From Footprints to Handprints: Principles for Assessing an Organisation's Positive Impacts on Biodiversity

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Summary

Organisations are increasingly acknowledging their responsibility to 'bend the curve of biodiversity loss' by reducing negative biodiversity impacts, often referred to as biodiversity footprints. A growing number of organisations are also interested in highlighting the positive impacts they have on biodiversity, driven by research, innovation and lobbying, for example. Limited guidance currently exists for how these positive impacts should be quantified, presenting a risk to organisations and biodiversity more widely. Building on the concept of carbon handprints, we introduce the concept of 'biodiversity handprints' as a framework to measure and communicate the positive contributions that organisations create for biodiversity. We establish ten guiding principles for assessing biodiversity handprints, building upon previous literature on environmental handprints and biodiversity offsetting. Overall, we propose that biodiversity handprints could be a useful tool for organisations to assess and report their positive impacts, albeit with large uncertainties. While biodiversity handprints may motivate and support progress towards global biodiversity goals, they must still accompany assessment and management of negative biodiversity impacts.

Keywords: Biodiversity handprint; biodiversity footprint; carbon handprint; biodiversity loss; biodiversity offsetting.

Science for Society

Organisations are significant drivers of global biodiversity loss and are increasingly recognising the importance of mitigating their negative biodiversity impacts, known as 'biodiversity footprints'. However, there is growing recognition that organisations can also generate positive impacts for biodiversity. Organisations may undertake research which supports conservation action, for example, or innovate products that reduce a customer's biodiversity impacts beyond their responsibility to reduce harm. Such impacts are not currently captured within biodiversity accounting frameworks, despite their potential to contribute towards global biodiversity goals. Reporting positive contributions can, for example, enable customers to make more sustainable choices, attract investments towards biodiversity-beneficial activities, or inform sustainability strategies.

We introduce the concept of 'biodiversity handprints' here, used as a framework to measure and communicate the positive contributions that organisations create for biodiversity. We establish ten guiding principles for organisations to follow when assessing biodiversity handprints, grounded in previous research into environmental handprints and biodiversity offsetting. Clear guidance for reporting positive impacts is essential for organisations, as inaccurate reporting drives unintended outcomes for biodiversity and organisational reputations. Our framework enables organisations to credibly measure and report their positive biodiversity contributions. However, assessing handprints comes with large uncertainties, as impacts may occur through complex value chains, and biodiversity outcomes are methodologically challenging to estimate. While biodiversity handprints may motivate and support progress towards global biodiversity goals, they cannot replace management of negative biodiversity impacts. We believe that the handprint framework could be a useful tool, applicable to a range of contexts. We would encourage corporations to apply the handprint framework to assess their positive biodiversity impacts, building upon the conceptual developments of this study.

1. Introduction

Human-driven biodiversity loss is eroding ecosystem integrity, destabilizing the biophysical foundations of human well-being and threatening the viability of global economies and societal stability (Dasgupta, 2021; IPBES, 2019; WEF, 2026). Organisations are increasingly recognizing their responsibility to halt and reverse this decline, driven by ambitious international commitments such as those articulated in the Global Biodiversity Framework (Addison et al., 2019; CBD, 2022; Locke, 2020). A key avenue for action is the avoidance and mitigation of negative biodiversity impacts, many of which are embedded within complex, globalized value chains (Bull et al., 2022; El Geneidy et al., 2026; Panwar, 2023; Peura et al., 2023). In this context, biodiversity footprinting has emerged as a leading approach for systematically quantifying and reporting organisational impacts within value chains (De Ryck et al., 2024). When integrated with the mitigation hierarchy, footprinting can guide the prioritization of concrete actions to reduce biodiversity loss (White et al., 2025).

The central role of mitigation of negative impacts is well established: without decisive actions, bending the curve of biodiversity loss remains unattainable (Moilanen & Kotiaho 2018). At the same time, a growing number of businesses and other organisations are seeking to understand and demonstrate the positive biodiversity impacts of their actions and products (Burek et al., 2022; Leitch et al., 2026; Liu & Tu, 2026). Emphasising positive impacts may be particularly effective in incentivising organisational change, complementing approaches that focus primarily on reducing harm. However, in contrast to well-established approaches for quantifying and reporting negative biodiversity impacts, methods for systematically quantifying and reporting positive contributions remain underdeveloped (Bang et al., 2025; Vatanen et al., 2018).

