

# The mental health impacts of human-ecosystem-animal relationships: A systematic scoping review of Eco-, Planetary, and One Health approaches

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## ABSTRACT

The threats to human and animal health, biodiversity conservation, and our living planet's future are ever-present and increasingly more severe due to climate change and environmental degradation. There is an emerging discourse exploring the mental health dimensions contained within these changes. To better understand and respond to these impacts requires novel and creative methodological approaches built on conceptual frameworks that integrate perspectives from the social and natural sciences. Three of the most influential interdisciplinary frameworks at the human-animal-ecosystem interface include: One Health, EcoHealth, and Planetary Health. These frameworks report mental health as an integral component within overall health-related outcomes. However, a comprehensive synthesis of the state of the literature that examines how mental health is explored within these approaches does not currently exist. A systematic scoping review was therefore conducted to obtain clear understandings of patterns, gaps, and broad themes, and to highlight future research needs and considerations. Standardized PRISMA guidelines, including explicitly defined inclusion/exclusion criteria and dual screening/extractions, were used. 13 papers were included: seven using the One Health Framework, with Planetary and EcoHealth each represented by three. Trends observed include a predominate focus on companion animals as interventions, "sense of place" used as a component of mental well-being, and non-physical health-related measurements of animal well-being as an outcome within One Health research. The lack in retrieved studies also highlight the dearth in literature on mental health as a pillar of these three well established frameworks. Compiling what is known in the evidence-base as a launching point for scientific engagement, this review describes guidance for investigators on how to conduct mental health research within these framework parameters so that future studies can elucidate mechanisms underpinning the intersections between the biosphere and human mental-health and data-driven interventions and policy recommendations that simultaneously address mental health and global change can be proposed and enacted.

## 1. Introduction

Several conceptual frameworks exist that aim to re-address the balance and relationships between the health of humans and our shared planet. Conceptual frameworks offer explicit expressions of how constructs are linked together logically, allow for generation of clear research questions and hypotheses, and provide guidance for study design options, potential data sources, and analytical methods. Three of the most influential frameworks that both stress interdisciplinary approaches and work within the intersections of ecosystem, animal, and human health include One Health (OH), EcoHealth (EH), and Planetary

Health (PH) [1]. The origin and evolution of each framework, as well as descriptive comparisons and distinctions between the three, have been well documented elsewhere [1,2] and a brief description of each is offered in Table 1. While there have multiple calls to merge the three frameworks due to their perceived underlying assumptions and the argument that unification is necessary to share infrastructure and attract more funders, policy influence, and advocacy power [2–6], it has also been asserted that key differences among the three approaches means each should be considered as distinct and unique [1]. Nevertheless, each framework reports mental health as an integral part of overall human health-related outcomes [7–9], echoing the World Health Organization's

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**Table 1**  
Brief description of each framework.

- EcoHealth is the oldest of the included frameworks. The term was first coined in the 1990s [11] and usage of the framework increased after the establishment of the journal *EcoHealth* in 2004 [12]. It is defined as being “committed to fostering the health of humans, animals, and ecosystems and to conducting research which recognizes the inextricable linkages between the health of all species and their environments” [1]. Compared with the other frameworks, the approach has a more biodiversity focus and heavily emphasizes community-based participatory research [12,13]. EcoHealth is therefore centered around environmental and socioeconomic issues and there is good uptake of the approach from those in the fields of ecology, biodiversity conservation, and anthropology [5].
- By contrast, One Health is driven by biomedical questions with an emphasis on zoonoses and has good uptake among those in the veterinary medicine fields [3]. The term was first used in 2003 [14], and the *One Health Commission* defines it as “an integrated, unifying approach” that “recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and inter-dependent” [15].
- Planetary Health is the most recent approach and was developed and launched in 2015 from the *Rockefeller Foundation-Lancet Commission on Planetary Health*, which stated that overall planetary health is “the achievement of the highest attainable standard of health, well-being, and equity worldwide” and is obtained through “judicious attention” to human and Earth’s natural systems [7]. Planetary Health emerged from the fields of public and global health, and while the approach shares with the previous frameworks the push to bridge disciplines to incorporate both human and environmental health outcomes [12], it has been labelled as more “anthropogenic” as its primary focus is on human health [1].

declaration that there is “no health without mental health” [10].

While there is emerging evidence exploring the mental health impacts of our ever-changing planet, including those of climate change [16] and air pollution [17], this evidence-base remains at its nascent [18]. For instance, within the emerging field of climate change and mental health, commonly cited frameworks have been developed to elucidate direct (e.g., traumatic responses from floods) and indirect (e.g., through economic disruptions) pathways [19,20]. However, the relationships and underlying mechanisms among these associations have not been adequately analyzed and understood, with multiple calls for systems-based approaches put forward to further build more relevant and accurate theories that reflect the complicated, nuanced, and changeable nature of mental health within a changing climate [16,21,22]. This tentative and therefore inconclusive understanding of the mental health-environment relationship underscores the need to move beyond established and siloed approaches to empirically address unanswered questions that locate human mental health within its wider ecological context.

The OH, EH, and PH frameworks are therefore uniquely positioned to frame research questions and methodological approaches to better anticipate the mental health consequences of our changing planet and to implement and measure the impacts of win-win interventions that simultaneously alleviate mental health and planetary threats. A current and comprehensive synthesis of the existing literature on how these frameworks have investigated these linkages is therefore needed to help obtain a clear understanding of patterns and gaps in existing research, identify broad themes, and highlight future research needs and methodological considerations.

## 2. Methods

Due to the broad nature of this paper’s research objective, the authors chose a scoping review as a methodological approach. Scoping reviews are similar to systematic reviews in their use of rigorous, exhaustive, transparent, and systematic search strategies to identify and analyze all relevant literature [23]. However, while systematic reviews assess and review literature centered around a specific research question where study designs can be identified in advance and outcomes are often uniform, scoping reviews aim to instead map key concepts underpinning a broader research area where multiple study designs and outcomes are applied to ultimately identify areas that require future inquiry [24].

