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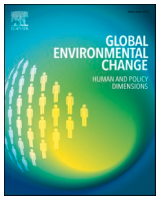

Understanding the role of pluralistic ignorance in biodiversity conservation: A research agenda

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ABSTRACT

Most people believe that biodiversity loss is human-caused, yet they may not realize how many others share this belief. Such collective misperceptions—known as pluralistic ignorance—may hinder individual and system changes required to address biodiversity loss. At the same time, reducing pluralistic ignorance may promote positive change. In this Perspective, we provide a brief overview of existing work on pluralistic ignorance about environmental topics and propose an agenda for impactful pluralistic ignorance research in the biodiversity domain. We highlight several research gaps and offer recommendations, including (a) investigating different forms of pluralistic ignorance, (b) improving our understanding of consequences and determinants, and (c) broadening the intervention toolkit to counter pluralistic ignorance for biodiversity conservation. To increase the Perspective's practical applicability, we describe historical and contemporary case studies on pluralistic ignorance and biodiversity conservation from around the globe.

1. Introduction

A major area of global environmental change is biodiversity loss driven by human activity (Ceballos et al., 2017; IPBES, 2019; Jaureguiberry et al., 2022; Sala et al., 2000). While most people are concerned about declining biodiversity (The Economist Intelligence Unit, 2021), they may not realize how many others share this concern (see Bouman et al., 2020; Geiger et al., 2025; Leviston et al., 2013, 2024;

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Pearson et al., 2018; Sparkman et al., 2022). Such perception gaps are known as pluralistic ignorance (Korte, 1972; O'Gorman, 1986; Prentice and Miller, 1993) and can hamper contributions to large-scale environmental problems (Boon-Falleur et al., 2022; Santos et al., 2021). Reducing pluralistic ignorance may help realize individual and system changes required to address these problems (Andre et al., 2024a; Boon-Falleur et al., 2022; van der Linden et al., 2019). For example, reducing Americans' misperceptions about China's support for a bilateral climate treaty boosted public support for this treaty (Mildenberger and Tingley, 2019).

Pluralistic ignorance has been extensively researched across contexts. The most recent meta-analysis and scoping review published in 2021 include various topics, but only five studies on pluralistic ignorance about environmental issues (Bursztyn and Yang, 2021; Sargent and Newman, 2021). Since 2021, the number of studies has been growing substantially. In this Perspective, we provide a brief overview of existing work on pluralistic ignorance (see Supplement A for search strategy) that disproportionately focused on a single group (the public), environmental issue (climate change), and intervention (consensus messaging; e.g., Andre et al., 2024a; Geiger and Swim, 2016; Geiger et al., 2025; Jachimowicz et al., 2018; Lees et al., 2023; Leviston et al., 2013; Lyons and Hasell, 2024; Sabherwal et al., 2021; Sparkman et al., 2022; van der Linden et al., 2019). Based on this overview, we propose a forward-looking research agenda on how the existing evidence base can be used and systematically expanded to help conserve and restore biodiversity. While climate change can be a polarizing topic (e.g., Marlon et al., 2023), people worldwide generally agree that biodiversity loss is a serious global problem (The Economist Intelligence Unit, 2021). Given this widespread public consensus, we believe that the time is ripe to apply existing insights on pluralistic ignorance to biodiversity conservation to avoid missing this window of opportunity.

The literature overview and the research agenda are structured according to the conceptual framework in Fig. 1. Box 1 provides a glossary of key terms. In the following, we outline different forms of pluralistic ignorance, consequences and determinants, and possible measures to counter pluralistic ignorance. To increase the Perspective's practical applicability, we highlight historical and contemporary case studies from around the globe (see Supplement A for identification strategy). These example case studies reflect on different groups, among which pluralistic ignorance may occur, possible consequences that may hamper progress in addressing biodiversity loss, and measures to reduce perception gaps to possibly improve biodiversity outcomes.

2. Key characteristics of pluralistic ignorance (*who*, *about whom*, and *about what*?)

2.1. Overview of past work

Pluralistic ignorance refers to groups systematically misperceiving others' cognitions (e.g., beliefs), affect (e.g., emotions), and behaviors. Hence, the phenomenon is characterized by three key elements (Fig. 1): the target group (the *who*), the referent group (the *about whom*), and the target outcome (the *about what*). Target and referent groups include geographic groups, from global to continental to national and local, and societal groups, such as the general public or more specific groups (e.g., neighbors, farmers, politicians, scientists) and institutions/organizations (e.g., governments, NGOs, businesses). Target outcomes can, for example, include others' beliefs, emotions, values, policy preferences, and behaviors.

So far, most studies on environmental pluralistic ignorance have focused on the general public as target and referent groups and climate change as a topic (Table 1). For example, past studies showed that the public underestimated pro-climate opinions (Abeles et al., 2019; Ballew et al., 2020; Geiger et al., 2025; Leviston et al., 2013; Mildenberger and

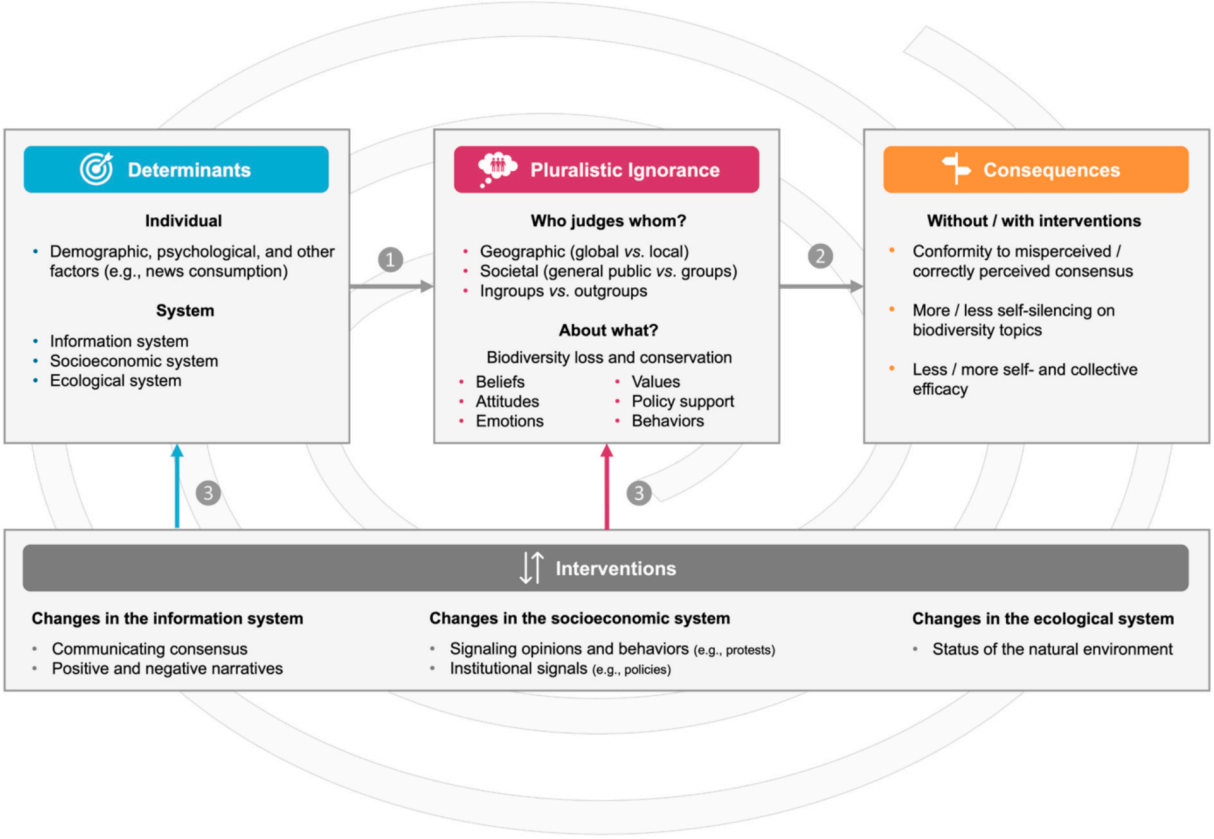

Fig. 1. Conceptual framework of pluralistic ignorance in the biodiversity context. Shown are key characteristics of pluralistic ignorance, consequences, determinants, and options for intervention.

Box 1
Definition of key concepts.

Biodiversity loss: Biodiversity loss refers to a reduction of the variety of life at any level—genetic, species, or ecosystem—within a given geographical area (IPBES secretariat, 2017).

Conservation: "Actions that are intended to establish, improve, or maintain good relations with nature" (Sandbrook, 2015, p. 1).