When credibly measured and communicated, positive impacts can enable more sustainable consumer choices, attract investments into biodiversity-beneficial activities, inform organisational sustainability strategies, and mobilise private finance towards biodiversity-enhancing services and products. More fundamentally, achieving global ambitions for nature requires moving beyond no net loss towards measurable net positive outcomes for biodiversity, representing a transformative change from merely offsetting harm to actively restoring and regenerating ecosystems (Milner-Gulland, 2022; Milner-Gulland et al., 2021; Victurine et al., 2024). Reflecting this shift, initial efforts to quantify and report positive biodiversity impacts are emerging across sectors, including impact investing, product innovation, and academia (Asselin et al., 2020; Burek et al., 2022, 2025; Lhoest et al., 2024).

The absence of a generally accepted framework for quantifying and reporting positive biodiversity impacts represents a major obstacle for organisations (Elliot et al., 2024). These challenges are further amplified by the complexity of increasingly global value chains through which biodiversity impacts (positive and negative) arise, making robust quantification and attribution of positive impacts difficult (Bang et al., 2025; Russell, 2019). In the absence of coherent guidance on positive impacts, organisations may develop heterogeneous, non-comparable methodologies or refrain from reporting positive impacts altogether - a practice increasingly referred to as greenhushing (Hilton, 2025; Russell, 2019). Conversely, weak safeguards can create incentives for selective disclosure of positive impacts for impression management purposes (Blanco-Zaitegi et al., 2024; Durand et al., 2025; Folke et al., 2019). The lack of guidance also presents risks to businesses: reported positive impacts that do not reflect genuine biodiversity gains risk undermining organisational credibility through accusations of greenwashing while legitimising biodiversity loss (Guillaume et al., 2020). Despite initial advances to clarify the scenarios in which positive actions arise (Bang et al., 2025; Leitch et al., 2026), there remains no coherent and widely accepted approach for the credible quantification and reporting of positive biodiversity impacts.

As biodiversity is increasingly mainstreamed in business decision-making (Katic et al., 2023), this represents a critical moment to scrutinise how and under what conditions positive biodiversity impacts should be assessed. Here we propose the concept of 'biodiversity handprints', building upon literature on environmental and social 'handprints'. 'Handprints' first emerged as a concept in environmental education and were later formalised in environmental impact literature to characterize the environmental benefits of products, services, or organisations, with most applications to date focusing on carbon . In the carbon literature, a handprint is focused on the positive contributions an actor can make to reduce GHG emissions (Vatanen et al., 2018).

A clear gap remains in how the handprint concept can be meaningfully and credibly applied to biodiversity (Guillaume et al., 2020; Vatanen et al., 2021). Developing such guidance could enable organisations to more robustly quantify and track progress towards nature-positive goals. Here, we develop a conceptual and methodological foundation for biodiversity handprints, articulated through a set of guiding principles for their credible assessment and reporting. We discuss how their application can support organisational action aligned with broader biodiversity ambitions, including nature positive goals (White et al., 2024).

2. Biodiversity handprints- conceptual foundations

Biodiversity handprints refer to an actor's demonstrable and additional positive contributions to biodiversity, beyond their responsibility to reduce harm (Burek, 2025). Importantly, biodiversity handprints are conceptually distinct from biodiversity offsets. Offsets are designed to compensate for negative impacts in accordance with the mitigation hierarchy (Milner-Gulland, 2022; Moilanen & Kotiaho, 2018). In comparison, handprints refer to additional actions to generate positive biodiversity outcomes, which are not used to mitigate an organisation's own negative impacts under the mitigation hierarchy. This distinction is fundamental, as handprints shift the focus from compensating harm to creating positive biodiversity contributions.

2.1 System boundaries for biodiversity handprints

From a system boundary perspective, biodiversity handprints arise from positive actions that occur beyond the direct mitigation of an organisation's own biodiversity footprint. Handprints therefore reflect additional contributions to biodiversity that often materialise through influences across and beyond its value chain (Almelhem et al., 2025; Sauer & Seuring, 2019; Young, 2018; Bang et al., 2025). In practice, deciding what negative impacts (i.e., footprint) can be attributable to an organisation– and where responsibility to reduce harm lies - is not always clear-cut (Weidema et al., 2018; Bang et al 2025). Limited traceability and transparency in global supply chains can constrain attributing impacts to different actors, and biodiversity impacts may be driven by historical actions, making attribution more challenging. (Bang et al., 2025; Gardner et al., 2019; Isil & Sebastianelli, 2020). Responsibility for negative impacts is increasingly understood as shared among value chain actors (Borchardt et al., 2025). Organisations may hold different perspectives and cultural values regarding whether a negative impact falls within their responsibility to reduce, even if it is attributable to their actions (Al-Shaer et al., 2024).

