

Article

The Drifting Baseline Syndrome: A Novel Concept of Perceived Biodiversity Change

Daniela Haluza *  and Gerald Wagner

Department of Environmental Health, Center for Public Health, Medical University of Vienna,
Kinderspitalgasse 15, 1090 Vienna, Austria

* Correspondence: daniela.haluza@meduniwien.ac.at

Abstract: The ongoing biodiversity crisis, driven by human activities, threatens ecosystems and public health. Understanding how different demographic groups perceive biodiversity change is key to effective conservation strategies. We conducted a cross-sectional survey of German-speaking participants ($n = 899$, 62.2% female) to assess biodiversity perception. Respondents reported declines in familiar species like fish and birds, but perceived microbial diversity as increasing. As for age-related differences, younger participants were generally less likely to recognize biodiversity change. However, this pattern did not hold uniformly across all age groups. No significant gender differences were observed. The well-established concept of shifting baseline syndrome shows how each generation tends to underestimate long-term ecological change. Our findings suggest a more complex pattern. We introduce the novel idea of a drifting baseline syndrome, in which biodiversity perceptions shift both downward and upward over time. This dynamic process goes beyond generational change alone. By bridging the gap between long-term and short-term perception shifts, the concept helps to deepen our understanding of how environmental change is perceived and remembered. Intergenerational dialogue and education can help address drifting baselines. These approaches may bridge perception gaps, encourage sustainable behaviors, and strengthen conservation efforts, ultimately benefiting both ecosystems and human well-being.

Keywords: biodiversity loss; environmental perception; public health; climate change; sustainability; ecology; one health; habitat loss; extinction of species; shifting baseline syndrome; Sustainable Development Goals (SDGs)



Received: 15 April 2025

Revised: 21 May 2025

Accepted: 23 May 2025

Published: 26 May 2025

Citation: Haluza, D.; Wagner, G. The Drifting Baseline Syndrome: A Novel Concept of Perceived Biodiversity Change. *Sustainability* **2025**, *17*, 4891. <https://doi.org/10.3390/su17114891>

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Human activity has led to the extinction of entire populations of diverse species. The main drivers of biodiversity decline are habitat destruction, climate change, overexploitation of natural resources, and increasing environmental pollution [1]. This loss has reduced the diversity of living organisms seriously, which in a broader sense also appears to threaten the familiar living conditions and health of humanity [2]. The recognition that biodiversity loss undermines ecological stability emerged in the 1980s [3]. Early research showed that species extinction can have long-term ripple effects on ecological functioning. Later studies refined these insights, highlighting the intricate relationships between species and their environments [4]. Environmental changes can ultimately harm human health [5]. A diverse ecosystem is more resilient to natural and human-induced disruptions, ensuring long-term planetary health [6].

The biodiversity hypothesis, as a further development of the hygiene hypothesis [7], attempts to explain the extent to which human health is favorably influenced by the

diversity of species [8]. This theory states that the biological diversity of our environment is immensely important for the development and maintenance of our immune system. Especially in the early years of our lives, contact with as many species and aspects of nature as possible is of great importance to avoid allergies [9]. Encounters with nature, including all of its biological diversity, are immensely important for humanity in all three dimensions of health, i. e., physical, mental, and social [10]. High biodiversity in green spaces is a key factor in promoting well-being, highlighting the importance of quality over quantity [11]. Scientific evidence supports that contact with nature and physical activities in nature demonstrably show further positive benefits on the human body, as evidenced by parameters such as lower cortisol levels and improved mood [12].

Traditional ecological knowledge, which is passed on from generation to generation, is of great importance in environmental protection, for instance in agriculture, and is subject to constant change [13]. In 1995, Daniel Pauly introduced the concept of shifting baseline syndrome (SBS), describing how environmental degradation becomes the accepted norm [14]. He criticized overfishing and unsustainable fleets, arguing that fisheries research prioritized catch optimization over ecological concerns, masking past biodiversity loss. This weak transmission of knowledge contributes to the social extinction of species—the collective forgetting of species, their cultural significance, or their declining presence in public awareness [15]. Peter H. Kahn, an expert in human-nature interactions, coined the concept of environmental generational amnesia, a broader form of the shifting baseline syndrome [16]. He argues that people fail to realize that the nature they experienced in childhood was already degraded, making it difficult to grasp the full extent of environmental change. This amnesia contributes to biodiversity loss, as each generation unknowingly accepts a diminished environment as the norm. Raising awareness of this phenomenon in an accessible way is essential for addressing the biodiversity crisis. Addressing this syndrome in a way that is accessible to the public is crucial for tackling the biodiversity crisis [17].