This scoping review is structured according to Arksey and O’Malley’s methodological framework for conducting scoping studies: 1. Defining the research question, 2. Identifying relevant literature, 3. Study selection, 4. Data extraction, and 5. Collating, summarizing, and reporting the results (the sixth stage, stakeholder consultation, is listed as optional). The review was aligned to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extensions for Protocols (PRISMA-P) and Scoping Reviews (PRISMA-ScR) for conducting and reporting on review steps and findings [25,26]. We used Mendeley in combination with Microsoft Excel spreadsheet software to track and conduct literature identification, study selection, data extraction, and results synthesis.

### 2.1. Defining research question

This paper’s research objective is to review all empirical literature guided by the OH, EH, and PH frameworks when investigating mental health outcomes. To identify gaps and patterns in the evidence base, this paper’s aims are to answer the following questions: 1. Which specific components of these frameworks are being identified? 2. What mental health outcomes are being measured? 3. Which methodological approaches are being used? 4. In what regions are studies taking place? 5. What populations are being studied (This includes information on described population characteristics both human (e.g., indigenous groups) and non-human (e.g., species type)? And 6. What are the key findings?

Our research questions were developed by following the recommendations of Levac et al.’s enhanced framework for scoping reviews by beginning broadly and then refining the question(s) [27]. We began by initially asking “What is known about mental health within the OH framework?” An exploratory search of article databases revealed several editorial and commentary papers elucidating the OH concept while reiterating mental health as an integral component of the framework [8,28–31]. However, these articles provided limited empirical sources that were explicitly guided by the OH approach.

We then expanded the search to include the EH and PH frameworks after seeing these often listed together and uncovering arguments that these approaches should be converged [2–6]. While other frameworks exist that emphasize transdisciplinary research to confront issues that connect health and ecological science (e.g., Conservation Medicine and GeoHealth) [12], the authors ended this expansion for both the sake of brevity and that these three frameworks are frequently described as the most influential [1,32].

### 2.2. Identifying relevant literature

The two search strings used for this review were (“mental health”) AND (“One Health” OR “EcoHealth” OR “Planetary Health”). Search terms were created for the search strings using medical subject heading (MeSH) terms as well as keywords from similar reviews and landmark studies [4,33–36]. Given that mental health is a broad concept, the search strategy consisted of an extensive and comprehensive set of terms covering “mental health”, “mental disorders” (covering both Common Mental Disorders (e.g., depression and anxiety disorders) and Serious Mental Illness (e.g., bipolar and schizophrenia)), “mental health services”, and “behavioral symptoms”. Variations of terms pertaining to “mental wellbeing” and other positive mental health indicators were also used. Lastly, other keywords found in the literature including “sense of place”, “solastalgia”, “biophilia”, and “zoöecia” were included, creating a total of 149 search terms (see *Supplementary Material A* for full list of search terms). We used Boolean logic and proximity operators to combine and refine the search terms. An initial PubMed search strategy was developed and then adapted to search eight other databases: PsycINFO, EMBASE, the Cochrane Library, GreenFILE, Global Health, CINAHL Plus, Scopus, and Web of Science. The search took place in July 2021 and only limitations on language and date were used.

### 2.3. Study selection

We screened peer-reviewed articles published in English from January 1990 through June 2021. We set the timeframe to begin in 1990 as this decade is when EH, the oldest of these frameworks, was first used [11]. The study selection process included two phases. In the initial title/abstract screening phase, the first two authors (CW and JC) designated a study to be eligible for the full-text screening phase if it (1) explicitly mentions one of the three frameworks, (2) mentions mental health, and (3) is a peer-reviewed article (studies designed as a letter to editor, editorial, commentary, or book chapter were excluded). Then, in the full-text screening phase, the first two authors designated a study to be included if it (4) measures any mental health outcome and (5) explicitly mentions one of these frameworks as a conceptual basis for the study design and/or data analysis.

Inclusion/exclusion criteria was developed collaboratively in both the research team and in discussions with our consultants (see Stage 6). “Mental health” was defined as a complete psychological state that reflects a meaning broader than the presence or absence of mental illness or psychiatric symptoms to also include positive indicators [37]. As our goal was to obtain a comprehensive sample of the literature, mental health outcomes were not restricted to be only primary outcomes.

As we were only interested in studies that explicitly use EH, OH, or PH as an underlying theoretical framework that guides their study design and/or data analysis process, we therefore excluded studies that mentioned these frameworks only in passing (for instance, in the abstract or introduction sections) as well as studies that only retroactively linked the study's findings to informing one of these frameworks (for instance, in the discussion section).

For both the title/abstract and full-text screening phases, two screeners (CW and JC) first independently screened 10% of articles then compared their individual decisions on whether studies met criteria for inclusion. For articles where individual decisions differed, the authors held discussions to reach consensus. This resulting shared understanding of the criteria was then applied to screening the remaining articles, where CW and JC each served as the primary screener for half of the articles. For articles where the primary screener deemed needing additional discussion, the non-primary screener served as a secondary screener and discussions were held to reach consensus. If decisions differed, a third screener (SZ) was involved in reaching group consensus.

### 2.4. Data extraction

Data were extracted from the final identified articles using structured tables in Microsoft Excel. The authors employed a dual extraction process for all papers. CW served as primary extractor for all articles, and JC and SZ each served as secondary extractors for half. As in the previous stages, disagreements were discussed to reach consensus. A fourth screener (MM) was involved as a third reviewer for articles in which the primary and secondary extractors did not agree.

### 2.5. Collating, summarizing, and reporting the results

We summarized our findings aligning to the specific questions our scoping review aimed to answer. In addition, we assessed the extracted data and identified any prevalent trends and emergent themes in study characteristics across the reviewed articles. Specifically, we used constant comparison and consensus-building discussions to identify, finalize, and report notable trends and themes [38].