Social consensus and descriptive norm: Social consensus describes what people in a social group typically believe; descriptive social norms refer to what people in a social group typically do (Cialdini et al., 1990; Goldberg et al., 2020). Consensus and norms can refer to various groups, such as the general public (public consensus/norm) or scientists (scientific consensus). For example, there is a strong public consensus about the seriousness of the loss of animal and plant species; most members of society agree that the loss of animal and plant species is a serious problem (The Economist Intelligence Unit, 2021).

Pluralistic ignorance: Pluralistic ignorance refers to situations in which many members of a social group (e.g., citizens of a country or residents of a neighborhood; the *who*) systematically misperceive others' (the *whom*) cognitions, affective states, and behaviors (the *about what*; Lees et al., 2023; O'Gorman, 1986; Prentice and Miller, 1993; Sargent and Newman, 2021). The original definition of pluralistic ignorance refers to ingroup misperceptions specifically. In this Perspective, we adopt a broader view to include outgroup misperceptions (also referred to as misperceptions of stereotypes; Köhler et al., 2025), as boundaries between ingroups and outgroups can be blurry.

Absolute pluralistic ignorance refers to groups misperceiving majority as minority cognitions, affect, or behaviors (or vice versa). Relative pluralistic ignorance refers to groups underestimating majority (or overestimating minority) cognitions, affect, or behaviors, but not to the extent of misperceiving them to be in the minority (majority; Korte, 1972). Of note, pluralistic ignorance is a group-level phenomenon. When we refer to the individual level, we use the term **social (mis)perceptions** or misperceptions of the social consensus/norm.

Individual and system change: Individual (or behavior) change refers to interventions (or measures) that target individuals' beliefs and behaviors (e.g., information campaigns aimed at the general public to reduce pluralistic ignorance; the *i*-frame; Chater and Loewenstein, 2023). In contrast, system-level change describes interventions that change systems of rules, norms, and institutions (e.g., adopting and implementing conservation policies, such as the Kunming-Montréal Global Biodiversity Framework; the *s*-frame; Chater and Loewenstein, 2023). Both types of measures are important for biodiversity conservation (Nielsen et al., 2021).

Ingroup and outgroup: An ingroup describes a group "to which one belongs or with which one identifies." An outgroup, by contrast, is a group "to which one does *not* belong or with which one does not identify" (American Psychological Association, 2018, para. 1).

Self- and collective efficacy: Self- and collective efficacy refer to beliefs that the self or a group, respectively, can (a) perform an intentional action (agent–action), (b) achieve a desirable aim (agent–aim), or (c) perform an intentional action to achieve a desirable aim (agent–action–aim; Hamann et al., 2024).

Tingley, 2019), concern about climate change (Leviston et al., 2024; Pearson et al., 2018; Sparkman et al., 2022), support for climate policies (Drews et al., 2022; Sparkman et al., 2022), and pro-environmental behavior (Andre et al., 2021; Chen et al., 2022). Few studies have investigated pluralistic ignorance about topics linked to biodiversity and, to some extent, also climate change, with existing studies focusing on ingroup pluralistic ignorance, such as the public's belief about the public's engagement in pro-environmental behavior (e.g., reducing meat consumption; Andre et al., 2021), Coloradans' beliefs about Coloradans' support for wolf reintroduction (Gonzalez et al., in prep, as cited in Niemiec et al., 2020), residents' beliefs about their neighbors' willingness to replace tiles with greenery (Hoffmann et al., 2024), and anglers beliefs about other anglers' compliance with regulations (Bova et al., 2017).

One of our case studies provides more direct evidence for pluralistic ignorance about biodiversity topics (Fig. 2; and see Supplement B for detailed methods). Specifically, this case study shows that most people are aware that biodiversity is declining due to human activity, yet they do not realize how many others share this belief. For example, 93.0 % of Mexicans in our sample agree that biodiversity loss is occurring and is at least in part human-caused, yet they *think* only 66.2 % hold this belief (Supplement B).

Together, this prior work suggests that pluralistic ignorance expands to biodiversity topics. Hence, one of the priority questions is:

Priority Research Question 1: Which groups misperceive consensus/norms around biodiversity topics? Whose cognitions, affective states, and behaviors are misperceived?

2.2. Outlook for future work

Based on gaps in past work, we identified three recommendations to tackle Priority Research Question 1. First, given that biodiversity loss is an important issue on local to global scales, we encourage researchers to investigate pluralistic ignorance among the global public and more specific ingroups and outgroups. We recommend investigating perceptions of and about relevant geographic and societal groups influencing conservation outcomes directly (e.g., farmers) or indirectly (e.g., journalists, scientists; Nielsen et al., 2021). For example, conservation scientists' calls to "fight the creeping rise of extinction denial" (Lees et al., 2020, p. 1440) may indicate pluralistic ignorance among scientists (*who*) about high levels of existing public (*about whom*) concern about biodiversity loss (*about what*; for additional case studies, see Table 2).

Second, we encourage investigating pluralistic ignorance about diverse target outcomes (*about what*), including beliefs, emotions (e.g., anger and hope), values (Latombe et al., 2022), support for conservation solutions (e.g., large green spaces; Sushinsky et al., 2013), and high-impact behaviors (e.g., reduced consumption of animal products; Selinske et al., 2020). In our view, beliefs about others' emotions warrant special attention. Biodiversity loss can be proximate and emotional (Brick et al., 2023), for example, when ecosystems such as coral reefs are deteriorating or livelihood-providing ecosystems are threatened ('t Sas-Rolfes et al., 2019). Learning about others' emotions can lead individuals to experience these emotions themselves (Intergroup Emotions Theory; Mackie and Smith, 2018; Moons et al., 2009), which may drive desired attitude and behavior change (Brick et al., 2023). As such, biodiversity loss not only provides an opportunity to research how people experience these trends (Brick et al., 2023) but also what people think about how others experience them.

Last, it will be desirable in the long run to improve upon existing methodologies. One way to assess pluralistic ignorance is accuracy scores (Fig. 2)—differences between respondents' perceptions of others' attitudes and their actual attitudes (for alternative measures, see Sargent

Table 1
Overview of previous studies on pluralistic ignorance in the environmental domain.

	Who – about whom?	*Public consensus* Public – Public	*Ingroup consensus* Group A/B – Group A/B	*Outgroup consensus* Group A/B – Group B/A
Pluralistic ignorance				
About what?	Beliefs	Problem perceptions of an earthquake (Major, 1997) Climate change beliefs (Abeles et al., 2019; Ballew et al., 2020; Geiger et al., 2025; Leviston et al., 2013; Mildenberger and Tingley, 2019)	Neighbors' beliefs about other neighbors' belief that tile replacement with greenery is a good thing to do (Hoffmann et al., 2024) US public's/Democrats'/Republicans' beliefs about Democrats'/Republican's climate change beliefs (Abeles et al., 2019; Ballew et al., 2020) Maryland residents' beliefs about others' (US public, Maryland residents, residents within one's own region in Maryland) climate change beliefs (Ban Rohring and Akerlof, 2020) Climate scientists' beliefs about other climate scientists' beliefs regarding the likelihood of global sea level rise outpacing the most extreme IPCC projections (Lewandowsky et al., 2015)	Democrats'/Republicans' beliefs about Republicans'/Democrats' climate change beliefs (Abeles et al., 2019; Ballew et al., 2020) Public beliefs about climate scientists' beliefs about climate change (Ban Rohring and Akerlof, 2020; Goldberg et al., 2022; Tschötschel et al., 2021; van der Linden et al., 2019; Većkalov, Geiger et al., 2024) Christian Americans' beliefs about their religious leaders' climate change beliefs (Syropoulos and Sparkman, 2025) Beliefs among staff in a natural history museum about their visitors' support for climate action (Talwar et al., 2024)
	Emotions	Climate change concern (Leviston et al., 2024; Sparkman et al., 2022)	City/rural dwellers' beliefs about other city/rural dwellers' climate change concern (Leviston et al., 2024) US public's beliefs about environmental concern among various societal groups (e.g., Whites and Blacks, older and younger, poor and wealthier; Pearson et al., 2018)	City/rural dwellers' beliefs about rural/city dwellers' climate change concern (Leviston et al., 2024)
	Values	Biospheric values (Bouman et al., 2020)	US public's beliefs about US public's biospheric values (Bouman et al., 2020)	US public's beliefs about Liberals'/Conservatives' biospheric values (Bouman et al., 2020)
	Policy support	Support for stronger regulation of environmental pollution (Taylor, 1982) Support for various transformative climate policies (Sparkman et al., 2022) Support for offshore wind projects (Sokoloski et al., 2018) Support for carbon tax (Drews et al., 2022)	Democrats'/Republicans' beliefs about public support for various climate policies (e.g., carbon tax on fossil fuel; Lees et al., 2023) Republicans' beliefs about Republicans' support for various climate mitigation policies (e.g., more solar panels; Dixon et al., 2024) US public's beliefs about Democrats'/Republicans' support for a cap-and-trade policy and carbon tax (Van Boven et al., 2018) Coloradons' beliefs about Coloradon's support for wolf reintroduction (Gonzalez et al., in prep, as cited in Niemiec et al., 2020)	US and Chinese public's beliefs about support for bilateral climate treaty among the public in the respective other country (Mildenberger and Tingley, 2019) US Congressional staffers' beliefs' about public support for regulating carbon dioxide (Mildenberger and Tingley, 2019) Elected officials' beliefs about their constituency's support for renewable energy and the importance of job creation (Caggiano et al., 2024)
	Behavioral intentions/behaviors	Willingness to contribute financially to fight climate change (Andre et al., 2024a, 2021) Willingness to fight climate change, reduce meat consumption, avoid traveling by plane and car, and adopt a sustainable shopping style (Andre et al., 2021) Pro-environmental behavior (e.g., saving electricity, using public transportation, environmental volunteer activities; Chen et al., 2022)	Anglers' beliefs about other angler's compliance with angling regulations (e.g., fishing in marine-protected areas; Bova et al., 2017) Healthy and sustainable eating in neighborhoods (Moojen et al., 2023, 2022)	
Consequences				
	Conformity to misperceived consensus	More pronounced misperceptions of public concern about climate change among the public are associated with less collective action and pro-environmental behavior (Leviston et al., 2024). Climate septics who overestimate the prevalence of their opinion are more resistant to changing their opinion (Leviston et al.,	Neighbors' beliefs about their neighbors' energy consumption influence personal willingness to reduce energy consumption (Jachimowicz et al., 2018). Political groups prioritize climate policies less when they believe that their political ingroup supports them less (Cole et al., 2022).	US public's misperceptions of support for a bilateral climate treaty among the Chinese public can hamper cooperation regarding this treaty (Mildenberger and Tingley, 2019). Misperceptions of the scientific consensus on climate change among the public can reduce personal belief in (human-caused) climate change, worry about climate change, and