As described, SBS and generational amnesia as related concepts describe how each generation perceives environmental conditions relative to those they first encountered, gradually accepting biodiversity loss as the new normal. However, in some cases, this shifting baseline can transition into what has been termed the lifting baseline syndrome (LBS) [18]. This occurs when newly observed species such as invasive or introduced species are perceived as signs of ecological recovery, even if they represent a fundamental change in biodiversity rather than a genuine restoration of lost species [19]. For example, in degraded ecosystems, the appearance of alien species may be misinterpreted as an increase in biodiversity, masking historical losses. Over time, these new species become part of the accepted ecosystem, further altering public perception of what constitutes a healthy environment [20]. This process demonstrates that shifting baselines do not always lead to a simple downward trajectory of ecological awareness. Rather, they can evolve into a lifting baseline effect where perceived biodiversity appears to increase, despite underlying ecological disruptions.

Baseline shifts are influenced by historical, economic, and political factors, highlighting the need to compare subjective perceptions with objective ecological changes [17,21]. Recent research highlights the need to study diverse populations and regions to fully understand environmental perceptions [22]. Using standardized methodologies, integrating quantitative surveys with qualitative insights, can enhance comparability. Recognizing these changes is crucial for environmental research, conservation ecology, and policy. While biodiversity is constantly changing, it is the accelerating loss, the so-called biodiversity crisis, that poses a growing global challenge [23]. Public awareness of this issue, however, varies considerably across demographic groups.

This study examines how factors such as age and gender influence perceptions of biodiversity change within a German-speaking population. Through a cross-sectional online survey, we explore whether these perceptions reflect the SBS [17], a lifting baseline effect as described by the LBS [18], or a more complex phenomenon of drifting baselines, where perceptions evolve differently across species and time, capturing the dynamic nature of biodiversity perceptions beyond generational shifts. In addition to its ecological and perceptual dimensions, biodiversity loss is also tightly linked to global sustainability efforts [24]. Biodiversity plays a central role in achieving the United Nations Sustainable Development Goals (SDGs), particularly SDG 14 (Life Below Water), SDG 15 (Life on Land), and SDG 3 (Good Health and Well-being) [25]. Understanding how the public perceives biodiversity change is essential for supporting these global objectives, as public awareness and engagement are critical for promoting conservation efforts and sustainable development. By examining individual perceptions of biodiversity trends, our study contributes to the broader discourse on environmental sustainability and aligns with international efforts to reduce biodiversity loss and foster ecological resilience.

2. Methods

2.1. Procedure of the Study

The survey in German was conducted as a non-representative, cross-sectional study using the SoSci Survey platform [26]. Survey validation involved a pilot test with 13 voluntary participants from diverse educational backgrounds to assess clarity, comprehensibility, and technical functionality. After slight changes addressing the feedback from the pretest, the study protocol including the final questionnaire was approved by the institutional Review Board of the Medical University Vienna (reference: 2024-04-18/01637251) and was conducted in harmony with the Declaration of Helsinki. Given the exploratory nature of this cross-sectional study, a convenience sampling strategy was employed. This approach might have introduced a self-selection bias, as individuals who choose to participate in online surveys related to environmental topics were potentially more environmentally aware and concerned compared to the general population, influencing reported perceptions of biodiversity awareness and concern.

The online survey was accessible via a web link from 17 May to 7 June 2024. To ensure broad participation across age groups, recruitment was carried out through social networks (WhatsApp, Facebook), email distribution, and personal outreach. No financial incentives were provided for participation, and the survey was not advertised. Inclusion criteria required participants to provide their informed consent prior to starting the survey, be at least 18 years old, and possess sufficient proficiency in German to comprehend and complete the questionnaire. The survey did not include randomized or adaptive questions. Participants had the flexibility to navigate back and forth within the questionnaire and modify their responses before submission. All collected data were securely stored in accordance with SoSci Survey's data protection regulations and were accessible only to the research team [26].

2.2. Questionnaire

The online questionnaire collected demographic data age (in years), gender (female, male, diverse), geographic region by country, and residence type (rural vs. urban) from participants. A species group is a classification category in biological taxonomy used to group organisms based on shared characteristics. In our study, we used the species groups insects, birds, plants, fish, fungi, mammals, viruses, and bacteria, each representing a different biological classification as potential biodiversity indicators [27].

In this study, we refer to two widely used ecological indicators: species richness [28] and abundance [21]. Species richness denotes the number of different species present in a given area, serving as a measure of biodiversity variety. Abundance, by contrast, refers to the number of individuals within a species or across multiple species in a particular habitat. While richness captures the diversity of life forms, abundance reflects population levels and ecological dominance. Both metrics are important for assessing biodiversity change and are often perceived differently by the public. To calculate two separate scores, i.e., species richness score and species abundance score, we assessed participants' perceptions of biodiversity changes using two distinct scales.

The species richness scale represented the diversity of species within an ecosystem. Participants rated their perceived changes in species richness over the past ten years on a scale from 1 (strongly decreased) to 5 (strongly increased), with an option for "not specified" marked as −1. The species groups were insects, birds, plants, fish, fungi, mammals, viruses, and bacteria.

The species abundance scale referred to the number of individuals within each species. Participants rated their perceived changes in species abundance over the past ten years on the same scale from 1 (strongly decreased) to 5 (strongly increased), with "not specified" again marked as −1. The species groups for abundance were also insects, birds, plants, fish, fungi, mammals, viruses, and bacteria. Finally, participants were given the opportunity to submit comments in a free text field.