## 3. Results

### 3.1. Summary of study characteristics

After removal of duplicates, the database searches identified 1786 unique articles. Through screening the title and abstract for each of these

articles, 178 were designated for full-text screening. The full-text screening found 13 articles to include in the review that were guided by one of the three frameworks and contained at least one mental health outcome (Fig. 1). Six studies listed mental health as a primary focus or outcome, all of which were guided by the OH framework [36,43–47]. Date of publication ranged from 2010 to 2021. Seven studies used the OH Framework [36,42–47], with EH [39–41] and PH [48–50] each represented by three.

The body of articles spanned from original research to systematic and literature reviews. Of the 11 original research articles, mixed-method methodologies were the most common ( $n = 4$ , 27.3%) followed equally by solely quantitative and qualitative approaches ( $n = 3$ , 27.3%). Original studies took place in 7 different countries, with most occurring in the Global North ( $n = 8$ , 61.5%). Table 2 lists the complete characteristics of each included article. Table 3 presents a comprehensive summary of findings for each extracted domain and lists the number of articles found in the three frameworks within each extracted component.

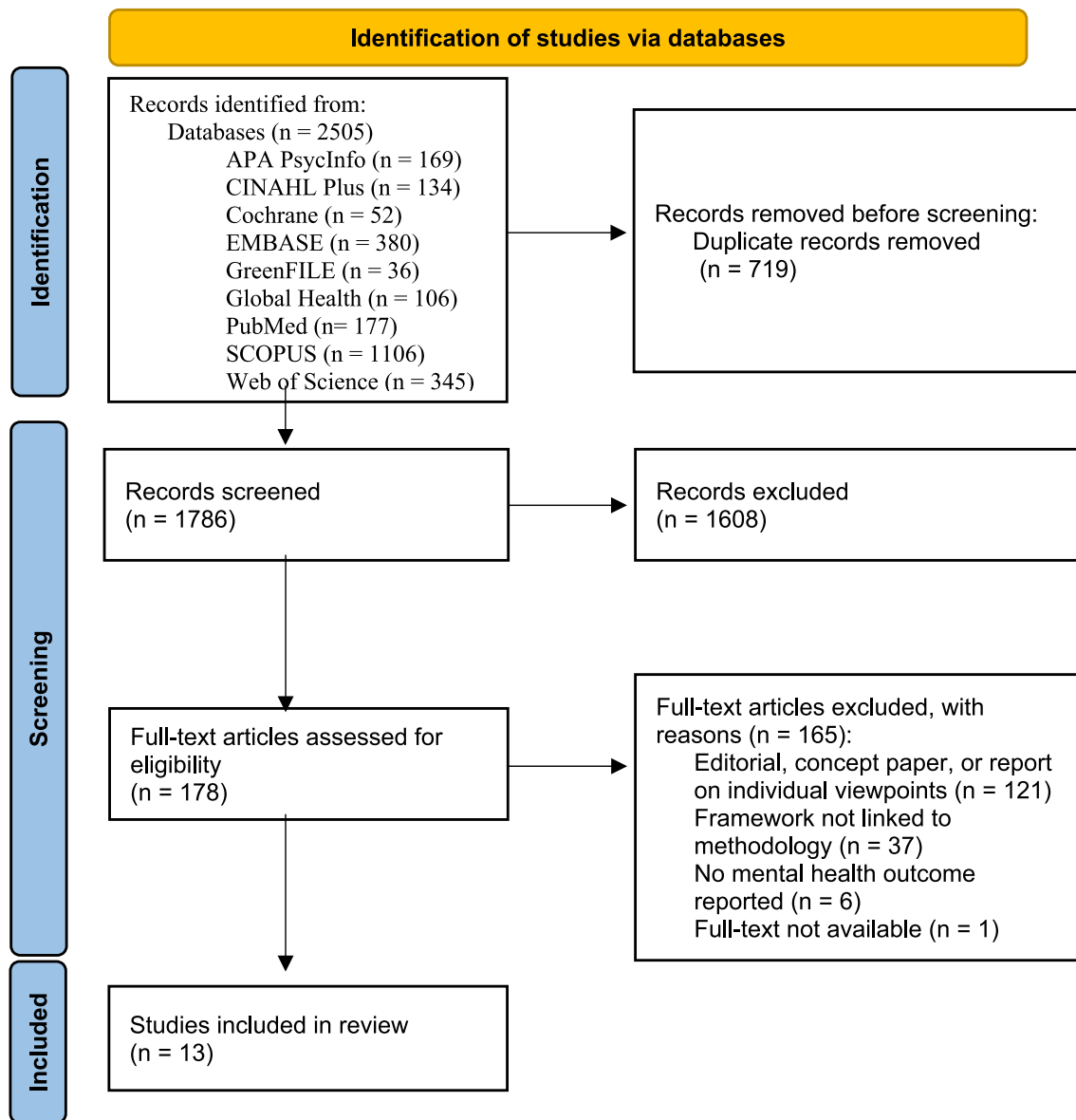
The studies included represent a variety of methodological approaches that investigate multiple mental health outcomes in a diverse selection of populations. For EH studies, there were wide variations in study aims and populations investigated, including a study on the connections between dogs and Inuit health [39], case studies exploring how humans relate and interact with national parks [36], and a paper investigating factors related to eco-consciousness in the nursing profession [40]. One unifying factor between the EH studies was the use of qualitative methods. There were similar variations in study aims and populations in the PH cohort, with a study exploring challenges of enacting environmental stewardship [48], a paper exploring connections between health and the environment in urban informal settlements [49], and a study that mapped pathways for climate resilient development [50].

