and more hopeful than the population as a whole about what Scotland can do to tackle climate, and became increasingly more optimistic that 'things will work out fine' over the course of the main Assembly period. 21% reported their feelings about climate change were having a negative impact on their mental health. Link	Participation

Intervention name	Location	Climate distress focus	Primary sub group	Intervention details	Primary outcome	Evidence effectiveness cluster	Evaluation results	Primary mechanism
				fair way?". Its report was published in June 2021.				
Good Grief Network	Developed	Yes	Any	Group sessions (over 10 weeks) delivered by peers in-person or virtually based on the Alcoholics Anonymous Approach; co-founded by Laura Schmidt and Aimee Lewis Reau	Reduced isolation/increased social capital	B	Internal evaluation suggested "participants report feeling less alone, more connected, empowered to take action in their lives". Link	Social
Wetlands for Wellbeing	UK	No	Poor mental health	The wetland Nature-based intervention was designed to facilitate engagement with nature as a treatment for individuals diagnosed with anxiety and/or depression. Participants took part in a two-hour session per week for six consecutive weeks	Relief from disorders e.g. anxiety/depression/ PTSD	B	Significant improvements in mental wellbeing, anxiety, stress and emotional wellbeing, as well as social isolation, confidence to be in nature, and management of physical health. Link	Nature
Cooperative enquiry Welsh school	UK	Yes	Youth	Two separate, but connected and consecutive inquiries were conducted in a high school in South	Reduced isolation/increased social capital	B	Cooperative inquiry helped the participants feel less alone and more connected with others in the group, with the teachers and the school, and prompted action. Link	Social

Intervention name	Location	Climate distress focus	Primary sub group	Intervention details	Primary outcome	Evidence effectiveness cluster	Evaluation results	Primary mechanism
				Wales; the first with a group of young people (13-14 year olds), the second with a group of supportive adults (their teachers and leaders).				
Climate Awakening	Developed	Yes	Any	Climate Emotions Conversations (group sharing and listening sessions; 4 participants per session) that occur 3 times per month guided by videos and conversation prompts; founded by Margaret Salamon	Validation of emotions	A	N/A	Social
Circularity	Developed	Yes	Any	Facilitation of in-person and virtual custom workshops that draw from climate psychology and nature therapy	Reduced isolation/increased social capital	C	N/A.	Social
Public mobile app to reduce symptoms of postdisaster distress	Developed	No	Youth	Sonoma Wildfire Mental Health Collaborative: "Sonoma Rises" mental health app based on SPR and uses select audio tools from PTSD Coach	Improved coping self-efficacy	A	No significant effects on clinical/functional outcomes detected; may be due to confounders/ small sample size. Link	Resilience

Intervention name	*Location*	*Climate distress focus*	*Primary sub group*	*Intervention details*	*Primary outcome*	*Evidence effectiveness cluster*	*Evaluation results*	*Primary mechanism*
Climate Psychology Alliance	UK	Yes	Any	Therapeutic outreach program involving trainings and workshops on climate psychology	Reduce general psychological distress/stress	A	N/A	Resilience
Conceivable Future	Developed	Yes	Any	House parties for individuals to connect, advocate against fossil fuel subsidies, and provide testimonies on the climate crisis, which is viewed as a reproductive justice crisis; led by Meghan Kallman and Josephine Ferorelli	Reduced isolation/increased social capital	A	N/A	Social
Deep Adaptation Forum	UK	Yes	Any	In-person or virtual groups and recurrent events (nature and frequency dependent on facilitators); speaker and workshop offerings; founded by Jem Bendell	Improved coping self-efficacy	A	N/A	Social
Eco-Anxious Stories	Developed	Yes	Any	Online platform for climate and mental health storytelling; participatory "Sharing our Stories" worksheet, and services include eco-anxiety workshops, content creation and resource	Reduce general psychological distress/stress	A	N/A	Communication