The retrospective ten-year timeframe was selected to guide participants' assessments of biodiversity-related changes. This decision was based on alignment with international standards for biodiversity reporting, notably those adopted by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) [29] and the Convention on Biological Diversity [19,30], which utilize decadal intervals to structure monitoring and policy review cycles. Using this timeframe enables comparability with existing national and global assessments and ensures methodological coherence with widely accepted biodiversity reporting frameworks. A ten-year period does not span a full human generation, but can capture meaningful ecological and perceptual change, particularly in the context of rapidly changing environmental baselines [31]. Moreover, longer recall periods are associated with increased risk of memory bias and reduced data reliability in self-report designs, so the selected timeframe represents a pragmatic balance between ecological relevance, international comparability, and methodological rigor.

2.3. Qualitative Content Analysis

For the data analysis, qualitative content analysis was employed as a structured method for the systematic examination of text-based data [32]. Qualitative responses were analyzed through inductive coding, allowing key themes to emerge from the data. Coding was performed by two independent researchers to enhance reliability. A deductive approach was used to classify responses into predefined categories based on theoretical criteria aligned with the research questions. Categories were iteratively refined and validated independently to ensure reliability. Thematic organization followed a multi-stage analysis of the text data, starting with an initial thorough reading of the text data to gain a comprehensive understanding of the material. In this initial stage, the researchers immersed themselves in the data to identify emerging themes and gain insights into the content. This familiarity laid the groundwork for developing a preliminary coding scheme.

Subsequently, a deductive coding framework was established based on theoretically derived criteria that aligned with the research questions. In this stage, specific segments of text were systematically assigned to predefined main and subcategories. This systematic coding allowed for the initial organization of the data. Following the initial coding, an

iterative process of review and refinement was undertaken. The categories were critically reassessed, and the coding scheme was adjusted as needed to accurately reflect the nuances and complexities of the responses. Independent researchers then validated these refinements to enhance the reliability and consistency of the categorization. Finally, the refined coding scheme was applied to the entire dataset in a comprehensive second round of analysis. This ensured that all data segments were consistently categorized, resulting in a robust thematic organization that accurately captured the main insights and patterns within the data.

2.4. Statistical Analysis

The collected data were processed using Microsoft Excel (Seattle, WA, USA), computer program R Statistical Software (Version 4.4.0) [33], and SPSS Statistics (Version 29.0, IBM Corp. SPSS Statistics for Windows, Armonk, NY, USA) [34]. Graphs were designed using Python (Version 3.11.4) [35]. Descriptive statistics were generated to summarize the data, and a significance level of 0.05 (α) was applied to all tests, with a Bonferroni correction for multiple comparisons.

Participants rated their perceived changes in biodiversity across eight species groups, i.e., insects, birds, plants, fish, fungi, mammals, viruses, and bacteria, on a Likert scale from 1 (strongly decreased) to 5 (strongly increased), with “not specified” being assigned a value of -1 . Internal consistency was assessed using Cronbach’s alpha (species richness: $\alpha = 0.735$, species abundance: $\alpha = 0.764$), indicating acceptable reliability for both scales. Two scores, one for species richness and one for species abundance, were calculated by averaging the valid responses for each species, excluding “not specified” answers.

Non-parametric statistical tests, including the Mann–Whitney U-test and Kruskal–Wallis test, were used for analysis. A binary variable for gender (female, male) was created. Four participants who identified as diverse were excluded due to insufficient representation. Participants were grouped into three age groups (18–40 years, 41–60 years, and 61+ years), and differences in perceived species richness and abundance were analyzed using the Kruskal–Wallis test. Pairwise comparisons between age groups were conducted with the Mann–Whitney U-test. Pearson correlation coefficients were calculated to examine the relationship between age and gender groups and biodiversity perception, with the species richness and abundance score, respectively. Additionally, a multiple linear regression was performed to model biodiversity perception, using both scores as dependent variables and age and gender as independent variables.

3. Results

3.1. Study Participant Characteristics

The questionnaire was accessed 2624 times, with 1057 respondents (40.28%) initiating the survey. Only responses from participants who completed the final page were considered valid, resulting in 931 datasets meeting this criterion. However, as participants could reach the final page by declining consent on the second page, seven cases were subsequently excluded. Additionally, 25 responses from underage participants were removed, yielding a final dataset of 899 valid survey responses for analysis. Thus, the completion rate was 85.04%, while the dropout rate was 14.96%. The valid response rate was 34.26%.

The average age of respondents was 45.78 years ($SD = 15.65$), with a median age of 46 years and an age range from 18 to 86 years, 62% of participants identifying as female, 37% as male, and 0.4% ($n = 4$) as diverse. The participant pool was divided into three age groups: 18–40 years, 41–60 years, and 61+ years. The largest proportion of participants was from the 41–60 years age group, comprising 45.5% of the total respondents. The 18–40 years group represented 36.1%, while the 61+ years group accounted for 18.4% of the participants.

