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RECEIVED 28 October 2025

REVISED 30 October 2025

ACCEPTED 11 November 2025

PUBLISHED 27 November 2025

CITATION

Provencher JF. Plastic pollution and
climate change: insights from
a One Health perspective.
Front Sci (2025) 3:1734228.
doi: 10.3389/fsci.2025.1734228

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Plastic pollution and climate change: insights from a One Health perspective

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KEYWORDS

One Health, harm reduction, plastic pollution, climate change, health equity,
environmental policy, biodiversity conservation

A Viewpoint on the Frontiers in Science Lead Article

**Plastic pollution under the influence of climate change: implications
for the abundance, distribution, and hazards in terrestrial and aquatic
ecosystems**

Key points

- Plastic pollution and climate change are interconnected global hazards that demand integrated, evidence-based responses bridging environmental and human health.
- Applying a One Health framework can unite ecological, social, and policy perspectives to design context-specific, equitable solutions to these dual threats.
- A harm reduction approach offers a pragmatic pathway to mitigate unavoidable impacts while guiding collaborative research and policy toward improved environmental outcomes.

Both plastic pollution and climate change have been the focus of international negotiations, large, targeted science programs, and ongoing debate over the best solutions. The policy spaces for these two issues have developed separately but in parallel for decades (1, 2). While biodiversity loss is another environmental concern, recent conventions and targets now recognize both climate change and plastic pollution as central global threats to biodiversity under the recent Kunming–Montreal Global Biodiversity Framework (targets 7 and 8; <https://www.cbd.int/gbf>).

Plastic pollution and climate change have shaped environmental priorities and policy agendas for over two decades. In their Frontiers in Science lead article, Kelly et al. (3) outline several interactions between these stressors—some well-established, others less studied—and discuss potential solutions. Notably, they emphasize the hazards that both plastic pollution and climate change pose to the environment. It is this hazard framing that is important to note and perhaps warrants more critical evaluation.

Beyond their interconnected sources and policy development, these two challenges share key similarities relevant to both hazards and solutions. Each threatens environmental

and human health, and neither spares any region. Both are long-term global problems: even if solutions were implemented immediately, legacy emissions would continue to affect ecosystems and people for years to come. Therefore, while solutions are critical, we must also ask how environmental scientists can best advance research that supports evidence-based decision-making for improved outcomes.

Working within a research group that is mandated to study wildlife health, including plastic pollution, contaminants, parasites, and pathogens through the lens of climate change, I often find concepts and tools that bridge ecotoxicology and disease ecology useful. Our group promotes a One Health approach as a holistic model for developing research programs. I believe the lessons from One Health can be applied to the interconnectedness between climate change and plastic pollution highlighted by Kelly et al. (3).

One Health, introduced more than two decades ago, has re-emerged as a global priority since the COVID-19 pandemic. While the One Health (or EcoHealth) approach is often interpreted as human-centered and pathogen-focused, there is growing momentum to broaden its scope beyond the gravitational pull of public health (4). Historically, public health framing casts animals and the environment mainly as sources of harm (e.g., pathogens). Recent work by Stephen et al. (4), however, argues for re-centering One Health principles to consider harms to biodiversity and promote health equity across human groups and animal populations alike, an approach that can strengthen conservation outcomes. Health equity is particularly important when prioritizing solutions for climate change and plastic pollution. These challenges do not have universal solutions: actions effective in one region may fail in another. Solutions are best developed within a settings-based approach that accounts for local drivers of health and targets context-specific interventions to reduce hazards from these dual threats. While connecting plastic pollution and One Health is not a new concept (5), the continued escalation of these global environmental threats demands further exploration of this integrated approach.

One Health also emphasizes the link between research, policy, and action through whole-systems thinking (6, 7). This approach is particularly important for climate change and plastic pollution science. Both discovery and applied research are critical, yet policy-driven science is essential during this era of policy formulation and implementation. No single policy can solve these issues; instead, a mosaic of municipal, regional, national, and international policies is emerging. Whole-systems thinking helps identify policy gaps and understand the barriers and enablers that shape real-world solutions. Recognizing the policy landscape and its drivers is critical for designing research that reflects complex, interacting systems.

Within the One Health framework, another useful concept for addressing multiple stressors is the harm reduction approach, long used in public health sectors and now increasingly applied to

environmental studies (8, 9). Harm reduction acknowledges that not all harm can be eliminated, focusing instead on actions that minimize it (8). Both plastic pollution and climate change are omnipresent, arising as by-products of industrial advances that have improved health metrics of billions of people across the globe. The improvement in global health care systems due to plastic personal protection equipment and tools, and fossil fuels in powering health infrastructure, illustrates this tension: technologies that enhance human health can simultaneously harm ecosystems. The challenge now is to reduce environmental damage without undermining human well-being—a goal aligned with harm reduction principles.

As Stephen (10) notes, harm reduction is both a goal and a process. Applying this approach to climate change and plastic pollution collectively encourages action and solutions where harm is greatest and prevention where systems remain intact. It directs attention to localized, collaborative solutions that minimize harm and enhance outcomes. The case of plastic straws illustrates this balance: campaigns to “ban the straw”—motivated by images of a plastic straw being removed from the nose of a turtle—aimed to reduce harm to wildlife but inadvertently affected people with disabilities who rely on straws to consume fluids (11). The confusion between banning straws altogether and banning plastic straws exemplifies the importance of inclusive harm reduction thinking.

Kelly et al. (3) call for integrating research on plastic pollution and climate stressors to inform policy on both fronts—an approach that reflects One Health thinking. I urge researchers to take this further: design studies that examine how these threats interact and explore solutions that yield co-benefits. What kinds of research can reveal synergies between mitigation strategies? How can we prioritize the regions or ecosystems most vulnerable to compounded harm? Granting agencies should support integrated research that advances solutions to these “wicked” problems.

Lastly, we must consider how results are communicated and used by policymakers. We cannot rely on a “Field of Dreams” mentality—if we write it, they will use it. As researchers, we must be active players in two-way exchanges with decision-makers to connect complex issues and co-develop harm reduction strategies that improve environmental health. Integrating One Health and harm reduction approaches is essential for shaping both science and policy around these dual threats and must be embedded throughout the full research–policy cycle.

Statements

Author contributions

JP: Conceptualization, Writing – original draft, Writing – review & editing.

Funding

The author declared that financial support was not received for this work and/or its publication.

Conflict of interest

The author declared that this work was conducted in the absence of financial relationships that could be construed as a potential conflict of interest.

The author is a Research Scientist for Environment and Climate Change Canada (ECCC) in the Ecotoxicology and Wildlife Health Division, which has a federal mandate to study how a variety of pathogens, parasites, and pollutants influence wildlife.

Generative AI statement

The author declared that generative AI was not used in the creation of this manuscript.

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