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Table 1 (*continued*)

	Who – about whom?	*Public consensus* Public – Public	*Ingroup consensus* Group A/B – Group A/B	*Outgroup consensus* Group A/B – Group B/A
		2013). Misperceptions among the public about the public's willingness to fight climate change reduce climate donations (Andre et al., 2024b). More pronounced misperceptions of pro-environmental behaviors among the public are associated with less pro-environmental engagement (Chen et al., 2022). Higher perceptions of the regional (*vs.* national) consensus on climate change are more strongly associated with more policy support (Ban Rohring and Akerlof, 2020). The more individuals perceive their group to endorse biospheric values, the higher their pro-environmental engagement (i.e., personal pro-environmental norms, energy saving; Bouman et al., 2020). Perceptions of stronger public support for China's coal-to-gas policy predict more personal policy support among the Chinese public (Schuldt et al., 2019).	Study participants' beliefs about other participants' behavior are associated with more pro-environmental behavior; study participants' beliefs about other participants' climate change beliefs are not associated with pro-environmental behavior (Wyss et al., 2023). Perceptions of stronger support among one's family and friends for China's coal-to-gas policy predict more personal policy support among the Chinese public (Schuldt et al., 2019). Fishers' misperceptions about other recreational fishers' compliance with regulations reduce their own complicance (Bova et al., 2017). Farmers may be more likely to adopt sustainable agricultural practices if they (correctly) perceive that other farmers engage in and approve of such practices (Swart et al., 2023).	sometimes support for public action (Rode et al., 2021; van der Linden et al., 2019; van Stekelenburg et al., 2022; Većkalov, Geiger et al., 2024). Misperceptions of the scientific consensus among the public are associated with weaker personal climate change beliefs (Hornsey et al., 2016; McCright et al., 2013; Tom, 2018) and stronger beliefs that climate change will harm people later and to a lesser extent (Ding et al., 2011). Perceptions of stronger support for China's coal-to-gas policy among the American public and other neighboring Asian countries predict more and less personal policy support among the Chinese public, respectively. Perceptions of stronger support among other outgroups (Chinese and foreign governments, industries, media, scientific community, future generations) do not predict personal support (Schuldt et al., 2019).
	Self-silencing	Misperceptions among the public of the public's pro-climate views reduce willingness to voice one's pro-climate opinion (Geiger et al., 2025).	Misperceptions among students of other students' concern about climate change reduce their willingness to express their pro-climate opinion (Geiger and Swim, 2016).	
	Efficacy beliefs	More pronounced misperceptions of (a) public concern about climate change and (b) pro-environmental behavior among the public are associated with weaker beliefs about self-efficacy toward (a) reducing the negative impacts of climate change (Leviston et al., 2024) and (b) contributing to environmental improvement (Chen et al., 2022).		Misperceptions of the scientific consensus among the public are associated with less collective efficacy in limiting climate (Ding et al., 2011).
Determinants				
	Individual-level	Some demographic groups (e.g., conservative, urban residents) are more subject to pluralistic ignorance about the public's climate change worry and policy support (Sparkman et al., 2022). Some demographic groups (e.g., older, less educated, male, and more conservative) show more pronounced pluralistic ignorance regarding the regional, state-level, and national social consensus on climate change (Ban Rohring and Akerlof, 2020). Older and those who are opposed to offshore wind projects themselves misperceive public support for such projects to a greater extent (Sokoloski et al., 2018). Those who oppose (*vs.* support) a carbon tax underestimate public support more (Drews et al., 2022). Individual news consumption of conservative and some liberal outlets in the US predicts more misperceptions about the public's climate change worry and policy support (Sparkman et al., 2022). More individual news media usage and information seeking are associated with less pronounced misperceptions of public concern for environmental problems (Major, 2000). Few individual-level factors robustly predict pluralistic ignorance about public support for	Republicans who oppose (*vs.* support) various climate mitigation policies underestimate Republicans' support for these policies more (Dixon et al., 2024).	Some demographic groups (e.g., conservative, Republican, older, less educated) are more subject to underestimations of climate scientists' agreement (McCright et al., 2013). Being male and Republican is related to lower perceptions of the scientific consensus (Ban Rohring and Akerlof, 2020).

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Table 1 (*continued*)

	Who – about whom?	*Public consensus* Public – Public	*Ingroup consensus* Group A/B – Group A/B	*Outgroup consensus* Group A/B – Group B/A
		climate policies, and these typically vary by policy (Lees et al., 2023).		
	System-level	More conservative US states and those with fewer climate protests show more pluralistic ignorance of the public's climate change worry and policy support (Sparkman et al., 2022). Country-level tightness-looseness may predict pluralistic ignorance of public opinion on climate change, with tight cultures being slightly more accurate (Geiger et al., 2025).	A higher county-level public consensus on climate change predicts slightly higher perceptions of regional-level consensus (Ban Rohring and Akerlof, 2020). People who learn about a national environmental policy perceive greater public support for such a policy in their state (Syropoulos et al., 2024). Province-level cultural tightness-looseness does not predict pluralistic ignorance about the public's pro-environmental engagement (Chen et al., 2022).	
Interventions				
	Information system	Informing people from various countries about the public consensus on climate change slightly increases willingness to express their pro-climate opinion but not personal support for climate policies or willingness to change their lifestyle to mitigate climate change (Geiger et al., 2025).	Informing people about the US public's and Republicans'—but not Democrats'—support for various climate policies (e.g., alternative energy, regulating CO_2) increases perceptions of support among the respective group. Information about Republicans' support can additionally boost personal support, especially among Republicans (Lyons and Hasell, 2024).	
		Informing people about the public's willingness to fight climate change boosts climate donations (Andre et al., 2024b). Informing people about the public's anger on climate inaction boosts personal belief in human-caused climate change and support for climate policies (Sabherwal et al., 2021).	Informing students about other students' concern about climate change increases their willingness to express their pro-climate opinion (Geiger and Swim, 2016). Informing neighbors about their neighbors' energy consumption boosts personal willingness to reduce energy consumption (Jachimowicz et al., 2018). Informing American Christians about the actual climate consensus among their religious leaders reduces pluralistic ignorance and increases the belief that church members believe in climate change and are open to conversations about climate change, as well as that climate action aligns with the church's values (Syropoulos and Sparkman, 2025).	Informing the US public about the Chinese public's consensus on climate change increases personal support for a bilateral climate treaty (Mildenberger and Tingley, 2019). Two meta-analyses of several experiments show that scientific consensus messages can reduce misperceptions and increase personal belief in climate change, worry but often not support for public action directly (Rode et al., 2021; van Stekelenburg et al., 2022). Once the staff at a natural history museum learned about their visitors' actual stance on climate change, they changed their exhibition to align with their visitors' climate attitudes, focusing on solutions and inspiring climate action (Talwar et al., 2024).