The majority of participants resided in Lower Austria (59.5%) or Vienna (23.4%), with Styria representing 3.8%, and Salzburg and Upper Austria each contributing 2.8%. Smaller proportions came from Burgenland (2 participants), Tyrol (1.3%), Vorarlberg (1%), and Carinthia (0.6%). Two participants did not specify their region. Regarding residence type, 50.8% lived in a rural area.

Although the survey was not designed to produce a representative sample of the Austrian population, a comparison with national census data offers helpful context for interpreting the results [36]. Age distribution in the sample resembled that of the general population, but with a slight overrepresentation of middle-aged and an underrepresentation of older adults: 36.1% of participants were aged 18–40 years (population: 35.3%), 45.5% were 41–60 years (population: 34.5%), and 18.4% were over 60 (population: 30.2%). In terms of gender, 62.2% of participants identified as female, 37.4% as male. This differs from the national distribution (50.8% female, 49.2% male), indicating an overrepresentation of women in the sample. Regarding place of residence, 50.8% of respondents reported living in rural areas, compared to approximately 40% of the Austrian population, suggesting a higher proportion of rural residents in the sample. The proportion of participants from Vienna (22.9%) closely matched the national figure.

3.2. Perceived Biodiversity Change for Species Richness and Abundance

To assess perceived biodiversity change, participants were asked to rate their personal perceptions of changes in eight species over the past ten years, focusing on both species richness (diversity) and species abundance (number of individuals per species) using a five-point Likert scale. The results, presented in Figures 1 and 2, show the distribution of responses in percentages, calculated from the sum of valid responses. A visual inspection of the data revealed that fish and birds were most commonly perceived to have decreased in both richness and abundance. On the other hand, bacteria and viruses were reported to have increased the most.

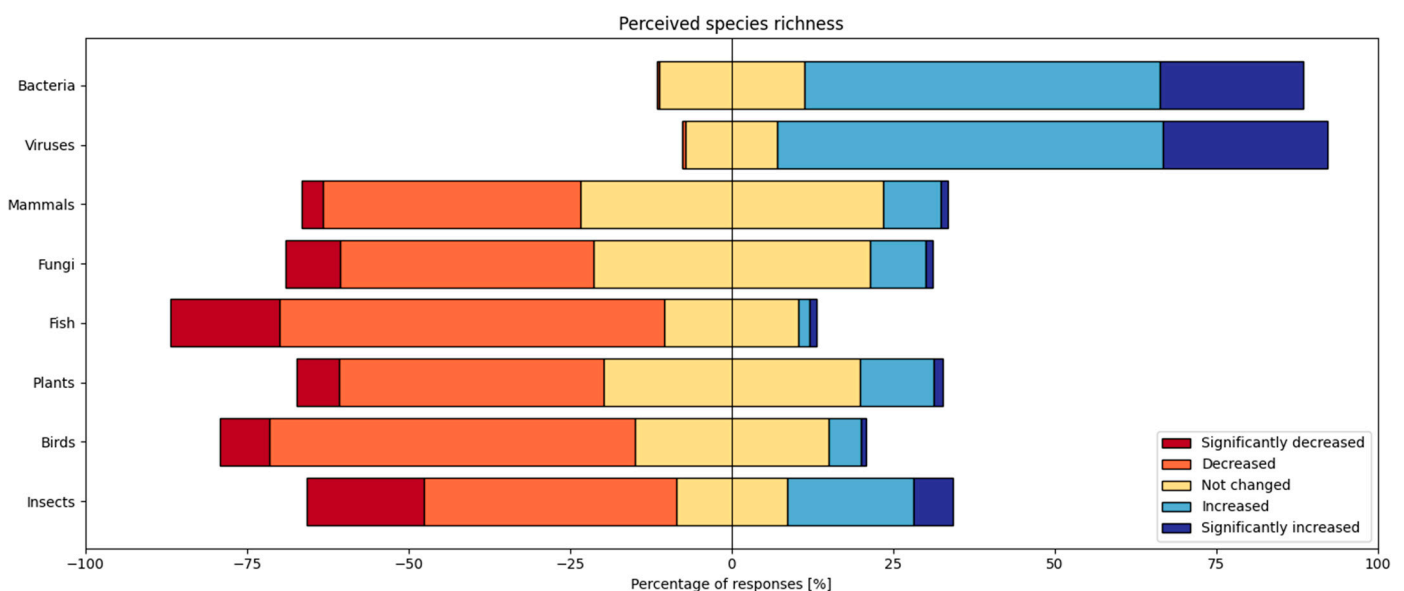


Figure 1. Perception of biodiversity change: percentage distribution of perceived species richness, stratified for different species, with responses for significantly decreased/decreased (left) and increased/significantly increased (right). Red: significantly decreased; orange: decreased; yellow: not changed; light blue: increased; dark blue: significantly increased.