### 3.2. Animal well-being

There were more perceptible trends within OH studies, chiefly an overall focus on including the health of domestic animals when exploring population mental health, and a particular focus on companion animals as interventions. Four of the seven OH studies, including one review, included a non-physical health-related measurement of animal well-being outcome in their analysis, all of which focused on variations of domesticated animals including pets [46,47], roaming dogs [45], and therapy dogs [43]. Three of these focused on animal stress or anxiety with one focusing on quality of life (measured with the Milan Pet Quality of Life Instrument, which is derived from validated scales for quality of life measures in dogs including psychological health and social and environmental satisfaction). A notable theme was three of the four studies that measured a non-physical health-related measurement of animal well-being did so within the context of animal welfare [43,45,46]. For instance, in a rabies intervention case study, an animal welfare assessment was developed where a qualitative scoring system would assess the impact of rabies and its control on dog distress and fear [45].

### 3.3. Companion animals as interventions

Despite the wide variation in methodologies and measured outcomes, some general themes were observed in the retrieved studies' main findings. All included papers build upon existing empirical evidence elucidating the complex connections between ecosystem and/or animal health with human mental health. Adverse ecosystem and/or animal health were demonstrated to lead to poor population mental health through various pathways. In two studies (EH [41] and PH [48]), these feelings of distress and sadness were connected to action steps taken to restore and protect ecological health. The most consistent theme concerned the relationship between interactions with



**Fig. 1.** PRISMA diagram of study selection process.

Flow chart of the scoping review From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: <https://doi.org/10.1136/bmj.n71>

domesticated animals (mainly dogs) and positive human mental health, which were seen in five OH papers [36, 43, 44, 46, 47] and one EH [39]. The inverse in this relationship was also explored where the mental health of pets during the context of COVID-19 was predominantly indirectly impacted by the psychological and physical state of their owners [47]. One OH paper on the effects of a therapy dog program on older veterans connected their findings with the concept of biophilia, or the contention that humans have an innate biological need to connect with non-human living organisms, and reported that companion animals can act as this healing connection to the natural world [43].

### 3.4. Additional frameworks proposed

For four studies, an additional proposed framework was a key part of their findings. One systematic review that compiled characteristics of urban green spaces concluded by proposing a framework explicitly informed by the OH approach that synthesizes the interlinkages between green space, wildlife support, and mental health [44]. One PH study

compiled findings from a 12-month health environmental assessment and combined these data with the existing literature to generate a multi-dimensional PH model of health and the environment in informal settlements [49]. The aforementioned rabies study first proposed a holistic model based on OH principals and then applied this framework to their rabies intervention. Lastly, a PH study used fuzzy cognitive mapping, a participatory modelling technique, to explore the experiences, knowledge, and perceptions of IPCC authors to present a model that visualizes the complex system and interrelated variables within climate resilient development pathways [50].

## 4. Discussion

After employing a systematic search strategy, only 13 studies were included in this scoping review despite the assertion each framework holds that mental health is a key component of overall health and well-being. The paucity of retrieved studies can be linked to several possible factors, including an overall lack of consideration paid to mental health

**Table 2**  
Complete characteristics of included articles.

Frame-work	Author(s) & Ref. No.	Title	Aims	Framework Specifics	MH Outcome	MH Measurement/ Primary? Y/N	Study Type	Conclusion	Location/ Setting	Population(s) (Human/non-human)
<b>EcoHealth</b>	Aenishaenslin [39]	<i>Understanding the connections between dogs, health and Inuit through a mixed-methods study</i>	To understand factors that affect human and dog health, dog-related risks for humans, and perceptions of dogs in Inuit communities.	<ul style="list-style-type: none"> <li>• Collaborative</li> <li>• Participatory</li> </ul>	<ul style="list-style-type: none"> <li>• Anxiety</li> <li>• Wellbeing</li> </ul>	<ul style="list-style-type: none"> <li>• Survey (anxiety)</li> <li>• Qual data (anxiety and well-being)</li> <li>• N</li> </ul>	<i>Mixed Methods</i> <ul style="list-style-type: none"> <li>• Cross-sectional</li> <li>• Semi-structural interviews</li> </ul>	Highlights the positive role of dogs and their importance for Inuit health and well-being, illustrates dog-related health risks, and unpacks differences in dog-management practices between Inuit and non-Inuit.	Canada  Inuit villages	<ul style="list-style-type: none"> <li>• Dog owners (Inuit/ non-Inuit)</li> <li>• Dogs</li> </ul>
	Cleland & Wyborn [40]	<i>A reflective lens: Applying critical systems thinking and visual methods to EcoHealth research</i>	To explore how humans relate to and interact with protected areas to better support and understand their role in human ecosystems	<ul style="list-style-type: none"> <li>• Collaborative</li> <li>• Systems-focused</li> </ul>	• Wellbeing	<ul style="list-style-type: none"> <li>• Qual data</li> <li>• N</li> </ul>	<i>Qualitative</i> <ul style="list-style-type: none"> <li>• Semi-structured interviews</li> <li>• Rich pictures</li> </ul>	Describes the complex and paradoxical perceptions that individuals and communities hold about national parks.	Australia National Park	• People with interest in national parks
	Hanley & Jakubec [41]	<i>Beyond the slogans: Understanding the ecological consciousness of nurses to advance ecological knowledge and practice</i>	To explore factors that influence eco-consciousness and how it affects and is integrated into nursing practice.	<ul style="list-style-type: none"> <li>• Environmental capacity building symbiotic with ethical/ political engagement</li> </ul>	• Anxiety	<ul style="list-style-type: none"> <li>• Qual data</li> <li>• N</li> </ul>	<i>Qualitative</i> <ul style="list-style-type: none"> <li>• Open-ended questions</li> </ul>	The knowledge gap between nursing education and climate change/ ecological health creates distress. This distress is linked to awakening eco-consciousness and taking action.	Canada	<ul style="list-style-type: none"> <li>• Nurses and nursing students</li> <li>• Urban ecology characteristics</li> </ul>
<b>One Health</b>	Arsyad et al. [42]	<i>A one health exploration of the reasons for low cocoa productivity in West Sulawesi</i>	To investigate multiple factors that may impact cocoa productivity	<ul style="list-style-type: none"> <li>• Collaborative</li> <li>• Holistic approach applied to conception of livelihoods</li> </ul>	<ul style="list-style-type: none"> <li>• Depression diagnosis</li> <li>• Mental health “problems”</li> </ul>	<ul style="list-style-type: none"> <li>• Health and livelihood questionnaire (depression diagnosis)</li> <li>• Qual data (MH “problems”)</li> <li>• N</li> </ul>	<i>Mixed methods</i> <ul style="list-style-type: none"> <li>• Cross-sectional</li> <li>• Semi-structural interviews</li> </ul>	Poor education, health, mental health, agricultural practices, nutrition, and land management are factors in diminishing capacity of cocoa farmers to improve their livelihoods.	Indonesia	<ul style="list-style-type: none"> <li>• Farmers and their families</li> <li>• Livestock</li> <li>• Soil</li> <li>• Cocoa trees</li> </ul>
	Dell et al. [43]	<i>Effects of a therapy dog program on the wellbeing of older veterans living in a long term care residence</i>	To investigate how therapy dog visits influenced the wellbeing of older adult war veterans.	<ul style="list-style-type: none"> <li>• Zooeyia.</li> <li>• Holistic approach applied to social environment</li> </ul>	<i>Humans:</i> <ul style="list-style-type: none"> <li>• Anxiety</li> <li>• Happiness,</li> <li>• Elevated/ calm mood.</li> </ul> <i>Dogs</i> <ul style="list-style-type: none"> <li>• Anxiety (context of animal welfare)</li> </ul>	<ul style="list-style-type: none"> <li>• Questionnaires (multiple MH outcomes)</li> <li>• Qual data (multiple MH outcomes, including dog anxiety)</li> <li>• Y</li> </ul>	<i>Mixed methods</i> <ul style="list-style-type: none"> <li>• Modified instrumental case study</li> </ul>	Therapy dogs have positive influence on memory recollection and the physical and mental health of veterans.	Multiple villages Canada  Veterans' affairs residence	<ul style="list-style-type: none"> <li>• Older veterans</li> <li>• Therapy dogs</li> <li>• Handlers</li> </ul>
	Felappi et al. [44]	<i>Green infrastructure through the lens of “One Health”: A systematic review and integrative</i>	To propose a framework on the linkages between urban green spaces and	<ul style="list-style-type: none"> <li>• Collaborative</li> <li>• Holistic approach applied to urban green spaces</li> </ul>	• Multiple	<ul style="list-style-type: none"> <li>• Multiple</li> <li>• Y</li> </ul>	<i>Review</i> <ul style="list-style-type: none"> <li>• Systematic Review</li> </ul>	In addition to framework presented, features of urban green spaces that affect mental health and urban wildlife support are	Multiple (mainly Europe and North America)	<ul style="list-style-type: none"> <li>• Multiple animals</li> <li>• Multiple green space indicators</li> </ul>