Here we recommend that organisations take responsibility, at a minimum, for the most immediate actors in their value chain. Responsibility could be proportional to the share of the actor's annual expenses or production attributable to the organisation. For example, if an organisation purchases one-fifth of a supplier's total output, then they should be responsible for one-fifth of the supplier's negative impacts (Houdet & Teren, 2022). Transparency in value chains is expected to improve over time, for example through regulatory developments and digital traceability technologies (Stenzel & Waichman, 2023), enabling increasingly robust methods for attribution of responsibility (Farrelly et al., 2026). Clearly defining system boundaries and actor responsibilities is a critical prerequisite for designing effective biodiversity strategies (Bang et al 2025), and the credible assessment of handprints.

2.2 Generating biodiversity handprints

Biodiversity handprints may occur either through reducing pressures on biodiversity caused by other individuals or organisations, or through directly improving the state of biodiversity beyond mitigation of an organisation's own biodiversity footprint.

Firstly, biodiversity handprints can occur due to reductions in pressure when an organisation's actions influence upstream, downstream, or beyond value chain actors, thereby reducing the biodiversity footprint of other organisations or individuals (Norris et al., 2021). Importantly, impact reductions considered as a handprint must not overlap with reductions to the focal organisation's own footprint. Such impacts should be understood as mitigation within the organisation's own system boundary (see Section 2.1), rather than as additional benefits that constitute biodiversity handprints.

Secondly, biodiversity handprints may result from actions that improve the state of biodiversity, such as ecosystem restoration or conservation interventions. In many cases, these impacts are mediated through complex causal pathways, including behavioural change among other actors, making attribution inherently challenging. Importantly, these actions can only be considered handprints if they are not explicitly used to mitigate an organisation's own negative impacts as part of the mitigation hierarchy. Actions which generate a biodiversity handprint cannot be used for handprinting; we comment upon the role of handprints in comparison to offsets in greater detail within the Discussion.

Organisational actions that produce biodiversity handprints can be classified into four distinct categories (Norris 2021; Table 1). First, innovation refers to development of products, services, or practices that contribute to handprints through the reduction of pressures on biodiversity of other organisations and individuals. For example, a company may produce plant-based meat alternatives that facilitate reduction in meat consumption and associated pressures to biodiversity. Second, initiatives encompass actions that promote behavioural change and enable other actors to undertake biodiversity-beneficial actions. Third, investments enable innovations or initiatives that reduce biodiversity pressures or improve the state of biodiversity through the actions of other actors (e.g., (Thompson, 2022, 2023)). Fourth, additional conservation actions such as restoration or protection generate positive biodiversity outcomes, both within and beyond the value chain, therefore improving the state of biodiversity outside the scope of mitigating an organisation's own impacts. Additional conservation actions is rapidly developing concept with significant overlap with handprints, and is commented upon in further detail elsewhere (Leitch et al., 2026).

Handprint action	Description	Examples
i) Innovation	An organisation creates products, services, or practices that enable other actors to reduce their biodiversity impacts	Developing products or services that help customers to reduce their biodiversity impact via efficiency improvements
ii) Initiative	Organisation undertakes actions that encourage behaviour change in other actors, generating positive biodiversity outcomes	Promoting pro-environmental behaviours in communities; advocating for conservation policies; conducting research and teaching that supports sustainability action
iii) Investment	Organisation allocates financial resources to support innovations or initiatives that reduce the biodiversity impacts of other actors	Investing in companies or projects that deliver biodiversity-positive products, services, or interventions
iv) Additional conservation actions	Organisation undertakes actions intended to benefit biodiversity that are not linked to its own negative impacts	Donating to conservation organisations while adhering to the mitigation hierarchy; establishing a protected area

Table 1: Overview of actions that generate a biodiversity handprint.

2.3 Quantifying biodiversity handprints

We illustrate approaches to quantifying different types of handprints in Figure 1. Handprints may arise from reducing pressures on biodiversity caused by other actors (Figure 1a), or from additional conservation actions that directly improve the state of biodiversity, provided they are not explicitly linked to mitigating the organisation's own impacts (Figure 1b). Importantly, generating a biodiversity handprint does not eliminate the original biodiversity impact of the focal organisation. Therefore, handprints and footprints be reported separately.