Figure 1 illustrates the distribution of responses for perceived species richness across the species groups, differentiating between respondents who observed declines and those

who noted increases. For insects, 18.2% reported a strong decline in species richness, and 39% noted a decrease. Meanwhile, 17.2% perceived no change, whereas 19.5% and 6.1% observed an increase or strong increase, respectively. The response “not specified” was chosen by 97 participants. A similar pattern emerged for birds, with 7.8% reporting a strong decrease and 56.6% noting a decline. Nearly a third (29.9%) perceived no change, while only 5.0% and 0.9% reported an increase or strong increase. Again, 97 participants selected “not specified.” For plants, 6.6% of respondents observed a strong decrease in species richness, and 40.9% noted a decline. 39.8% perceived no change, while 11.3% and 1.4% saw an increase or strong increase. Notably, 128 participants did not specify an answer. The strongest perceived declines were reported for fish, with 16.8% indicating a strong decrease and 59.9% noting a general decrease. Only 20.8% saw no change, and a mere 1.6% and 1.2% perceived an increase or strong increase. Fish had the highest number of “not specified” responses ($n = 399$).

For fungi, 8.5% reported a strong decrease and 39.1% a decline in species richness, while 42.9% noted no change. A smaller proportion (8.5% and 1.1%) observed an increase or strong increase. The response “not specified” was selected 367 times. Mammals showed a similar pattern to that of fungi, but with the least concern for strong declines, with only 3.3% perceiving a significant decrease and 39.8% noting a decline. Almost half (47%) reported no change, and 8.9% and 1.1% observed an increase or strong increase. “Not specified” was chosen by 257 participants. In contrast to the abovementioned six species, bacteria and viruses were overwhelmingly perceived as increasing in species richness. Only 0.6% of participants reported a decrease for either group, while the majority noted an increase (55% for bacteria, 59.7% for viruses) or even a strong increase (25.4% for both groups). The number of “not specified” responses was high, with 231 for viruses and 288 for bacteria.

Figure 2 presents the distribution of perceived changes in species abundance, differentiating between respondents who observed declines and those who noted increases. This visualization provides insight into the varied public perceptions of biodiversity trends. Insects were widely perceived as declining, with 53.6% of respondents reporting a decrease, including 16.4% who observed a significant decline. However, 22.8% noted an increase, suggesting some variation in local observations or species-specific trends. A stronger consensus emerged for birds, where 64.5% perceived a decline, with 55.5% reporting a moderate decrease. Only 6.4% observed an increase, reinforcing concerns about avian population losses.

Similarly, plant populations were predominantly perceived as decreasing (48.9%), though a substantial proportion (39.2%) reported no change. Fish showed the most pronounced decline, with 73.1% of respondents observing a decrease, including 14.1% noting a significant drop. Only 4.5% perceived an increase, highlighting widespread concern over aquatic biodiversity loss.

Perceptions of fungi and mammals were more balanced. While 48.4% reported a decline in fungi populations, 42.3% saw no change, and 9.3% observed an increase. Mammals followed a similar pattern, with 46.7% perceiving a decrease, 42.6% reporting stability, and 10.8% noting an increase.

In contrast, perceptions of microbial life—viruses and bacteria—were markedly different. The majority of respondents (82.4%) believed that viruses had increased, with only 0.9% perceiving a decline. Bacteria followed a similar trend, with 77.4% reporting an increase and just 1.1% noting a decrease. These findings likely reflect heightened awareness of infectious diseases and microbial dynamics in the context of global health concerns.