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Table 2 (continued)

Frame-work	Author(s) & Ref. No.	Title	Aims	Framework Specifics	MH Outcome	MH Measurement/ Primary? Y/N	Study Type	Conclusion	Location/ Setting	Population(s) (Human/non-human)
		<i>framework uncovering synergies and trade-offs between mental health and wildlife support in cities</i>	mental health-wildlife-environment.					compiled. Synergies and trade-offs between these dimensions are identified.		
	Häsler et al. [45]	<i>A One Health framework for the evaluation of rabies control programmes: a case study from Colombo City, Sri Lanka</i>	To present a wholistic framework for the assessment of rabies interventions and apply it to a rabies control case study	<ul style="list-style-type: none"> <li>• Collaborative</li> </ul>	<i>Human:</i> <ul style="list-style-type: none"> <li>• Anxiety</li> </ul> <i>Dog:</i> <ul style="list-style-type: none"> <li>• Anxiety (context of animal welfare)</li> </ul>	<ul style="list-style-type: none"> <li>• Derived from DALYs (human anxiety)</li> <li>• Qual data (animal anxiety)</li> <li>• Y</li> </ul>	<i>Mixed Methods</i> <ul style="list-style-type: none"> <li>• Case study</li> </ul>	In addition to framework presented, in the case study there was a decrease in the number of dog rabies cases, increased education on treatment of dog bites, increased acceptance of dogs in society, and a positive overall net value.	Sri Lanka  Colombo City	<ul style="list-style-type: none"> <li>• Dog owners</li> <li>• Non-dog owners</li> <li>• Dogs (roaming)</li> </ul>
	Min et al. [36]	<i>Owners' attitudes toward their companion dogs are associated with the owners' depression symptoms-an exploratory study in South Korea</i>	To explore how the human-animal bond affects the mental health benefits of dog ownership	<ul style="list-style-type: none"> <li>• Zooeyia</li> </ul>	<ul style="list-style-type: none"> <li>• Depressive symptoms</li> </ul>	<ul style="list-style-type: none"> <li>• CESD-10</li> <li>• Y</li> </ul>	<i>Quantitative</i> <ul style="list-style-type: none"> <li>• Cross-sectional</li> </ul>	A positive significant association was found between owners' depression symptoms and unfavorable attitudes toward their dogs.	South Korea	<ul style="list-style-type: none"> <li>• Young adults with companion dogs</li> <li>• Companion dogs</li> </ul>
	Overgaauw et al. [46]	<i>A One Health perspective on the human-companion animal relationship with emphasis on zoonotic aspects</i>	To focus on zoonotic aspects in relationships between humans and pets, discuss problems associated with keeping exotic animals, and offer recommendations to prevent transmission of zoonotic pathogens.	<ul style="list-style-type: none"> <li>• Collaborative</li> <li>• Zooeyia</li> <li>• Focus on zoonotic infectious diseases</li> </ul>	<i>Humans:</i> <ul style="list-style-type: none"> <li>• Multiple</li> </ul> <i>Pets:</i> <ul style="list-style-type: none"> <li>• Anxiety</li> </ul>	<ul style="list-style-type: none"> <li>• Multiple</li> <li>• Y</li> </ul>	<i>Review</i> <ul style="list-style-type: none"> <li>• Literature Review</li> </ul>	Pets have positive effect on human health/ well-being. Owners are more aware of pet health, welfare, and well-being. Anthropomorphism, exotic animals and imported rescue dogs may increase contracting zoonotic infections. Recommendations include hygienic practices, responsible breeding and care, and education.	Multiple	<ul style="list-style-type: none"> <li>• Pet owners</li> <li>• Pets (dogs, cats, exotic animals)</li> <li>• Soil</li> </ul>
	Piotti et al. [47]	<i>Use of the Milan Pet Quality of Life Instrument (MPQL) to measure pets' quality of life during COVID-19</i>	To measure effect of pets and humans' personality traits, environmental/ demographic factors, lockdown, and the pet-human relationship on pets' quality of life during COVID.	<ul style="list-style-type: none"> <li>• Human-pet bond</li> <li>• Holistic approach applied to animal mental health</li> </ul>	<i>Humans:</i> <ul style="list-style-type: none"> <li>• Psychological quality of life</li> </ul> <i>Cats/Dogs:</i> <ul style="list-style-type: none"> <li>• Psychological quality of life</li> </ul>	<ul style="list-style-type: none"> <li>• Milan Pet Quality of Life (MPQL) (both human and animal QoL)</li> <li>• Y</li> </ul>	<i>Quantitative</i> <ul style="list-style-type: none"> <li>• Cross-sectional</li> </ul>	Pets' psychological QoL during COVID-19 was predominantly indirectly affected by the psychological and physical state of their owner. Physical QoL of pets was impacted by various pet-related factors. Environmental QoL was most directly affected by the COVID-19 pandemic.	Italy	<ul style="list-style-type: none"> <li>• Pet owners</li> <li>• Dogs/cats</li> </ul>