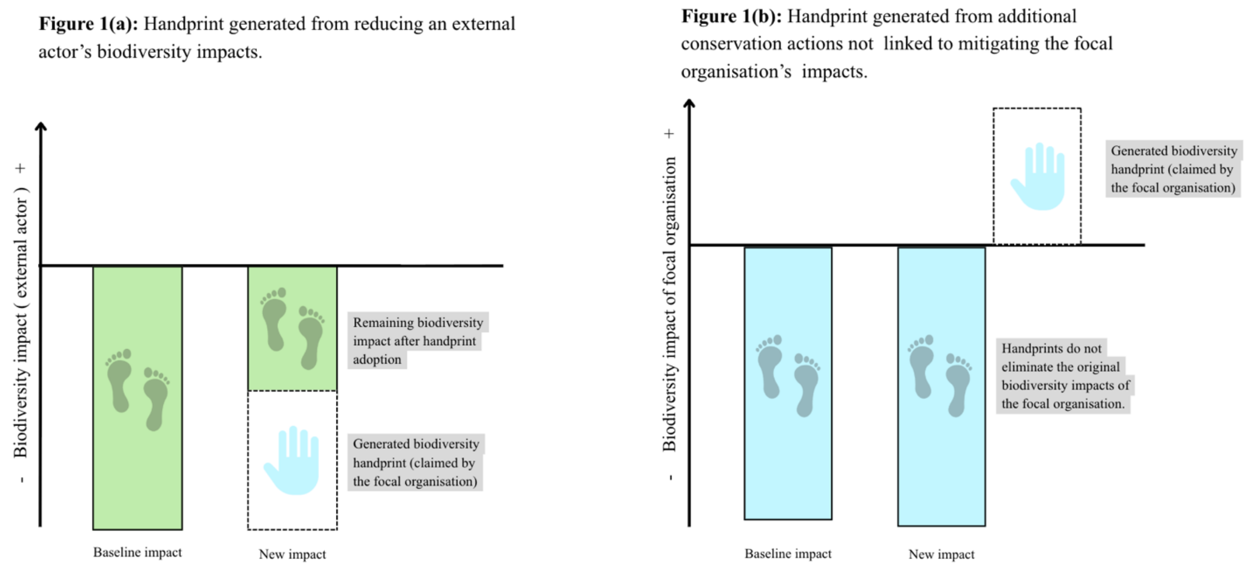

Figure 1: Quantifying biodiversity handprints, from the perspective of a focal organisation. Biodiversity handprints can be quantified in terms of how much they reduce the biodiversity footprint of upstream, downstream, or beyond value chain actors ('external actors') (Figure 1a). Handprints may also undertake additional conservation actions not directly linked to mitigating the focal organisation's own impacts (Figure 1b). However, generating handprints does not eliminate the original biodiversity impacts of the focal organisation.

Quantifying handprints requires comparison against a robust counterfactual scenario in which the action did not occur, ensuring outcomes can be credibly attributed to the specific intervention (Baylis et al., 2016; Maron et al., 2018). Comparison against a counterfactual scenario can be methodologically challenging as biodiversity handprints can arise from physical products as well as from more abstract ideas and practices. There is likely a scale of feasibility in identifying and quantifying positive actions for biodiversity. Quantifying handprints for innovations that demonstrate a clear increase in energy or material efficiency, and therefore reductions in other individual or organisations biodiversity impacts, for example, may be relatively straightforward (Burek et al., 2022). The handprint of additional conservation actions or investments may also be feasible to quantify, although constrained by the selection of appropriate counterfactuals and impact metrics (Langhammer et al., 2024; Leitch et al., 2026; Thompson, 2022, 2023). Quantifying positive outcomes from initiatives such as research or promotion of pro-environmental behaviours, however, is particularly difficult, although initial attempts have been made in a university context (Burek, 2025).

Here, we recommend that actions that are not quantifiable should be excluded from reporting of biodiversity handprints, as they do not represent a demonstrable positive contribution to biodiversity.

However such actions may still be worthwhile for biodiversity, and may be reported qualitatively (Martin et al., 2024; Tobin-de la Puente, 2026). As impact evaluation methodologies develop, it is likely that a greater number of actions can be quantified according to the handprint framework, while ensuring integrity of the handprint concept.

3. Principles for assessing biodiversity handprints

Despite growing interest and emerging applications, robust guidance for assessing biodiversity handprints remains underdeveloped. In particular, the quantification and attribution of positive biodiversity impacts are subject to significant methodological challenges, creating risks of inconsistent, non-comparable, or potentially misleading claims. Without clear guiding principles, handprint assessments risk undermining both scientific credibility and organisational accountability.