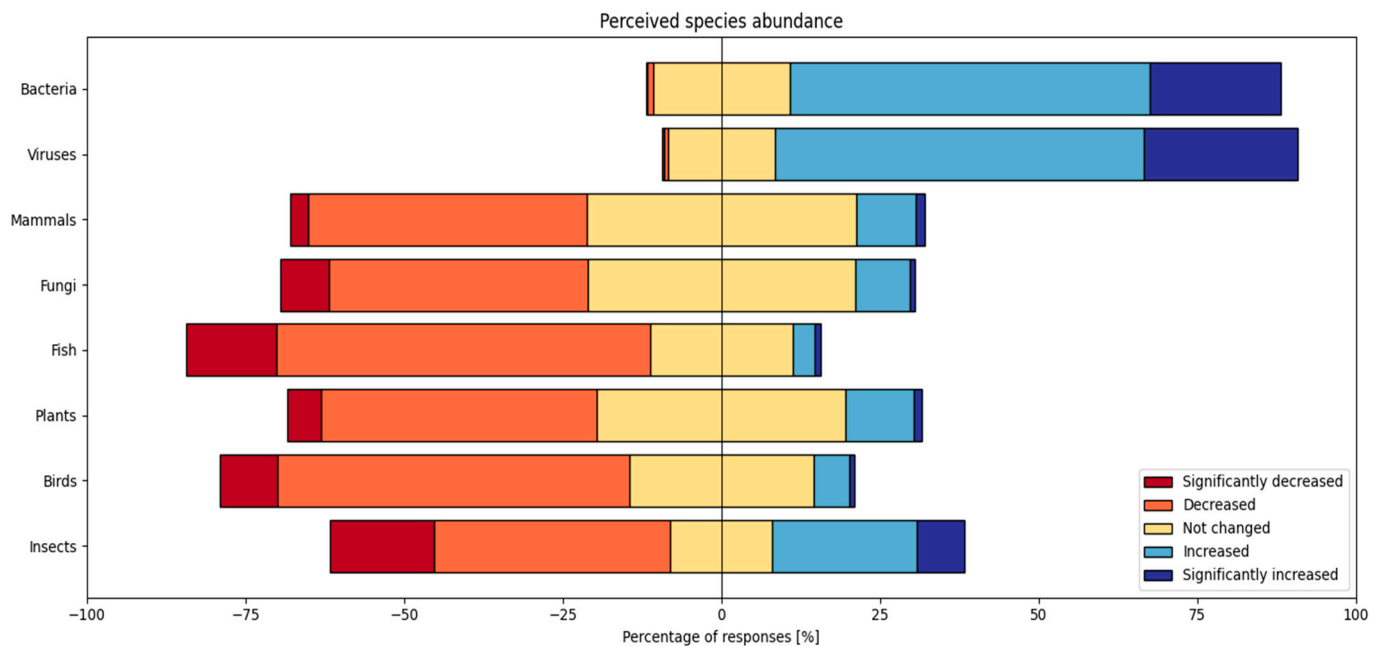


Figure 2. Perception of biodiversity change: Percentage distribution of perceived species abundance, stratified for different species, with responses for significantly decreased/decreased (**left**) and increased/significantly increased (**right**). Red: significantly decreased; orange: decreased; yellow: not changed; light blue: increased; dark blue: significantly increased.

3.3. Age and Gender Differences in Perceived Species Richness and Abundance

A Kruskal–Wallis rank sum test assessed differences in species richness across three age groups, i.e., 18–40 years, 41–60 years, and 61–86 years. The test revealed a statistically significant difference between the generations ($\chi^2 = 10.276$, $df = 2$, $p = 0.006$). Subsequent pairwise comparisons using the Wilcoxon rank sum test with continuity correction indicated a significant difference between the 18–40 years and 41–60 years groups ($p = 0.008$). However, no significant differences were found between the perceptions of the 61–86 years group and the other two groups: 18–40 years ($p = 1.0$) and 41–60 years ($p = 0.109$). The p -values were adjusted for multiple comparisons using the Bonferroni method. This analysis suggests that the 41–60 years group perceived species richness differently from the 18–40 years group, while no substantial differences were observed between the older and younger age groups.

Further, as for perceived species abundance across age groups, the Kruskal–Wallis rank sum test revealed a significant difference (chi-squared = 10.276, $df = 2$, $p = 0.006$). Specifically, pairwise comparisons using the Wilcoxon rank sum test indicated a significant difference between the 18–40 years and 41–60 years groups ($p = 0.008$). However, the comparison between the 41–60 years and 61–86 years groups showed no significant difference ($p = 1.0$), and the comparison between the 18–40 years and 61–86 years groups also did not reach statistical significance ($p = 0.109$). These p -values were adjusted using the Bonferroni method.

The Wilcoxon rank sum tests assessing gender differences in species richness ($W = 86,563$, $p = 0.784$) and abundance ($W = 79,269$, $p = 0.935$) revealed no statistically significant differences. These findings suggest that gender does not play a distinguishing role in the perception of species richness or abundance.

The analysis of the correlations between age and perceived species richness ($r = -0.0428$, $t = -1.2604$, $df = 867$, $p\text{-value} = 0.2079$) and species abundance ($r = -0.0526$, $t = -1.5117$, $df = 823$, $p\text{-value} = 0.131$) showed weak negative relationships, indicating no significant associations. The correlation analysis between gender and perceived species richness revealed

no significant relationship ($r = -0.0060$, $t = -0.17747$, $df = 867$, $p\text{-value} = 0.8592$), with similar results for species abundance ($r = -0.0071$, $t = -0.20266$, $df = 823$, $p\text{-value} = 0.8394$), indicating that gender does not appear to play a significant role in shaping perceptions of species richness and abundance.

The multiple regression analysis showed that neither age ($\beta = -0.00125$, 95% CI $[-0.0032, 0.0007]$, $p = 0.208$) nor gender ($\beta = -0.00369$, 95% CI $[-0.0661, 0.0587]$, $p = 0.908$) significantly predicted perceived species richness. The overall model explained a negligible proportion of variance ($R^2 = 0.0018$, $F(2, 866) = 0.8$, $p = 0.4496$). Similarly, for perceived species abundance loss, neither age ($\beta = -0.00168$, 95% CI $[-0.00386, 0.00050]$, $p = 0.132$) nor gender ($\beta = -0.00578$, 95% CI $[-0.0764, 0.0649]$, $p = 0.873$) were significant predictors. The model explained only a minimal amount of variance ($R^2 = 0.0028$, $F(2, 822) = 1.154$, $p = 0.3159$). Overall, neither age nor gender was meaningfully associated with perceived species richness or abundance, and the models explained only negligible variance. This suggests that biodiversity perceptions were broadly similar across demographic groups, pointing to the influence of other factors.