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Table 2 (continued)

Frame-work	Author(s) & Ref. No.	Title	Aims	Framework Specifics	MH Outcome	MH Measurement/ Primary? Y/N	Study Type	Conclusion	Location/ Setting	Population(s) (Human/non-human)
Planetary Health	Clinch [48]	<i>Environmental stewardship in austere times: nurturing sustainable socio-ecological relations</i>	To explore the challenges of enacting environmental stewardship in the context of austerity	<ul style="list-style-type: none"> <li>Participatory research</li> </ul>	<ul style="list-style-type: none"> <li>Anxiety</li> <li>Depression</li> </ul>	<ul style="list-style-type: none"> <li>Qual data</li> <li>N</li> </ul>	<i>Qualitative</i> <ul style="list-style-type: none"> <li>Ethnography</li> </ul>	Aligning stewardship work with the ethical principles of permaculture can summon agency and action to address challenges wrought by austerity and climate change. However, the scale of work needed for stewardship can bring stress and depression.	UK Calder River catchment	<ul style="list-style-type: none"> <li>People who live alongside the Calder River</li> <li>Biodiversity (plant and wildlife) of study area</li> </ul>
	French et al. [49]	<i>A planetary health model for reducing exposure to fecal contamination in urban informal settlements: Baseline findings from Makassar, Indonesia</i>	To generate conceptual model of health and environment in urban informal settlements and complete environmental assessment in flood-prone settlements	<ul style="list-style-type: none"> <li>Systems approach</li> <li>Holistic approach applied to social environment</li> </ul>	<ul style="list-style-type: none"> <li>Well-being</li> <li>Quality of Life</li> </ul>	<ul style="list-style-type: none"> <li>Survey; included measures of subjective wellbeing, depression (CES-D-10), quality of life (PedsQL)</li> <li>N</li> </ul>	<i>Quantitative</i> <ul style="list-style-type: none"> <li>Repeated cross-sectional</li> </ul>	Settlements were prone to environmental contamination problems with multiple high-risk exposure pathways resulting in poor health and wellbeing outcomes	Indonesia	<ul style="list-style-type: none"> <li>Residents of informal settlements</li> <li>Mosquitoes, shrews, rats, livestock, and pets</li> <li>Water, sediment, and soil</li> <li>IPCC authors</li> </ul>
	Singh & Chudasama [50]	<i>Pathways for climate resilient development: Human well-being within a safe and just space in the 21st century</i>	To explore enabling conditions and the relative roles of adaptation, mitigation, and SDGs in attaining climate resilient development.	<ul style="list-style-type: none"> <li>Ethical dimension</li> </ul>	<ul style="list-style-type: none"> <li>Well-being</li> </ul>	<ul style="list-style-type: none"> <li>Definition of well-being includes positive mental health concepts</li> <li>N</li> </ul>	<i>Mixed methods</i> <ul style="list-style-type: none"> <li>Fuzzy cognitive models</li> </ul>	The following enabling conditions are critical to achieve climate resilient developments: ethics, values, and worldviews framing narratives and action; commitment to finance, technology and partnerships by national governments; engagement of actors across local and global scales; and innovations in policy, institutions, and practice.	n/a	