Note. In this overview, we only include studies that explicitly test pluralistic ignorance, the difference between an actual and perceived social consensus/norms, except when reviewing the literature on predictors and outcomes, as correlations of misperceptions with other measures are statistically equivalent to correlations of perceptions with other measures.

and Newman, 2021). This involves surveying respondents about their perceptions of others' attitudes (e.g., What percentage of Mexicans, do you believe, would agree that biodiversity is declining and human activity is responsible?) on a scale from 0 % to 100 % and comparing these perceptions to the actual attitudes respondents hold (e.g., the percentage of Mexican respondents who agree biodiversity is declining due to human activity). To reduce socially desirable responding and accurately gauge the actual consensus/norm, future work may include alternative measures of attitudes related to biodiversity loss and conservation (e.g., list experiments; Kiewiet de Jonge and Nickerson, 2014), conjoint experiments (Hainmueller et al., 2014) with varying attributes of biodiversity conservation policies (for large-scale energy projects, see Caggiano et al., 2024), and objective rather than self-reported behavioral measures.

3. Consequences of pluralistic ignorance

3.1. Overview of past work

Consequences of pluralistic ignorance include (a) conformity to (mis) perceived consensus/norms (e.g., resistance to policy or behavior change), (b) self-silencing, and (c) lower self- and collective efficacy. In line with Social Identity Theory (Tajfel and Turner, 2004) and Self-Categorization Theory (Turner et al., 1987), individuals adapt their cognitions, affect, and behaviors to what they *think* salient others think, feel, and do (Fischbacher et al., 2001; Frey and Meier, 2004; Ostrom, 2000). For example, those who underestimate ingroup public concern about climate change are more likely to conform to this misperceived consensus, resulting in less collective action and individual pro-environmental behavior (Leviston et al., 2024; see Table 1 for additional studies). In line with this, Mildenberger and Tingley (2019) identified pluralistic ignorance as a barrier to support climate policy change.

According to the Spiral of Silence Theory (Noelle-Neumann, 1993), pluralistic ignorance—mistakenly believing that one holds a minority (*vs.* majority) opinion—can foster self-silencing (Geiger and Swim, 2016; Geiger et al., 2025), further exacerbating pluralistic ignorance and contributing to more self-silencing over time (Noelle-Neumann, 1993). Supporting this theorizing, qualitative work showed that Members of Parliament in the United Kingdom reported self-silencing or downplaying climate change because their constituents rarely asked about the issue (Willis, 2018), which may have led them to erroneously assume that their constituents care less about environmental issues than they actually do.

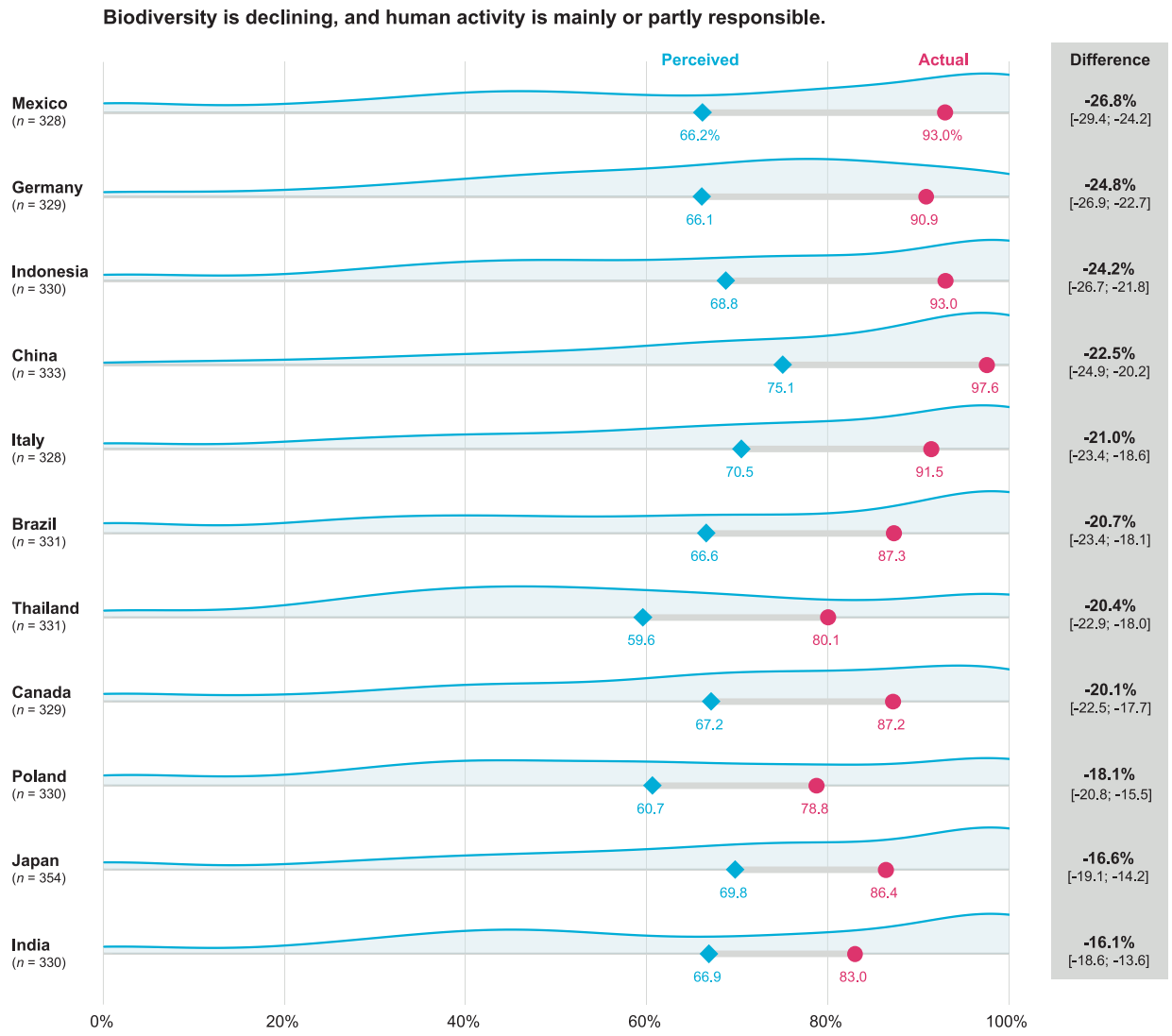

Fig. 2. Actual (pink dots) and perceived (blue diamonds) public consensus about human-caused biodiversity loss across 11 countries. Note. The figure is based on quota samples from 11 countries (n = 3,653) collected in a cross-sectional online survey (see Geiger et al., 2025). The pink dots represent the actual proportion of participants in each country who agree that biodiversity loss is at least to some extent human-caused. The blue diamonds indicate the posterior means of each country's perceived prevalence of this belief. The blue area represents the distribution of the perceived prevalence of this belief in each country. The estimated difference between the perceived and actual public consensus (pluralistic ignorance), including the 90 % credible interval, is shown on the right. Because values are rounded to one decimal place, the difference between the displayed actual (pink) and perceived (blue) proportions may slightly differ from the estimated difference. Countries are ordered by the magnitude of pluralistic ignorance, from largest to smallest. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Pluralistic ignorance may also weaken self- and collective efficacy—beliefs that oneself (self-efficacy) or one's ingroup (collective efficacy) can perform an action to achieve a desirable aim (Bandura, 1982; Bandura and Adams, 1977; Hamann et al., 2024). Emphasizing that most people engage in a certain behavior can increase feelings of self-efficacy about engaging in this behavior (Stok et al., 2014). Further correlational research suggests that those who underestimate public concern (Leviston et al., 2024) or scientific consensus (Ding et al., 2011) about climate change to a greater extent experience less self- and collective efficacy, respectively, in limiting climate change.

For biodiversity specifically, we only identified two studies that investigated the consequences of social misperceptions. Both studies focused on conformity to (mis)perceived consensus/norms. Specifically, recreational fishers were more likely to violate existing regulations if they overestimated others' non-compliance with these regulations (Bova et al., 2017). Similarly, farmers were more likely to adopt sustainable agricultural practices if they (correctly) perceived that other farmers engaged in and approved of such practices (Swart et al., 2023). Based on these observations, the second priority research question we suggest is:

Priority Research Question 2: To what extent do different forms of social misperceptions/pluralistic ignorance hamper individual and system-level biodiversity conservation efforts?

3.2. *Outlook for future work*

To address Priority Research Question 2 and maximize conservation outcomes, we recommend focusing on and applying the reviewed theories to groups that make major direct or indirect contributions to biodiversity. To illustrate, we provide an example case study (Table 2) about self-silencing among media professionals who indirectly influence biodiversity outcomes through information provision to others (Nielsen et al., 2021). Media professionals may underestimate public preferences for biodiversity coverage (Neverla and Hoppe, 2023), possibly contributing to self-silencing on the issue (e.g., only 0.2 % of broadcast minutes

Table 2
Historical and contemporary example case studies from several countries based on the conceptual framework.