3.4. Qualitative Free-Text Analysis

Among the 899 survey participants, 138 individuals (15.3%) provided qualitative feedback in response to the open-ended question. The responses were systematically categorized into four overarching thematic codes: politics, everyday life, biodiversity, and system criticism.

Politics ($n = 45$, 32.6%): Responses in this category predominantly addressed governmental actions, policy decisions, and the perceived inadequacy of political measures regarding environmental sustainability. Participants emphasized the necessity for immediate and decisive interventions. Here are some quotes:

“Act now! Bold political decisions with far-reaching impact are needed. Stop road construction, stop land sealing, stop deforestation.”

(female, 44 years)

“Politics should finally take these issues seriously and implement appropriate measures instead of always offering inadequate proposals!”

(female, 62 years)

Everyday life ($n = 40$, 29.0%): Comments in this category pertained to individual behavioral adaptations and personal perspectives on environmental engagement. These statements often reflected a nuanced balance between pro-environmental attitudes and skepticism toward activism. Here are some quotes:

“I really care for nature. I try to recycle, provide a home for bees, and conserve energy, but I’m not a fan of protests about climate change or similar issues.”

(female, 26 years)

“There is a difference between living in an apartment with a balcony and living on a large property in the countryside.”

(female, 28 years)

“The motto for overcoming the crisis is: embrace limitation and simplicity, welcome wildflowers, deadwood, and nettles in the garden, move away from perfectionism, and reconnect with untamed nature.”

(female, 65 years)

Biodiversity ($n = 35$, 25.4%): A substantial proportion of responses focused on environmental degradation, species loss, and observable ecological changes. Here are some quotes:

“When swimming in Lake Constance, you no longer encounter any fish.”

(female, 47 years)

“Wolves, wolf hybrids, and otters harm biodiversity.”

(male, 67 years)

“Early mowing of the meadows—many flowers and herbs are gone.”

(female, 68 years)

“Personal observation in my region: For several years now, kestrels (introduced through a settlement project) and red kites (naturally established) have become native to our area. The number of corvids has also increased. Small bird populations have grown as well, though I cannot provide detailed information on specific species. However, insect density has declined, possibly due to the excessive use of grassland—now mowed 4–5 times per year instead of the traditional 2–3 times. Unfortunately, due to economic pressure in agriculture, this practice has become necessary to achieve a positive financial outcome.”

(male, 27 years)

System criticism (n = 18, 13.0%): A smaller subset of responses expressed skepticism toward overarching sociopolitical and economic structures, extending beyond individual policy decisions to systemic influences on environmental crises. Here are some quotes:

“Bought science contributes greatly to our woes.”

(female, 62 years)

“Our politicians around the globe are knowingly driving us toward catastrophe.”

(male, 58 years)

“As long as not all countries commit to climate protection, the impact remains minimal. India, China, the U.S., Russia, and many underdeveloped countries contribute significantly to global environmental destruction. In my humble opinion, overpopulation is the biggest problem our planet faces.”

(male, 41 years)

Overall, the distribution of qualitative responses highlights a predominant concern with political action and everyday environmental practices, followed by biodiversity issues and systemic critiques. These findings underscore the diverse perspectives held by participants and the multifaceted nature of environmental discourse. Notably, many participants expressed strong dissatisfaction with political inaction and ineffective environmental policy (“Act now! Bold political decisions. . .”; “Politics should finally take these issues seriously. . .”). While most common among older participants (e.g., 60-year-old women), we suggest that these statements reflect widespread frustration that may underlie the high overall concern for biodiversity. Although this critique is not visible in the quantitative models, it offers context for the strong support for urgent biodiversity protection found in the closed-ended questions. The prevalence of political appeals suggests that biodiversity loss is often seen not merely as an ecological issue, but as a result of policy failure.

In the everyday life theme, expressions of environmental ambivalence mirror the lower concern scores observed among younger participants. For example, some expressed skepticism toward activism (“I’m not a fan of protests about climate change. . .”, a 26-year-old woman said) and emphasized lifestyle-based rather than collective actions. These attitudes may explain the statistically lower, though non-significant, concern scores in this group.

Regarding biodiversity, reports of declining fish populations (“When swimming in Lake Constance, you no longer encounter any fish”) and changes in meadow flora (“Early

mowing of the meadows—many flowers and herbs are gone”) align with quantitative findings showing perceived losses in fish and plant species groups. Notably, fish showed the steepest perceived declines, aligning with global aquatic biodiversity trends. These narratives highlight the importance of these species groups in public perception and support the accuracy of participants’ ecological observations. This connection suggests that personal experiences with environmental changes, especially in the case of freshwater and grassland ecosystems, influence how the public might perceive biodiversity change.