**Table 3**  
Summary of findings from the 13 articles included in the scoping review.

Domain	Summary of Findings	EH	OH	PH
Framework Components Identified	• Intersectoral collaboration (n = 6, 46.2%)	2	4	–
	• Expanded human-ecological interface to additional concepts (n = 5, 38.5%)	–	4	1
	o <i>The Social Environment</i> (n = 2, 15.4%)	–	1	–
	o <i>Livelihoods</i> (n = 1, 7.7%)	–	1	–
	o <i>Green Spaces</i> (n = 1, 7.7%)	–	1	–
	o <i>Animal Mental Health</i> (n = 1, 7.7%)	–	1	–
	• Human-Animal Bond (n = 4, 30.8%)	–	4	–
	o <i>Defined as Zooeyia</i> (n = 3, 23.1%)	–	3	–
	• Participatory Research (n = 2, 15.4%)	1	–	1
	• Systems Approach (n = 2, 15.4%)	1	–	1
Mental Health Outcomes	• Ethical Dimension (n = 2, 15.4%)	1	–	1
	• Anxiety (n = 5, 38.5%)	2	2	1
	• Well-being (n = 4, 30.8%)	2	–	2
	o <i>Definition includes “sense of place”</i> (n = 2, 15.4%)	2	–	–
	• Depression (n = 3, 23.1%)	–	2	1
	• Animal mental health (n = 4, 30.8%)	–	4	–
	o <i>Anxiety/Stress</i>	–	3	–
	o <i>Psychological Quality of Life</i>	–	1	–
	• Quality of life (n = 2, 15.4%)	–	1	1
	• Positive mental health (n = 1, 7.7%)	–	1	–
Methodological Approaches	• Original research (n = 11, 84.6%)	3	5	3
	o <i>Mixed methods</i> (n = 4, 30.8%)	1	3	1
	o <i>Quantitative</i> (n = 3, 23.1%)	–	2	1
	o <i>Qualitative</i> (n = 3, 23.1%)	2	–	1
	• Reviews (n = 2, 15.4%)	–	2	–
	• Global north (n = 8, 61.5%)	3	4	1
	o <i>Canada</i> (n = 3, 23.1%)	2	1	–
	o <i>Australia</i> (n = 1, 7.7%)	1	–	–
	o <i>Europe and North America</i> (n = 1, 7.7%)	–	1	–
	o <i>Italy</i> (n = 1, 7.7%)	–	1	–
Regions	o <i>South Korea</i> (n = 1, 7.7%)	–	1	–
	o <i>United Kingdom</i> (n = 1, 7.7%)	–	–	1
	• Global South (n = 3, 23.1%)	–	2	1
	o <i>Indonesia</i> (n = 2, 15.4%)	–	1	1
	o <i>Sri Lanka</i> (n = 1, 7.7%)	–	1	–
	• Human (n = 13, 100%)	3	7	3
	o <i>Dog/pet owners</i> (n = 5, 38.5%)	1	4	–
	o <i>Nurses/Nursing Students</i>	1	–	–
	o <i>Farmers and their families</i>	–	1	–
	o <i>Older Veterans</i>	–	1	–
Populations studied	o <i>People with interest in national parks</i>	1	–	–
	o <i>IPCC Authors</i>	–	–	1
	o <i>Informal residents</i>	–	–	1
	o <i>Residents alongside river</i>	–	–	1
	• Animal (n = 11, 84.6%)	1	7	2
	o <i>Dogs/pets</i> (n = 7, 53.8%)	1	6	1
	o <i>Livestock</i>	–	1	1
	o <i>Animal wildlife biodiversity</i>	–	–	1
	o <i>Mosquitos, shrews, and rats</i>	–	–	1
	• Non-animal (n = 6, 46.2%)	1	3	2
	o <i>Soil</i>	–	2	1
	o <i>Urban ecology/green space characteristics</i>	1	1	–
	o <i>Trees</i>	–	1	–
	o <i>Wildlife biodiversity</i>	–	–	1
	o <i>Water</i>	–	–	1

within broader conceptualizations of public health [51], as well as the complexity involved in measuring mental health outcomes as they connect with the broad system of components contained within the biosphere [52]. This complexity broadens given the challenges associated with monitoring and predicting the mental health implications

from a continuously changing environment [51]. The dearth of studies in this review also reflects the overall lack of studies measuring mental health within the related fields of climate change [16], ecosystem services [53], and biodiversity loss [54].

We address this gap in the literature by providing guidance for investigators on how to conduct mental health research within the parameters of the three frameworks. As guidance is already available regarding the practical design and implementation of EH, OH, and PH research [9,55,56] our recommendations center on expanding the mental health component within these existing action-steps. And while the evidence-base presented here is limited, the papers included in this review offer a sufficient baseline and guiding post for future studies with their varied methodological approaches and aims.

#### 4.1. Mental health considerations

Researchers that utilize these frameworks should first fully integrate the assertion that there is no health without mental health [10] and include mental health outcomes for more holistic assessments of overall health. As demonstrated by the included articles, measurements of mental health need not be a primary outcome but can be secondary or tertiary, such as when measuring mental health within broader conceptualizations of well-being that include other social and economic measurements. For instance, for an included PH paper highlighting key risk factors for fecal-oral exposure in informal settlements [49], human health and well-being were assessed and compiled though such factors that included mental health as well as biomarkers, healthcare utilization, and socioeconomic status.

The way mental health is seen, felt, and experienced can be deeply mediated by social, cultural, and religious factors. The methods of measuring mental health outcomes should be cognizant of these contextual influences. The use of scales to document symptom severity or diagnostic classification can help measure the burden of adverse mental health conditions and how it changes over time, especially in larger and longitudinal studies. However, cross-cultural validity of psychiatric concepts must be considered. For example, in Min et al.'s [36] study measuring the association of dog owners' depressive symptoms with attitudes toward their companion dogs, depressive symptoms were measured with a Korean version of the Center for Epidemiologic Studies Depression scale (CESD-10) which has been demonstrated as a valid and reliable measure of depression in Korean populations [57]. Future work within these frameworks should take into consideration specific demographics and population groups, recognizing that there may be heterogeneity in how mental health impacts different groups.

The type of mental health outcomes investigated should also be expanded to include more concepts that specifically describe the emotional connections that tie us to our planet. For example, two EH papers [39,40] that used qualitative methods both generated “well-being” as a mental health outcome tied to the concept of “sense of place”, which refers to the emotional ties one ascribes with their surrounding environments. This emotional bond can relate to identity, solace, security, and belonging [58]. In one of these studies that examined perceptions of dogs in Inuit communities, a musher reported owning dogs as a way to “connect to their culture, to be on the land, and see how their ancestors lived” [39]. “Sense of place” has increasingly become a central concept in analyzing mental health risks posed by climate change in indigenous as well as farming communities [58].