While the concept of handprints has been more extensively developed in the climate domain, these approaches cannot be directly transferred to biodiversity. For one, broad consensus and standardisation has been established for carbon impact assessment. Climate impacts are consistently reported using the CO_2 equivalent (CO_2e) metric (IPCC, 2014). In comparison, biodiversity outcomes are inherently location-specific and shaped by multiple interacting drivers of biodiversity loss. Biodiversity impact assessment lack a standardised link to global biodiversity loss, and cannot be described through a single metric (Wauchope et al., 2024), although efforts for more standardised approaches are progressing (El Geneidy et al., 2026; Kalliolevo et al., 2025). Reducing biodiversity to a limited set of indicators and interpretating values from aggregated results risks delivering unintended outcomes for conservation, such as displacement of biodiversity impacts (Brock & Bernard, 2025; Miles et al., 2025; Ramm et al., 2026). Accordingly, the principles presented here draw on both the literature on avoided biodiversity impacts (e.g. Moilanen & Laitila, 2016) and prior work on carbon handprints (e.g. Alvarenga et al., 2020; Lakanen et al., 2022; Niero et al., 2025; Norris et al., 2021) .

We propose ten principles (Table 2) to guide the credible assessment and reporting of biodiversity handprints. These principles operationalise the concepts of system boundaries, additionality, mechanisms, and attribution introduced above, and aim to ensure that reported positive impacts are transparent, robust, and comparable across contexts.

Principle		Guidance
1.	**No handprint without footprint**: Handprints must never be assessed or reported unless negative biodiversity impacts are concurrently assessed and reported.	Organisations must assess and report their negative biodiversity impacts (their footprints) before conducting any handprint assessment. Footprints and handprints must be reported separately to maintain transparency and avoid conflation. Handprints must complement, not replace, the quantification and reporting of negative impacts, ensuring that positive contributions are communicated only alongside a clear and complete account of an organisation's biodiversity responsibilities.
2.	**Beyond-footprint**: Handprints must refer only to positive biodiversity impacts that occur beyond an organisation's footprint and are additional to addressing those impacts.	Beyond an organisation's footprint means outside the scope of its own negative biodiversity impacts across local operations and the value chain. Positive impacts qualify as handprints only if they do not mitigate the organisation's negative impacts, but instead deliver additional biodiversity benefits elsewhere. This distinction prevents double counting between footprint reduction and handprint claims.
3.	**Counterfactual baseline**: Handprints must be calculated against an appropriate counterfactual baseline.	The counterfactual baseline must be evidence-based and transparently documented, clearly indicating what would have occurred in the absence of the actions that benefitted biodiversity (Grönman et al., 2019). It should be independently verified to ensure credibility and prevent inappropriate or inflated claims (Moilanen & Kotiaho, 2018; Zu Ermgassen et al., 2026). The counterfactual should be periodically reviewed and updated to remain relevant over time, ensuring that handprint estimates continue to reflect genuine additional biodiversity benefits (see also principle 5).
4.	**Additionality**: Handprints must provide benefits that would not have otherwise occurred.	Actions generating handprints must go beyond legal, regulatory, or compliance requirements and exceed what would be achieved through business-as-usual practices (i.e. a causal additionality condition).
5.	**Time-bound validity**: Handprints must be periodically reassessed to	Handprints do not always represent permanent positive impacts. For innovations, validity depends on how long the underlying innovation continues to outperform relevant alternatives and

	reflect how long they outperform alternatives and remain in use (innovations) and whether gains persist.	remains adopted in practice (Rizzo et al., 2024). As these conditions change over time, the magnitude and relevance of handprints may decline or cease. Other types of handprints maintain validity for as long as their gains persist. Handprints must be reassessed at appropriate intervals.
6.	**Attribution and ownership:** Impacts must be attributed to the actors responsible for creating them.	Handprints should be attributed to the actors that ideate, produce or carry out the action generating the positive impacts (Russell, 2019), while responsibility for negative biodiversity impacts (footprint) remains with those that cause them. Where multiple actors contribute, shared ownership may be appropriate, but allocation must be clearly justified to avoid overlap or double counting.
7.	**System-level impacts:** Handprints must account for rebound effects and other system-level impacts that may reduce or negate expected biodiversity gains.	Handprints are subject to rebound effects, where actions that reduce pressures on biodiversity may fail to deliver expected gains or even increase impacts at the system level (Andrew & Pigosso, 2024). Such outcomes are analogous to leakage effects observed in biodiversity offsetting (Moilanen & Laitila, 2016). For example, efficiency improvements can make resource use cheaper and more widespread (Jevon's Paradox), potentially increasing total pressure on biodiversity (Figge et al., 2014). Organisations should identify and transparently report such system-level risks to ensure credible handprint claims.
8.	**Methods and metrics:** Handprints must be assessed using appropriate methods and metrics that are transparently documented.	Given the lack of fully standardized approaches for measuring biodiversity impacts, organisations should apply methods and metrics that reflect current best practice and are appropriate to the assessment context. This includes using up-to-date data, clearly justified methodological choices, and frameworks aligned with recognized initiatives (e.g., TNFD, 2023; Nature Positive Initiative, 2024).
9.	**Trade-offs across drivers and locations**: Handprint calculations must account for trade-offs between biodiversity loss drivers and locations.	Biodiversity loss arises from multiple drivers (Jaureguiberry et al., 2022). Handprints may deliver biodiversity gains by reducing pressures from one driver or in one location while increasing or shifting pressures elsewhere. Positive impacts must not come at the cost of hidden or displaced harms and should be managed through safeguards (Bull et al., 2025).18/06/2026 09:36:00