Path	Case Study
Pluralistic ignorance (who about whom about what?)	
Public – public	**Global:** People across 11 countries substantially underestimate belief in human-caused biodiversity loss among the public within these 11 countries, ranging from a minimum of −16.1% in India (90% CrI [−18.6%, −13.6%]) up to a maximum of −26.8% in Mexico (90% CrI [−29.4%, −24.2%]). To illustrate, 93.0% of Mexicans in our sample agree that biodiversity loss was occurring and at least in part human-caused, yet they *think* only 66.2% of the Mexican population hold this view—a perception gap of 26.8% (Figure 2).
Public – scientists	**Global:** There is near unanimous agreement among biodiversity scientists that global biodiversity loss likely harms ecosystem functioning or nature's contribution to people (Isbell et al., 2023). Given prior work on (mis)perceptions of various scientific consensuses (Kerr and Wilson, 2018; Lewandowsky et al., 2013; van der Linden et al., 2019; Većkalov, Geiger et al., 2024), it is likely that the public also underestimates this consensus.
Scientists – public	**Global:** Existing calls to "fight the creeping rise of extinction denial" (Lees et al., 2020, p. 1440) from conservation scientists may indicate pluralistic ignorance among conservation scientists about high levels of existing public concern about biodiversity loss (The Economist Intelligence Unit, 2021).
Policymakers – public	**Local:** Local policymakers may underestimate regional support for specific conservation solutions, such as wolf reintroduction (Gonzalez et al., Niemiec et al., 2020).
① Determinants → Pluralistic ignorance	
Individual level	
Perspective taking → pluralistic ignorance	**Global:** People who tend to take others' perspective are more accurate in predicting others' behavior, and previous research found perspective-taking (**determinant**) to be related to **pluralistic ignorance** (Lees et al., 2023). Cross-cultural studies revealed that Chinese are better at perspective-taking than Americans (Wu et al., 2013; Wu and Keysar, 2007), suggesting that the level of pluralistic ignorance, possibly also about biodiversity conservation, may be partly accounted for by individual and cultural differences in perspective-taking.
(In)visibility of individual conservation behavior → pluralistic ignorance	**Germany:** One of the previous Chancellors of Germany, Angela Merkel, spearheaded the *LifeWeb* initiative that supports developing and emerging countries in financing protected areas (CBD Secretariat, n.d.), at the ninth Conference of the Parties (COP) of the Convention on Biological Diversity in 2008. This sparked the participation of various other countries (Lee et al., 2021), potentially also by making her contribution visible (**determinant**) and correcting previous misperceptions that other countries would not contribute (**pluralistic ignorance**). **Japan:** According to a survey on biodiversity in 2022, 86.4% of Japanese people believe that biodiversity loss is human-caused. One of the most popular reasons for not engaging in biodiversity conservation activities was not knowing anybody who participates in such activities and believing that one's behavior would not matter (Cabinet Office of Japan, 2022). Thus, believing in human-caused biodiversity loss does not necessarily translate into pro-conservation behavior, and the absence of visible pro-conservation behaviors (**determinant**) may foster **pluralistic ignorance**. **Thailand**: When the current King of Thailand's son, Vacharaesorn Vivacharawongse, returned to his homeland in December 2023, he visited the Klongkhlon Mangrove Reforestation Project in Samut Songkhram Province (The Nation Thailand, 2023). Given that this was only his second visit to Thailand after having lived abroad for 27 years, there was widespread media coverage of him and volunteers engaging in a tree-planting activity (**determinant**). This led many people to comment online that they would like to visit the project in person. Consequently, this may have reduced **pluralistic ignorance** as many individuals now see that others like them would also like to engage in a similar nature conservation activity due to the King's son's visit to the Mangrove Reforestation project.
System-level	
Actual mass media coverage → pluralistic ignorance	**Germany:** In total, 47% of Germans support more biodiversity coverage as part of the main evening program, and 38% want a daily update on the topic (Neverla and Hoppe, 2023). Given these numbers, it is likely that the German population broadly and strongly supports coverage of biodiversity issues. However, German media professionals may underestimate how much Germans would like to see biodiversity covered in the media (**pluralistic ignorance**). This pluralistic ignorance among media professionals may lead them to avoid covering biodiversity issues (**consequence**). This is also supported by the fact that only 0.2% of broadcast minutes on German TV cover biodiversity-related topics. Accordingly, 82% of people in Germany perceive that biodiversity is only slightly or not at all present in the media (Neverla and Hoppe, 2023). This perceived absence of biodiversity in the media (**determinant**) may mislead policymakers and scientists to infer that people in Germany do not care about biodiversity. If policymakers and politicians systematically misperceive a minority of the public supporting biodiversity conservation (**pluralistic ignorance**), they may be less likely to support, implement, and advocate for corresponding policies (**consequence**). **Indonesia:** Media coverage of conservation-related issues in Indonesia has been minimal. In the four most popular online media outlets, conservation and environment-related content only constituted around 8% of the entire news coverage in 2018 (**determinant**) (Wijayanto and Nurhajati, 2019). This media silence may provide misleading cues that public interest or support for conservation is lacking in Indonesia (**pluralistic ignorance**). **Indonesia:** Much of the mass media coverage on deforestation in Indonesia has blamed private citizens for their role in encroaching on pristine forests for agriculture and timber harvesting (e.g., in Media Indonesia, Kompas, and Detik News). However, studies show that practices encouraged by palm oil producers, mining, and pulp and paper industries often drive deforestation in Indonesia (Abood et al., 2015; Cisneros et al., 2021; Dermawan et al., 2022). Thus, mass media reports on the issue make private citizens' minority behavior highly visible, while actual drivers of deforestation are concealed (**determinant**). This can create misleading impressions that community members allow deforestation for individual use, which does not reflect the actual dynamics (**pluralistic ignorance**).

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Table 2 (*continued*)

Path	Case Study
(In)visibility of public opinion → pluralistic ignorance	**Brazil:** Most of the Brazilian population (93%) are against wild animal traffic or hunting (Wey Gasparini, 2021). Nonetheless, the media tends to overreport about issues related to this crime. Such reporting can make wild animal traffic and hunting highly visible (**determinant**), which may contribute to normalizing these crimes and misperceptions that the Brazilian population supports such practices more than they do in reality (**pluralistic ignorance**) (G1 Fantástico, 2024). **Italy:** Illegal fishing activities have garnered significant attention in the media due to their detrimental impacts on fish stocks and marine ecosystems. However, there is often little emphasis on the numerous local and national initiatives (e.g., Findus Italia's collaboration with the Marine Stewardship Council) for sustainable fishing to protect fish resources and promote responsible fishing practices. Such initiatives may receive less media attention and thus visibility (**determinant**) than episodes of illegal fishing and its consequences, potentially contributing to a distorted perception of the number of people engaging in such illegal activities *vs*. those engaging in marine conservation efforts (**pluralistic ignorance**). **Thailand:** After the King of Thailand's son visited the mangrove reforestation project, many people visibly commented online (**determinant**) that they would like to engage in similar efforts and see the project in person (The Nation Thailand, 2023)—potentially increasing perceptions of the social consensus surrounding biodiversity conservation in Thailand (**pluralistic ignorance**).
Socioeconomic structures → pluralistic ignorance	**Global:** Governmental decisions, such as being a party to the Convention on Biological Diversity (**determinant**), can signal to the public within a country but also to other governments that a country cares about biodiversity conservation, potentially reducing opposing impressions (**pluralistic ignorance**). **United States:** Weed and grass height, as well as lawn irrigation ordinances by municipalities (**determinant**), may encourage people to maintain a neat, mowed lawn (Sisser et al., 2016), regardless of their preferences. This can create the impression that more people approve of this practice than in reality (**pluralistic ignorance**).
② Pluralistic ignorance → Consequences	
Pluralistic ignorance → Conformity to (mis)perceived consensus/norms	**Brazil:** There is a unanimous consensus among wildlife professionals and experts that capturing wild animals and plants for illegal trade negatively affects biodiversity (Charity and Machado Ferreira, 2020). If government officials and policymakers underestimate this consensus (**pluralistic ignorance**), they may be less likely to prioritize and develop strategies for combating illegal trade and strengthening current legislation (**consequence**). **Europe:** Farmers are more likely to adopt sustainable agricultural practices if they perceive that other farmers engage in and approve of such practices (Swart et al., 2023). If farmers underestimate the actual consensus regarding sustainable land management practices (**pluralistic ignorance**), for example, after agri-environmental schemes end (Kuhfuss et al., 2016; Sereke et al., 2016), they may be less likely to continue implementing these (**consequence**). By contrast, if farmers (correctly) perceive that other farmers engage in and approve of sustainable agricultural practices (Swart et al., 2023), farmers are more likely to adopt these, which can benefit bird and arthropod diversity in particular (Mupepele et al., 2021). **Indonesia:** A public opinion survey (United States Agency for International Development or the United States Government, 2018) using quota samples ($N = 2{,}097$ respondents from 34 administrative provinces) revealed that 90% of Indonesians would support government efforts to increase the number of terrestrial and marine protected areas in the country. If policymakers underestimate this overwhelming support in communities (**pluralistic ignorance**), they may be less likely to implement these (**consequence**), with negative consequences for biodiversity (Lester et al., 2009).
Pluralistic ignorance → Cooperation	**Japan:** Coral reefs, the most biologically diverse shallow water marine ecosystems (Roberts et al., 2002), are important for ocean biodiversity and provide economic and recreational benefits (Brander et al., 2007), especially for scuba diving and fishing businesses. Yet there is a tension between these two industries (Toyoshima and Nadaoka, 2016). People working in fishing industries often erroneously assume that those in the scuba diving business do not care about coral reefs and exploit them to benefit financially. This **pluralistic ignorance** seems to have hindered intergroup cooperation (**consequence**) in the past until governmental and system-level interventions (e.g., introduction of payment for ecosystem services) successfully established cooperation between the two industries (Toyoshima and Nadaoka, 2016). **Indonesia**: There is tension between fisher communities and tourism operators living on the small island of Selayar in Indonesia. This has created a sense of unease about tourism initiatives being pursued on the island despite the potential benefits of some forms of tourism for conservation. At the start, tourism operators perceived that there would only be minimal resistance from the fisher communities on the island (**pluralistic ignorance**), but in actuality, these communities were wary about the impacts of tourism on their traditional livelihoods (Praptiwi et al., 2021). As a result, the current condition has reached the point where local fisher communities perceived that the benefits from tourism in the area are shared inequitably, leading to reluctance to cooperate (**consequence**) and physical resistance, including against the establishment of a private marine protected area by a resort owner.
Pluralistic ignorance ↔ Discussions	**Global:** If politicians/policymakers are rarely asked about biodiversity conservation (**determinant**), this can cause the impression that the general public does not care about the issue (**pluralistic ignorance**), which may, in turn, contribute to self-silencing (**consequence**) among politicians/policymakers or making statements that downplay the issue (**consequence**). Such silencing or downplaying can contribute to more **pluralistic ignorance** in the general population. **Global:** If journalists (mistakenly) believe that the public prefers coverage of light-hearted topics in summer over environmental issues (**pluralistic ignorance**), this may result in the media avoiding covering these topics (**consequence**), exacerbating **pluralistic ignorance** among the public that people do not care about environmental issues.
③ Intervention → Pluralistic ignorance	