Other concepts to consider when measuring emotional interactions between humans, ecosystems, and animals include “solastalgia” and “eco-anxiety”. Altered landscapes and environments from such drivers as climate change or environmental degradation, especially in populations with strong place attachment, can cause a particular form of emotional stress or melancholia. “Solastalgia” encompasses this emotional response [59]. There are a variety of approaches used to measure solastalgia experiences, including through qualitative interviews and from the Environmental Distress Scale (EDS) [60].



Differentiating from “solastalgia”, which is a grief response to a present and actual environmental loss, “eco-anxiety” relates to the emotions one feels regarding future environmental change [61]. “Eco-anxiety” remains a relatively new concept, and while several scales exist to measure its severity, the operationalization of the term remains unclear, and studies are needed to better understand this conceptual construct [61].

Additional mental health outcomes to consider include nature-deficit disorder, eco-paralysis, and topophilia, which is a positive emotional experience derived from one's sense of place and considered an inverse of solastalgia [60]. As the concept of mental health reflects a meaning broader than the presence or absence of mental illness to also include positive indicators, other positive mental health outcomes such as post-traumatic growth, happiness, and satisfaction should be considered to capture the full capacity of mental health impacts. Only two of the original research articles included positive mental health outcomes [43,50].

There are also tangible benefits to focusing on the psychological health of animals as it relates to human health and well-being. For instance, stress hormones in animals regulate immune defenses and consequently impact how hosts manage and control parasites and diseases, which when crossed over to human populations can have co-occurring mental health consequences [62]. However, animal health indicators were relegated only to OH studies. This speaks to a larger issue of incongruities between the definitions of health between the three frameworks, in addition to the discrepancies held in how the scientific community defines mental health and psychological well-being in animals. More conceptual and philosophical analysis are therefore needed to find suitable definitions of mental health that fully encompasses the well-being for both humans and animals, as well as for plants and ecosystems [1].

#### 4.2. Building holistic research questions and agendas

Research questions should first and foremost be built from empirical or theoretical understandings of the relationships between human, animal, and ecosystem health while aiming to achieve a systems-based understanding of the drivers of a mental health-related issue. It is crucial therefore to build a multi-disciplinary team from both within and outside one's area of expertise at all stages within this formative and iterative process, including those with experience in mental health research and direct service provision. Drawing from the studies in this review, direct practitioners can include community mental health nurses [41] and clinical social workers [43], but can also involve psychiatrists, counselors, and other professional or informal/non-traditional practitioners with intimate knowledge of community mental health. Research should also avoid a solely expert-driven approach and include at all stages key stakeholders and community members with inherent knowledge of the systems they inhabit. These partnerships will both enhance the scope of the research but can also lead to continuing networks and collaborations that can both improve uptake and adapt interventions that outlast research projects. Lastly, as factors such as pollution, climate change, and emerging infectious diseases are disproportionately impacting vulnerable populations [63], these communities should be placed at the forefront of research agendas.

Measurements of non-human features are wide and diverse and should reflect the overall research aims and objectives. As measuring the underlying mechanisms and pathways between animal, ecosystem, and human health is a fundamental component to these frameworks, research plans should include robust measures of exposure to natural elements when measuring mental health outcomes. Exposure refers to the amount of contact one has with natural systems and can be measured through such factors as access and proximity. Exposure should also include more specific considerations, including the time spent in environmental systems (dose) and the specific ways people interact with the natural world (e.g., swimming vs. observing water) [53].

#### 4.3. Limitations

Several limitations must be noted regarding this scoping review. First, the review does not assess the methodological rigor of the included studies. However, this limitation relates closely to the purpose of scoping reviews which are to review the current state of knowledge within the literature, illustrate gaps, and establish and advocate for a new research agenda. In addition, our search was limited to English-only articles and empirical papers, other grey literature and non-English studies may also outline mental health research within these frameworks that we did not include. Lastly, throughout the scoping review process we met with experts and outside perspectives to assist in conceptualizing the research question, ensure that appropriate disciplinary language was used, and seek guidance on dissemination strategies for cross-disciplinary accessibility. However, as these conversations were not standardized, recorded, and analyzed, and no data from these consultations were included in the paper. Therefore, we did not include the sixth step in Arksey and O'Malley's framework for scoping reviews in our methodology. While Arksey and O'Malley list consultation as an optional stage, consulting with stakeholders in a systematic fashion adds methodological rigor and enhances the validity and applicability of study findings [27]. As our research moves forward from this review, we will specifically plan to continue soliciting expert knowledge from a wide range of mental healthcare researchers, practitioners, ecologists, anthropologists, veterinarians, medical professionals, and community leaders to learn of additional potential ways forward to build the evidence base for mental health within the context of these frameworks.

#### 5. Conclusion

In systematically reviewing the complete body of mental health literature whose methods are guided by the One Health, EcoHealth, and Planetary Health frameworks, the objective of this review was to identify existing trends and noticeable gaps in the existing evidence-base in hopes of informing future studies, encourage creative and innovative research directions, and ultimately better safeguard the health of our planet and reduce suffering. As the main finding of this review is the lack in existing literature, it should be noted that the complex challenges associated with measuring and protecting mental health within a changing world is an ideal match for the One Health, EcoHealth, and Planetary Health approaches, which were developed to grapple with complex systems. Applying these frameworks can also allow for new understandings of mental health and offer approaches to research and interventions that will be invaluable in better understanding, discovering, and addressing the full range of outcomes from our changing planet.

#### Declaration of Competing Interest

The authors declare that they have no conflict of interest.

#### Data availability

No data was used for the research described in the article.

#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.onehlt.2023.100621>.

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