10.	**Uncertainty**: Handprint calculations must account for uncertainty.	Handprint assessments involve significant uncertainties, particularly when modelling avoided future biodiversity impacts. Organisations should identify, document, and transparently report key sources of uncertainty, including assumptions, data limitations, and methodological choices (Bromwich et al., 2025). Uncertainty multipliers should be applied to explicitly account for uncertainty and prevent overestimation of biodiversity gains.

Table 2: The ten principles and guidance for assessing biodiversity handprints.

4. Practical considerations for biodiversity handprint assessment

Ensuring handprints contribute towards global biodiversity goals requires not only clear principles but also their effective application in organisational practice. Building on the principles outlined in Table 2, this section highlights key considerations for implementing biodiversity handprint assessments.

A fundamental prerequisite is the comprehensive assessment of an organisation's biodiversity footprint (Principle 1). In practice, this requires clearly defining and justifying system boundaries for both footprint and handprint assessments. Without transparent scoping, there is a risk that organisations overemphasise positive contributions by comparing them to only a subset of their negative impacts. For example, a university may highlight the handprint generated through its sustainability research (Burek et al., 2022), yet such contributions must be contextualised against potentially substantial value chain impacts generated by the research activities (Bull et al., 2022; El Geneidy et al., 2026). To maintain credibility, footprint and handprint results must be reported separately and interpreted in conjunction.

A second key challenge lies in distinguishing between mitigation versus genuinely additional positive contributions outside the scope of organisation's own negative biodiversity impacts (Principle 2). In practice, organisations must clearly articulate how specific actions generate biodiversity benefits beyond addressing their own impacts. This distinction can be particularly ambiguous for innovations that simultaneously reduce an organisation's own footprint and influence other actors (Kakar et al., 2024; Liu & Tu, 2026; White et al., 2021) While such innovations may contribute to mitigation, only effects that reduce the impacts of external actors or create additional benefits beyond the organisation's responsibility to reduce harm constitute handprint contributions. Robust quantification of handprints requires comparison to an appropriate counterfactual scenario, ensuring the principles of additionality are met (Principle 3 & 4) (Behm et al., 2016; Pajula et al., 2021). This often involves comparing handprint-generating products or services to realistic market alternatives (Russell, 2019). Existing datasets, such as Environmental Product Declarations, can support such comparisons, while consequential Life Cycle Assessment methods may be used for more abstract handprint activities, including behavioural or policy influence and advocacy (Marson et al., 2025; Nurdiawati et al., 2025). Given the centrality of counterfactual assumptions, transparency and independent verification are critical to ensure credibility (Moilanen & Kotiaho, 2018; Zu Ermgassen et al., 2026).

Ensuring that handprints remain additional over time introduces further complexity (Principle 5). Biodiversity benefits of innovations are inherently dynamic as market conditions and technological baselines evolve. As a result, handprints are time-bound and may diminish or cease as alternatives improve, or the innovation no longer represents an improvement against market averages (Rizzo et al., 2024). Organisations should therefore estimate and report the expected duration of handprints using average innovation and adoption lifespans for a particular product, service or practice, a practice similar to the generation of response curves in biodiversity offsetting (Jalkanen et al., 2026; Moilanen & Kotiaho, 2018). Handprints arising from other types of actions may maintain their additionality over longer periods, depending on the persistence of the intervention and counterfactual conditions.

Attribution presents another practical challenge, particularly in complex value chains where responsibility is distributed across multiple actors (Principle 6). While double counting of negative impacts may not pose a risk for biodiversity, overlapping claims of positive impacts does. Simultaneously, overlapping of handprint claims undermines both the credibility of an organisation's actions and the principle of additionality for positive impacts (Moilanen & Kotiaho, 2018). Organisations should therefore clearly define ownership of handprints, attribute impacts to the actors enabling them, and transparently communicate any shared contributions (Kasurinen et al., 2019). This may be challenging in practice, so it should be clearly stated what boundaries are being used for handprint assessments, and where overlaps may be possible.