Intervention name	*Location*	*Climate distress focus*	*Primary sub group*	*Intervention details*	*Primary outcome*	*Evidence effectiveness cluster*	*Evaluation results*	*Primary mechanism*
				development; founded by Rachel Malena-Chan				
Force of Nature	UK	Yes	Youth	Training programs for young people, youth speakers agency, student consulting network for businesses and non-profits, Anxiety-to-Agency workshops for students and educators; founded by Clover Hogan	Improved general wellbeing or mental health	A	N/A	Resilience
Globe and Psyche	Developed	Yes	Practitioners	Local conversation meetings to "explore what climate change means in their area, both its impacts and also opportunities for personal and collective healing"	Reduce general psychological distress/stress	A	N/A	Practitioners
Hold This Space	Developed	Yes	Any	An interactive website that guides individuals to "feel, imagine and connect" around climate change issues; developed by Common Vision in partnership with Climate Cares and Force of Nature	Improved general wellbeing or mental health	A	N/A	Communication
One Earth Sangha	Developed	Yes	Any	Trainings, courses, and events aimed to	Improved levels of empowerment	A	N/A	Resilience

Intervention name	*Location*	*Climate distress focus*	*Primary sub group*	*Intervention details*	*Primary outcome*	*Evidence effectiveness cluster*	*Evaluation results*	*Primary mechanism*
				build practices, community and action based on Buddhist tradition and Dharma teachings				
Project InsideOut	Developed	Yes	Any	Online hub with interactive tools and resources to engage with and transform feelings, with the goal of becoming Guides to inspire changes in others	Improved levels of empowerment	A	N/A	Practitioners
The Climate Journal Project	Developed	Yes	Activists	Live journal circles and weekly climate journal prompts to "cope with eco-anxiety, move past paralysis and transition into action"; founded by Yvonne Cuaresma	Improved coping self-efficacy	A	N/A	Resilience
The Eco-Anxiety in Africa Project (TEAP)	Global south	Yes	Youth	A project of Sustyvibes founded by Jennifer Uchendu; offers research service, community action events, and physical/virtual spaces for sharing climate emotions	Validation of emotions	A	N/A	Social
The Resilience Project UK	UK	Yes	Youth	Youth are trained through a residential program then lead	Improved general wellbeing or mental health	A	N/A	Participation

Intervention name	*Location*	*Climate distress focus*	*Primary sub group*	*Intervention details*	*Primary outcome*	*Evidence effectiveness cluster*	*Evaluation results*	*Primary mechanism*
				8-week Circles (typically 10 youth per Circle) to build knowledge and co-design programs to build resilience for other youth				
The Resilient Activist	Developed	Yes	a	Self-care, speaker's bureau, online events, climate cafés, and nature-connected programming that support emotional wellbeing; founded by Sami Aaron	Improved coping self-efficacy	A	N/A	Resilience
The Rest of Activism	UK	Yes	Any	A grant-subsidized program (by the Emergence Foundation) founded by Jo Musher-Sherwood that includes a weekly facilitated structured online space to support individuals' "joy-filled activism"; monthly subscription fee required for membership	Reduce general psychological distress/stress	A	N/A	Resilience
The Resource Innovation Group (TRIG)	Developed	Yes	Practitioners	Workshops, webinars, and conferences based on the Resilience Growth Model of Transformation	Improved coping self-efficacy	A	N/A	Practitioners

Intervention name	Location	Climate distress focus	Primary sub group	Intervention details	Primary outcome	Evidence effectiveness cluster	Evaluation results	Primary mechanism
Transition Network	UK	Yes	Any	Global network of community-led Transition groups that aim to build resilient communities and caring culture with an "Inner Transition" dimension (and "Heart & Soul" groups) that investigate the emotional/ psychological aspects of climate action	Improved coping self-efficacy	A	N/A	Resilience
Flood Re	Scotland	No	Low income	Underwriting flood insurance in the UK for citizens/businesses in flood-risk areas and building back better (BBB) so that properties are more resilient to flooding	Reduce general psychological distress/stress	A	N/A	Capacity
Psychology for a Safe Climate (PSC)	Developed	Yes	Practitioners	Professional Development series designed to equip health and mental health professionals with knowledge and skills needed to become more climate aware. 3-session series.	Improved general wellbeing or mental health	A	N/A	Practitioners