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Table 2 (*continued*)

Path	Case Study
Changes in information system (consensus/norm messaging) → pluralistic ignorance	**Global:** Claims such as "biodiversity scientists must fight the creeping rise of extinction denial" (Lees et al., 2020, p. 1440) are essentially an intervention emphasizing a negative trend (**intervention**). Such statements can create the impression that most of the public and biodiversity scientists deny the issue (**pluralistic ignorance**) despite very high actual consensus (scientists: 96%; Isbell et al., 2023; public: 89%; The Economist Intelligence Unit, 2021). This pluralistic ignorance may lead (behavioral) scientists to prioritize educational measures instead of potentially more suitable interventions (**consequence**). **China:** In 2000, China's Wolong Nature Reserve implemented the Grain-to-Green Program—one of the largest National programs to conserve biodiversity by converting cropland to forest or pasture. Similar re-enrollment rates were found under the scenario of 75% of neighbors reconverting their land plots back to agriculture and a payment of 200 yuan/mu and under the scenario of 25% of neighbors reconverting their land with a 158 yuan/mu payment. In other words, payments needed to be higher to motivate farmers to re-enroll if only few of their neighbors participated. Informing farmers about other farmers' re-enrollment (**intervention**) in their neighborhood may reduce **pluralistic ignorance** that most farmers are not willing to re-enroll, reducing willingness to stay in the program (Chen et al., 2009).
Changes in information system (narrative intervention) → pluralistic ignorance	**Italy:** The message that "76% of Italians favor abolishing hunting. What are we waiting for to ban it?" (Cipolla, 2022) underscores a widespread sentiment supporting the abolition of hunting in Italy (**intervention**). This could influence public perception by highlighting the majority's opposition to hunting (**pluralistic ignorance**) and signaling a call for legislative action to address concerns about wildlife protection and public safety (**consequence**). **United States:** Signs in national parks emphasizing that "The vast majority of past visitors have stayed on the established paths and trails, helping to preserve the natural state of the sequoias and vegetation in this park" (**intervention**) can effectively reduce the number of visitors who leave the trail. One potential mechanism may be lowering expectations that many other visitors leave the track (**pluralistic ignorance**) (Winter, 2008). **United States:** A message stating that 70% of Coloradoans supported the reintroduction of wolves (**intervention**) successfully increased perceptions of the consensus about how many Coloradoans would support such a ballot initiative (**pluralistic ignorance**). Ultimately, however, this updated norm did not translate into changes in behavioral intentions (Niemiec et al., 2020). **Global:** Every week, the global movement Conservation Optimism (Milner-Gulland, 2024) highlights seven successful conservation stories from around the world (**intervention**), for example, establishing a new area in Nova Scotia (Canada) to protect land, forests, wetlands, and water or preserving the traditional landscape satoyama—a mix of forests, grasslands, rice fields, water bodies, etc.—in Nagano (Japan; Thompson, 2024). Such stories may reduce the impression that people do not care about biodiversity conservation (**pluralistic ignorance**).
Changes in the socioeconomic system (signaling) → pluralistic ignorance	**Global:** The Convention on Biological Diversity set up a website where non-state actors, such as businesses, non-governmental organizations, academia, and individuals, can showcase contributions and commitments to the Sharm El-Sheikh to Kunming and Montreal Action Agenda for Nature and People (Convention on Biological Diversity, n.d.) (**intervention**). Making these 718 pledges visible may reduce **pluralistic ignorance** across actors. **Brazil:** Indigenous populations are often underrepresented in decision-making spaces and the Brazilian media, yet their role in environmental preservation is crucial (Kettle, 2023; Pimenta, 2019). This underrepresentation (**determinant**) can lead to widespread pluralistic ignorance. Making existing convictions and conservation efforts visible—for example, when Indigenous groups unite to protest for the designation of further Indigenous territories and greater protection of all existing territories to protect the rainforest and its biodiversity (WWF, 2024) (**intervention**)—may clear up potentially existing misperceptions and increase perceptions that others, especially Indigenous groups, care about conservation and already engage in extensive conservation efforts (**pluralistic ignorance**). **Brazil:** President Luiz Inácio Lula da Silva initiated various conservation initiatives. For example, he recently signed a milestone declaration to establish two new extractive reserves, including mangroves—protected areas that are publicly owned and allow for sustainable use by local communities (Rare, 2024). At the ceremony, he emphasized that "we have a very serious commitment to the issue of environmental preservation, starting with the preservation of our forests, the demarcation of our indigenous lands" (Rare, 2024, para. 5). Changing prevailing structures and making commitments visible (**intervention**) may increase perceived norms surrounding biodiversity conservation and reduce potential doubts in the population that the government's priorities lie elsewhere (**pluralistic ignorance**). **Canada/Germany:** When protesters voice their true opinion for more biodiversity protection (**intervention**), for example, in the German city Göttingen or Montréal in Canada as part of the latest United Nations Biodiversity Conference, this may have reduced **pluralistic ignorance** and strengthened the impression that people care about biodiversity and conservation issues. **Germany:** Farmers' conservation behaviors (e.g., using native wild herbs and flowering plants around orchards, providing nesting sites) are often invisible (**determinant**). Invisible behaviors may create the impression among farmers and the general public that (other) farmers do not engage in these practices and do not care about biodiversity protection (**pluralistic ignorance**). To make such behaviors visible and potentially reduce pluralistic ignorance, fruit farmers in the Lake Constance area, one of Germany's most important fruit-growing regions, can put up a sign outdoors stating that they promote biodiversity (Obst vom Bodensee Marketinggesellschaft mbH, n.d.) (**intervention**). **Japan:** The Japanese Committee for the United Nations Decade on Biodiversity has set up a campaign aimed to make individual (otherwise invisible) efforts and commitment visible (**intervention**) to foster accurate beliefs that many people engage in biodiversity conservation efforts (**pluralistic ignorance**). In their campaign named "My行動宣言 (Declaration of my commitment)," they distribute a poster template that includes five tick boxes (Act 1: To eat locally grown food and taste what's in season; Act 2: To go out and enjoy nature, visit zoos/botanical gardens, and get in touch with nature and animals; Act 3: To feel and experience the beauty of nature and changing seasons and to communicate it through photographs, drawings, and writings. Act 4: To participate in local and national activities to protect the connection between people, culture, other animals, and nature; Act 5: To buy environment-friendly products). The poster template is expected to facilitate communications about individual commitment and has been adapted for