At the system level, biodiversity handprints may generate unintended consequences (Principle 7). For instance, efficiency improvements can trigger rebound effects, increasing overall resource use and undermining biodiversity gains, analogous to leakage effects observed in biodiversity offsetting (Moilanen & Laitila, 2016). One mechanism for this is Jevon's paradox, where efficiency gains reduce costs and stimulate increased consumption (Figge et al., 2014). While such dynamics are difficult to quantify, organisations should identify and transparently disclose potential system-level risks and reflect them in counterfactual assumptions and reporting (Balmford et al., 2025).

The selection of appropriate methods and metrics remains a major implementation challenge (Principle 8)(Crenna et al., 2020; European Commission, 2023). In the absence of standardised approaches, organisations must rely on best available science and emerging frameworks such as the Nature Positive Initiative (NPI, 2024) and Taskforce on Nature-related Financial Disclosures (TNFD, 2023). Life cycle–based approaches, including Life Cycle Impact Assessment, offer a promising avenue for capturing impacts across value chains and multiple drivers of biodiversity loss (Marques et al., 2017; Wilting et al., 2017). However, their application is often constrained by data limitations and uncertainty (Bromwich et al., 2025). In such cases, pressure-based indicators (e.g. water use or greenhouse gas emissions) may provide a pragmatic, interim alternative for estimating positive impacts, provided their limitations are clearly acknowledged. These approaches are also important for identifying and managing trade-offs across drivers and locations (Bull et al., 2025), a focal consideration in organisational risk management (Principle 9).

Uncertainty is inherent to biodiversity assessments, particularly where impacts are indirect or modelled, as is likely the case for many handprinting actions (Principle 10). Sources of uncertainty include data gaps, model assumptions, and the complex multidimensional nature of biodiversity itself (Bromwich et al., 2025; Duelli & Obrist, 2003; Magurran, 2021). Organisations should explicitly account for uncertainty through transparent documentation, for example through the use of uncertainty multipliers.

Transparent reporting and clear communication of results is central for assessing biodiversity handprints, in line with the above principles. Choices of system boundaries, counterfactual scenarios, assessment methods, metrics, and attribution of responsibility must be clearly documented, well-defined and evidence based. Communicating methodological choices, limitations and uncertainties alongside handprint results is essential for maintaining credibility and enabling informed interpretation.

In practice, organisations will typically generate handprints through multiple actions rather than a single action. These can be assessed individually and either aggregated or reported separately, depending on context. However, aggregation must be approached cautiously to avoid inappropriate comparisons with overall biodiversity impacts, reinforcing the importance of maintaining a clear distinction between footprint and handprint reporting.

5. Discussion

Biodiversity handprints provide a promising approach for organisations to explicitly capture their positive contributions towards biodiversity. Yet, their utility in advancing global biodiversity goals remains contingent on how they are applied in practice. Importantly, handprints are not an alternative to mitigating biodiversity footprints, but a constrained and complementary mechanism to recognise an organisation's additional positive contributions to biodiversity beyond their responsibility to reduce harm. In this sense, handprints reframe organisational impacts from impact minimisation or offsetting towards a more proactive logic of enabling positive change.

This shift does not diminish the central importance of mitigating negative biodiversity impacts. Reducing negative biodiversity impacts remains the primary pathway through which organisations contribute to global biodiversity goals (Locke, 2020; Maron et al., 2024; Milner-Gulland, 2022; White et al., 2024). Biodiversity handprints do not address an organisation's own impacts and are therefore insufficient on their own to halt and reverse biodiversity loss (Maron et al., 2018). Rather, the importance of handprints lies in incentivising systemic change in organisations, for example through innovation, behavioural influence, and financial support for biodiversity-enhancing activities. These actions, seen alongside other actions linked to negative impacts, can help corporations develop a biodiversity strategy aligned with global biodiversity goals (Bang et al 2025). In this role, biodiversity handprints can complement mitigation by expanding the scope of organisational action.

The effectiveness of biodiversity handprints is nevertheless constrained by broader system dynamics. Efficiency improvements enabled by handprint-generating actions may be negated by increasing levels of consumption, thereby limiting overall biodiversity gains. This highlight the importance of complementing handprints with policies that address sufficiency and the overall level of consumption in societies (Bärnthaler & Gough, 2023; Haberl et al., 2020). Without such integration, handprints could risk reinforcing relative improvements without achieving absolute reductions in pressures on biodiversity.