Intervention name	Location	Climate distress focus	Primary sub group	Intervention details	Primary outcome	Evidence effectiveness cluster	Evaluation results	Primary mechanism
Ecotherapy and Climate Conscious Training and Consultation for Mental Health Professionals	Developed	Yes	Practitioners	10-session, weekly group based online training for mental health practitioners to train in eco-therapy or climate-conscious therapy	Improved general wellbeing or mental health	A	N/A	Practitioners
The work that reconnects	UK	Yes	Any	Wide variety of activities, including workshops, study groups, webinars, conversation cafes and retreats around the world	Improved coping self-efficacy	A	N/A	Resilience
Living with the Climate Crisis	UK	Yes	Any	Living with the Climate Crisis and its predcessor Carbon Conversations offer emotionally safe spaces to discuss and share feelings arounf climate change	Reduced isolation/increased social capital	A	N/A	Social
Emotional Resilience Toolkit for Climate Work	Developed	Yes	Activists	A facilitation guide for individuals, including a compilation of five practices	Improved coping self-efficacy	A	N/A	Resilience
Green Latinos Coalition	Developed	Yes	Minorities	A broad coalition of Latino leaders committed to addressing national, regional and local environmental issues	Improved general wellbeing or mental health	A	N/A	Participation

Intervention name	*Location*	*Climate distress focus*	*Primary sub group*	*Intervention details*	*Primary outcome*	*Evidence effectiveness cluster*	*Evaluation results*	*Primary mechanism*
Outdoor Afro	Developed	Yes	Minorities	A non-profit that connects more than 100 leaders in 56 cities around the US to connect thousands of people to nature experiences	Reduced isolation/increased social capital	A	N/A	Participation
Sunrise Movement	Developed	Yes	Youth	"A youth movement working to stop climate change and create millions of good jobs in the process"	Improved levels of empowerment	A	N/A	Participation
Fridays For Future	Scotland	Yes	Youth	Youth-led global strike movement, the goal of FFF "is to put moral pressure on policymakers, to make them listen to scientists, and then to take forceful action to limit global warming"	Improved levels of empowerment	A	N/A	Participation
Youth Vs Apocalypse (YVA)	Developed	Yes	Youth	"A diverse group of young climate justice activists working together to lit the voices of youth, in particular youth of color and working-class youth."	Improved levels of empowerment	A	N/A	Participation
Classroom guide for confronting	Developed	Yes	Teachers	A paper that includes a strategic guide for confronting anxiety and despair in	Reduce general psychological distress/stress	A	N/A	Resilience

Intervention name	Location	Climate distress focus	Primary sub group	Intervention details	Primary outcome	Evidence effectiveness cluster	Evaluation results	Primary mechanism
anxiety and despair				environmental studies and sciences				
Contemplative pedagogy	Developed	Yes	Teachers	Contemplative pedagogy is a method of integrating emotions into teaching practices, involving using mindfulness, silence, sensitivity to feelings in the body in teaching practice	Improved coping self-efficacy	A	N/A	Resilience
Existential Toolkit for Climate Justice Educators	Developed	Yes	Teachers	A website to help support environmental educators with hundreds of curated resources for educators	Improved coping self-efficacy	A	N/A	Resilience
Staying Sane in the Face of Climate Change	Developed	Yes	Youth	A toolkit (two versions) to support emotional resilience, mental health and action and build capacity of educators and students of crisis students to remain positive, resilient and effective.	Improved coping self-efficacy	A	N/A	Resilience
Transform our world	Developed	Yes	Teachers	An online hub to support teachers in bringing environmental and social action in the classroom	Validation of emotions	A	N/A	Resilience

Intervention name	*Location*	*Climate distress focus*	*Primary sub group*	*Intervention details*	*Primary outcome*	*Evidence effectiveness cluster*	*Evaluation results*	*Primary mechanism*
Biocitizen	Developed	Yes	Youth	Offer summer camps, after-school enrichment, day hikes and overnight trips for children and teens.	Increased hope/optimism	A	N/A	Nature
Acta Non Verba	Developed	Yes	Youth	Offers services including education, childcare, economic empowerment, and access to green, safe spaces and healthy food	Improved general wellbeing or mental health	A	N/A	Nature
The evolving edge	Developed	Yes	A	Undoing Oppression sub-area that includes an Anti-Oppression Resource Group, a Spiral Journey Facilitator Development Program, and School for the Great Turning which is oriented to centering BIPOC activists, organizers, healers, and educators.	Improved coping self-efficacy	A	N/A	Climate justice

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