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Table 2 (*continued*)

Path	Case Study
	different populations, such as divers and those working in agriculture, forestry, and fisheries industries. **Japan:** The Japanese Committee for the International Union for Conservation of Nature runs an online platform called "にじゅうまるプロジェクト" (Nijyuumaru Project or double circle/excellence project) where visitors can see municipalities, businesses, non-profit organizations, educational and research institutions declaring their engagement in activities to improve biodiversity (**intervention**). This project aims to increase awareness among website visitors that many individuals and organizations are working towards improving biodiversity. This makes otherwise invisible conservation behaviors visible (**determinant**), possibly reducing **pluralistic ignorance**.
Changes in the socioeconomic system → pluralistic ignorance	**Indonesia:** The Indonesian government has incorporated the target of increasing the protected status of Indonesian seas to cover 30% of its maritime area by 2045 in its Blue Economy Roadmap coordinated by the Ministry of Marine Affairs and Fisheries (Fajar, 2023). Following this decision, various government officials engaged with the media to explain how this target is set to be achieved (e.g., in Antara), which will involve specific laws issued by the decentralized government of Indonesian provinces. This decision, including the media engagement campaign (**intervention**), may shift perceptions of social norms in the general public about biodiversity conservation and reduce **pluralistic ignorance**. **Thailand:** Thai Prime Minister Srettha Thavisin has decided not to declare Chiang Mai a disaster zone in March 2024, despite seasonal forest fires causing air pollution and destroying forest biodiversity (Herawati & Santoso, 2011; Kafle, 2006), out of fear that it would hurt the local economy. This headline news in the mainstream Thai media (Tanraska, 2024) (**intervention**) may have given the impression that the Thai government's top priority is to protect the local economy rather than proactively combating and preventing forest fires (**pluralistic ignorance**). This is not entirely true, given various other potentially less visible efforts, such as the Department of National Parks, Wildlife, and Plant Conservation having recently stepped up efforts in preventing such incidents in Chiang Mai and surrounding areas (Johjit, 2024).
Changes in ecological system → pluralistic ignorance	**Italy:** The Biodiversity Lab, inaugurated by social enterprise Rete Clima and international energy company E.ON Italia, serves as a pathway to discover innovative solutions for biodiversity conservation (**intervention**). For instance, the lab in Giussano Forest incorporates flower strips and log pyramids to enhance soil quality and provide refuge for wildlife, possibly combating the perception that biodiversity conservation efforts are lacking (**pluralistic ignorance**) (Musiu, 2024). **China:** Since 2017, the mega-city Chengdu has spent nearly $5 billion to build a 188 km^2 ecological zone known as the 'Green Belt' (**intervention**). This Green Belt brings residents closer to nature and is expected to enhance ecological protection (WCMC, n.d.). Such an initiative may reduce **pluralistic ignorance** that the local government is less willing to invest in ecosystems and biodiversity conservation within cities. **United Kingdom:** Breaking with a 300-year tradition of neatly mowed lawns (**determinant**), King's College at the University of Cambridge transformed one of their lawns into a wildflower meadow (**intervention**). Besides supporting three times more plant, spider, and bug species (Marshall et al., 2023), such conservation initiatives may reduce **pluralistic ignorance** that prominent institutions prioritize a mowed lawn over a wildflower meadow and disapprove of more biodiversity-friendly alternatives, further leading others to adopt similar biodiversity-friendly practices (**consequence**) (Garget, 2023).

on German television cover biodiversity-related topics; Neverla and Hoppe, 2023). This media silence can reinforce pluralistic ignorance among other groups (e.g., the public and policymakers), creating a vicious, self-perpetuating cycle. Similarly, when media professionals underestimate public concern about biodiversity loss, they may prioritize content to raise already high concern about biodiversity loss over solution-oriented content (for misperceptions of Belgian journalists about public support for environmental policies, see Beckers et al., 2021).

4. Determinants of pluralistic ignorance and corresponding interventions

These negative consequences underscore the importance of developing a comprehensive toolkit of interventions, targeting individual and system-level determinants (see also van Valkengoed et al., 2022) to address pluralistic ignorance effectively. As few individual-level factors predict social misperceptions consistently (Lees et al., 2023), we list them in Table 1 and focus on determinants and interventions across the information, socioeconomic, and ecological systems in Sections 4.1 to 4.3.

Priority Research Question 3: Which system-level factors predict pluralistic ignorance about biodiversity?

Priority Research Question 4: Which system-level interventions can reduce pluralistic ignorance to foster changes for biodiversity conservation?

4.1. *Information system*

4.1.1. *Overview of past work*

Mass media can signal social consensus (Tankard and Paluck, 2016) because people assume that media content reflects (reflection inference) and/or influences (persuasion inference) public opinion (Gunther, 1998; Gunther and Christen, 1999; Noelle-Neumann, 1993; Peter, 2022). Such inferences are based on direct (e.g., public opinion polls, depictions of opinions/behaviors of individuals/groups) and indirect cues (e.g., slant of media content; Gunther and Christen, 1999; Peter, 2022). Past work on environmental pluralistic ignorance has exclusively focused on direct cues, specifically providing accurate information about ingroup or outgroup beliefs (Geiger et al., 2025; Vlasceanu et al., 2024), emotions (Geiger and Swim, 2016; Sabherwal et al., 2021), support for policies (Lyons and Hasell, 2024; Mildenberger and Tingley, 2019), behavioral intentions (Andre et al., 2024b), and behaviors (Jachimowicz et al., 2018) as well as scientists' agreement about the causes of climate change (Rode et al., 2021; van Stekelenburg et al., 2022; Većkalov, Geiger et al., 2024; Vlasceanu et al., 2024; Table 1). It has been theorized that consensus information, especially about scientists, reduces misperceptions and acts as a gateway to improve personal attitudes about environmental issues (van der Linden, 2021; van der Linden et al., 2019). Yet, empirical evidence is mixed, particularly for more remote outcomes, such as policy preferences (Rode et al., 2021; van Stekelenburg et al., 2022; Većkalov, Geiger et al., 2024; Vlasceanu et al., 2024).

Besides consensus messages, narratives—(vivid) anecdotes and stories (Gunther and Christen, 1999; López-Pérez and Ramirez-Zamudio, 2020)—are widely used. Past work suggests that narratives

outweigh consensus information when forming judgments about the distribution of public opinion (Brosius and Bathelt, 1994), possibly increasing intervention effectiveness (Bursztyn and Yang, 2021). In contrast to these direct cues, the effects of indirect cues, such as the slant of newspaper articles (Gunther and Christen, 1999), have received relatively little scholarly attention.

4.1.2. Outlook for future work

Building on past research, we encourage future work to investigate (a) direct cues, including consensus information and narratives, and (b) indirect cues. In terms of direct cues, communicating public consensus may prove more effective for biodiversity topics than climate change (for limits of scientific consensus messages about climate change, see Chinn and and Hart, 2023; Chinn and Hart, 2021; Ma et al., 2019; Tschötschel et al., 2021). Climate change can be a polarizing topic (e.g., 58 % of people in the United States believe in largely human-caused climate change; Marlon et al., 2023), while the public seems to generally agree that biodiversity is declining (e.g., 86 % of people in the United States agree that biodiversity loss is a serious global problem; The Economist Intelligence Unit, 2021). This means that the climate consensus may not always be strong enough to be communicated in consensus interventions to ultimately shift personal attitudes and behaviors. However, given that consensus is stronger in the biodiversity domain, we believe the time is ripe to apply existing insights on consensus messaging to biodiversity topics to avoid missing this window of opportunity.

Besides consensus information, positive narratives about biodiversity recovery (*vs*. loss) may reduce pluralistic ignorance and result in stronger (positive) emotional reactions (White et al., 2020). As detailed in Table 2, the global movement Conservation Optimism (Milner-Gulland, 2024) applies this technique by highlighting weekly conservation success stories, for example, the preservation of the traditional landscape satoyama in Japan—a mix of forests, grasslands, rice fields, water bodies, etc. (Thompson, 2024). The mass media, on the other hand, often use negative narratives, for example, about minority behaviors that harm biodiversity. Negative narratives can increase pluralistic ignorance that many people do not care much about biodiversity and nature. One of our case studies (Table 2) highlights that much of the mass media coverage of deforestation in Indonesia has blamed private citizens for their role in encroaching on pristine forests for agriculture and timber harvesting, contrary to empirical evidence identifying practices of companies (e.g., palm oil producers, mining, and pulp and paper industries) as the main drivers (Abood et al., 2015; Cisneros et al., 2021; Dermawan et al., 2022). Thus, mass media reports make private citizens' minority behavior highly visible, while actual drivers of deforestation are concealed. This reporting may give misleading impressions that community members support deforestation for individual use. Given the widespread use of narratives about biodiversity conservation, we recommend investigating whether positive narratives can effectively reduce pluralistic ignorance and promote positive change relative to consensus information and whether negative narratives have opposing effects.