From a practical perspective, the implementation of biodiversity handprints remains demanding. Quantifying changes in biodiversity is technically demanding, requires high quality data, appropriate methods and metrics, and explicit treatment of uncertainty, all of which may currently be beyond the capacity of many organisations (Bromwich et al., 2025). This creates both practical and reputational risks, as poorly substantiated claims of positive biodiversity impacts may lead to accusations of greenwashing (Hilton, 2025; Santos et al., 2024; White et al., 2023). Although methodological and data related progress is being made (Bang et al., 2025; Bromwich et al., 2025), interim approaches may rely on proxies for biodiversity pressures, such as land use change or water consumption, provided their limitations are transparently reported (Maddinson et al., 2025; Vatanen et al., 2018).

An important question concerns how biodiversity handprints could contribute to balancing organisational impacts, particularly those embedded within global value chains (Figure 2). Global value chain impacts are challenging to address via traditional biodiversity offsetting due to their strict ecological requirements, but a need for compensation remains (Durand et al., 2025; Kalliolevo et al., 2025; Moilanen & Kotiaho, 2018). Biodiversity handprints may be used by organisations to 'counterbalance' their global value chain impacts, provided the stringent methodological and governance conditions formulated here are met (Figure 2) (Bang et al., 2025; Durand et al., 2025). In particular, their use for counterbalancing impacts would require robust demonstration of additionality, clearly defined and independently verified counterfactuals, transparent attribution of impacts, and careful consideration of temporal and spatial equivalence between gains and losses. Importantly, handprints do not eliminate the underlying biodiversity harm generated by an organisation, highlighting the essential role of mitigation in addressing biodiversity loss (Figure 2).

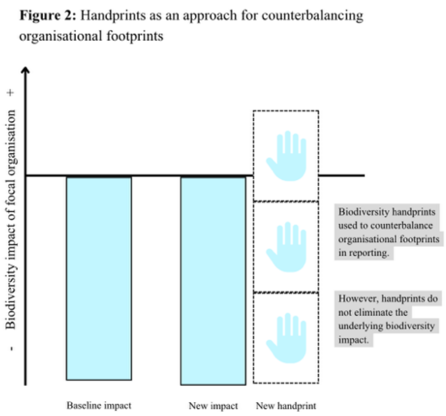

Figure 2: Biodiversity handprints as an approach for counterbalancing organisational footprints, from the perspective of the organisation generating the handprint ('focal organisation'). While biodiversity handprints may be used to counterbalance negative impacts, particularly within global value chains ('New handprint'), such accounting does not itself eliminate the underlying biodiversity harm ('New impact').

Handprints are conceptually distinct from biodiversity offsets. Although some actions to generate a handprint- undertaking habitat restoration, for example- may be similar to those that produce an offset, they occur in different contexts (Moilanen & Kotiaho, 2018; Zu Ermgassen et al., 2026). Traditional biodiversity offsets fall within the mitigation hierarchy, and typically compensate for direct impacts in known locations (Kalliolevo et al., 2025; Moilanen & Kotiaho, 2018). In comparison, actions that generate a biodiversity handprint cannot contribute to the mitigation hierarchy and instead may 'counterbalance' impacts across global value chains (Figure 2). Separate accounting and safeguards are therefore necessary to prevent double counting of positive actions, while acknowledging that both mechanisms play an important role to address biodiversity loss.

Finally, while the handprint concept focuses on positive impacts, it also draws attention to the negative impacts that organisations may have beyond their conventional footprint boundaries. Organisations may drive biodiversity loss indirectly through activities such as lobbying to weaken social or environmental legislation, or through marketing shaping consumption patterns (Bull et al., 2022; Folke et al., 2019; Frig et al., 2025; Norris et al., 2021). Conceptualising such negative biodiversity impacts as an additional, system-level footprints could broaden current assessment frameworks and facilitate transformative change for organisations. Applying the same principles to negative impacts would improve consistency between handprints and footprints, but raises additional methodological challenges.

Overall, here we present the concept of biodiversity handprints which offers a means to recognise and incentivise positive contributions towards biodiversity. The credibility of handprints depends on their rigorous application and clear separation from footprint mitigation. The role of handprints in advancing nature-positive outcomes will depend on continued methodological development and their integration within broader governance frameworks.

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Author contributions

Maddinson, C. and Pykäläinen, E., jointly co-ordinated the project and drafted the manuscript. Figures were produced by Maddinson, C. All authors contributed to the conceptual development of the manuscript, and provided input and reviews to all drafts.

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