In terms of indirect cues, a lack of media coverage about biodiversity loss may foster pluralistic ignorance (Noelle-Neumann, 1993). Biodiversity loss is covered up to eight times less in the media (Legagneux et al., 2018) compared to climate change, and related issues such as pollinator decline receive similarly little media attention (Althaus et al., 2021). For example, only around 8 % of the news coverage in the four most popular Indonesian online media outlets related to conservation and environmental issues in 2018 (Wijayanto and Nurhajati, 2019), despite the country being a global biodiversity hotspot. We call for future research to investigate this spiral of media silence.

4.2. Socioeconomic system

4.2.1. Overview of past work

Within the socioeconomic system, public individual/group displays of behaviors and opinions, or a lack thereof, inform social perceptions to a great extent (Tankard and Paluck, 2016). High-impact behaviors, such as environmentally friendly investments or voting for pro-environmental parties, are often invisible. When people lack visible examples of pro-environmental behavior, they may conclude that others do not care much about environmental protection (see Hoffmann et al., 2024; Ross, 1977), amplifying pluralistic ignorance (see Shamir and Shamir, 1997). Conversely, visible behaviors may help resolve pluralistic ignorance and stimulate pro-environmental change. For example, highly visible solar cell systems make others more likely to install such systems (Rode and Müller, 2021), and making pro-environmental behavior visible can create long-term pro-environmental change by increasing perceptions of the frequency of such behaviors (Hoffmann et al., 2024).

A similar logic applies to opinions. People report rarely discussing environmental issues in their daily lives (Maibach et al., 2016; Marlon et al., 2023), making public opinion invisible. According to the Spiral of Silence Theory (Noelle-Neumann, 1993), this silence can exacerbate pluralistic ignorance. Fortunately, vocal minorities advocating for environmental protection can break this silence and increase the visibility of pro-environmental opinions (for minority influences in organizations, see Halbesleben et al., 2007; Westphal and Bednar, 2005). Previous work suggests that people estimate an opinion to be more widely shared when more (*vs*. fewer) people express this opinion once or when a single individual repeatedly (*vs*. once) expresses this opinion (Weaver et al., 2007). For environmental topics specifically, US states with more compared to fewer climate protests showed less pronounced pluralistic ignorance of the public's climate change worry and policy support (Sparkman et al., 2022).

Decisions of institutions, particularly those seen as representing the public's interest, can also convey normative information (Gelfand et al., 2024; Tankard and Paluck, 2016) both directly and indirectly. Direct influences refer to people inferring cognitions, affect, and behaviors based on institutional signals (Benabou, 2015); indirect influences imply that institutional decisions increase certain cognitions, affect, and behaviors, and observing these changes can result in updated social perceptions (Tankard and Paluck, 2016). For example, consensus perceptions about climate action shift when a coalition of businesses or climate research institutions makes their commitment to fighting climate change visible (Constantino et al., 2021), and learning that one's country has adopted a 100 % renewable energy mandate slightly increases perceptions of state-level support for such a policy (Syropoulos et al., 2024). Importantly, if institutional decisions accurately reflect (contradict) public opinion, pluralistic ignorance may decrease (increase).

4.2.2. Outlook for future work

Several of our case studies highlight strategies that make individual/group contributions to biodiversity conservation visible (Table 2). At the global level, various non-state actors showcase their commitments to the Sharm El-Sheikh to Kunming and Montréal Action Agenda for Nature and People on the website of the Convention on Biological Diversity (Convention on Biological Diversity, n.d.). Locally, fruit farmers in the Lake Constance area (Germany) make otherwise invisible biodiversity-friendly farming practices (e.g., using native wild herbs and flowering plants around orchards) visible by putting up signs signaling that they engage in efforts to promote and conserve biodiversity (Obst vom Bodensee Marketinggesellschaft mbH, n.d.). While such signaling strategies are widely used, intervention studies are needed to investigate whether signaling can reduce pluralistic ignorance and contribute to widespread conservation behavior (see also Hoffmann, 2025).

Relatedly, as experimental evidence is absent (except Bouman and

Steg, 2024), we recommend investigating whether protests as a particular signaling strategy, such as Indigenous people in Brazil protesting for the designation of further Indigenous territories and greater protection of existing territories (WWF, 2024; Table 2), can break the spiral of silence (Noelle-Neumann, 1993) and signal these opinions to be more widespread than one may have initially thought.

Evidence on institutional signaling is relatively scarce, and it remains unclear to what extent institutional decisions can shift consensus perceptions. For example, does the decision of the Indonesian government to incorporate the target of increasing the protected status of Indonesian seas to cover 30 % of its maritime area by 2045 in its Blue Economy Roadmap coordinated by the Ministry of Marine Affairs and Fisheries (Fajar, 2023) reduce possibly existing pluralistic ignorance? It further remains unclear whether and to what extent the status quo of not having adopted a policy fosters pluralistic ignorance. This question is critically important for the UN Convention on Biological Diversity (United Nations, 2022)—the only global biodiversity policy framework. To date, the United States is not a party to the Convention (United Nations, 2022), which may erroneously signal to other countries that the American public does not care much about nature protection.

4.3. Ecological system

4.3.1. Overview of past work

An influential study shows that littered environments encourage littering, potentially by creating the impression that others approve, or at least do not disapprove, of littering (Cialdini et al., 1990). Hence, the reported or perceived state of the environment (e.g., cleanliness) may influence perceptions of social norms—either directly (i.e., inferring others' cognition, affect, and behavior or what others approve of) or indirectly (i.e., observing shifts in others' cognition, affect, and behavior due to environmental changes; see Hornsey et al., 2022; Mumenthaler et al., 2021).

4.3.2. Outlook for future work

Similarly, the reported or perceived ecological status of a given biome, ecosystem, or species may influence social perceptions about biodiversity conservation. To the extent that people can accurately perceive species richness (Fuller et al., 2007; Lindemann-Matthies et al., 2010), observing an area with low or declining levels of biodiversity may create the impression that others do not care much about biodiversity conservation. Conversely, existing conservation initiatives or high/increasing levels of (perceived) biodiversity may signal positive levels of others' care. One of our case studies (Table 2) describes the creation of the 'Green Belt'—an ecological zone in the megacity of Chengdu in China that aims to bring residents closer to nature and enhance biodiversity conservation (WCMC, n.d.). The proposed research agenda paves the way to testing whether visible changes to natural environments (or a lack thereof), such as the Green Belt, reduce (or increase) pluralistic ignorance and can further stimulate (hamper) biodiversity conservation efforts.

5. Conclusion

To date, there are few applications of pluralistic ignorance research to biodiversity topics. This Perspective offers a framework to organize existing work and develop impactful pluralistic ignorance research in the biodiversity domain. We hope this framework mobilizes scholars across disciplines to ask diverse research questions and build a strong evidence base, including (a) investigating different forms of pluralistic ignorance across relevant actors, (b) working toward a detailed assessment of determinants and consequences, and (c) developing a comprehensive toolkit to reduce pluralistic ignorance for improved biodiversity outcomes. This evidence base may contribute to how conservation efforts are designed, communicated, and supported by diverse stakeholders. In the long run, we hope that making biodiversity conservation efforts more visible can shift perceptions of what is normative and inspire further individual and system changes to protect and restore biodiversity worldwide.

CRediT authorship contribution statement

Sandra J. Geiger: Writing – review & editing, Writing – original draft, Visualization, Software, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Hirotaka Imada:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Carya Maharja:** Writing – review & editing, Writing – original draft, Methodology. **Nattavudh Powdthavee:** Writing – review & editing, Writing – original draft, Methodology. **Valeria Vitale:** Writing – review & editing, Writing – original draft, Methodology. **Lei Zhang:** Writing – review & editing, Writing – original draft, Methodology. **Claudio D. Rosa:** Writing – review & editing, Writing – original draft, Methodology. **Zenith N.C. Delabrida:** Writing – review & editing, Writing – original draft, Methodology. **Kristian S. Nielsen:** Writing – review & editing, Conceptualization. **Franz Essl:** Writing – review & editing. **Mathew P. White:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Sandra J. Geiger and Mathew P. White report financial support for the data collection was provided by the Leibniz Institute for Psychology (ZPID). If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Open Access funding was provided by the University of Vienna.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.gloenvcha.2025.103043.

Data availability

The dataset and code supporting the conclusions of the case study in this article are publicly available on the Open Science Framework (https://osf.io/fs5c3/).

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