Though less common in our survey, system-critical responses reveal a deeper skepticism toward global structures, including capitalism, economic growth imperatives, and geopolitical inequality (“Our politicians around the globe are knowingly driving us toward catastrophe”, “Overpopulation is the biggest problem. . .”). These views could help explain why some participants express fatalism or detachment from environmental action, especially younger or ambivalent respondents. Such narratives may also underlie the gap between personal concern and behavioral engagement, particularly when structural change is perceived as necessary. Although not captured in the quantitative data on biodiversity change assessed by species groups, this theme adds valuable depth to the understanding of emotional and cognitive responses to environmental change.

3.5. Conceptual Framework: The Drifting Baseline Syndrome

Understanding how people perceive biodiversity change is crucial in assessing public awareness and guiding conservation strategies. Several key psychological and sociological concepts have been widely used to explain altered environmental perceptions over time. The shifting baseline syndrome (SBS) [14,37] and the lifting baseline syndrome (LBS) [18] are key concepts that shape our perception of biodiversity changes in a distinct direction. The existence of a generational amnesia [16] is used to describe the phenomenon where people, especially children, unconsciously accept a degraded environment as normal, as they have no memory or experience of the richer, healthier ecosystems of the past. The idea is closely related to the SBS, highlighting decreases in biodiversity. Generational amnesia emphasizes the psychological process of forgetting, while SBS focuses on the resetting of reference points. These concepts highlight the importance of historical perspective in understanding and addressing biodiversity change [17].

However, the aforementioned explanatory frameworks, SBS and LBS, do not adequately capture the bidirectional shifts in perception that reflect fluctuating biodiversity trends within an individual’s lifetime. While these concepts have provided critical insight into long-term perceptual shifts, they fall short in capturing more nuanced, bidirectional changes in biodiversity perception that occur within individual lifespans. Our findings revealed both perceived increases and decreases in species richness and abundance across different species groups and age groups. This intra-individual variability does not fit neatly into the frameworks of shifting baselines, lifting baselines, or generational amnesia alone.

In the scientific discourse aimed at explaining our findings, specifically the diametrically opposed trends in perceived species richness and abundance, we propose the novel concept of the drifting baseline syndrome (DBS). Figure 3 illustrates three distinct baseline syndromes observed in biodiversity perception over time: the shifting baseline syndrome, characterized by a downward trend; the lifting baseline syndrome, marked by an upward trend; and the drifting baseline syndrome, which reflects fluctuating perceptions. These patterns highlight the complexity of how biodiversity is perceived across generations and contexts. DBS thus bridges and extends existing concepts, offering a more dynamic and nuanced understanding of how people perceive biodiversity change. Unlike SBS or LBS, which imply a unidirectional shift or rebound, DBS accounts for the dynamic nature of personal environmental memory, shaped not only by long-term trends, but also by recent

ecological events, public discourse, and media influences. It acknowledges that people may perceive biodiversity as both declining and improving, depending on the species group, geographic context, and timeframe considered.

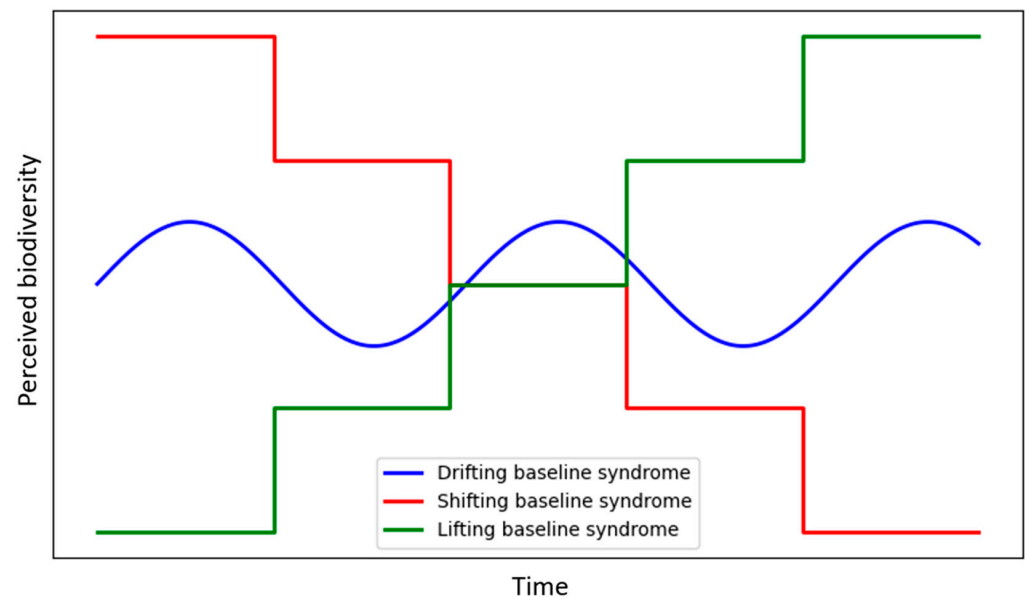


Figure 3. Baseline syndromes over time. The shifting baseline syndrome (red line) shows downward trends in perceived biodiversity, the lifting baseline syndrome (green line) reflects upward trends, and drifting baseline syndrome (blue line) captures fluctuations in perceived biodiversity.

4. Discussion

Biodiversity change is one of the most pressing challenges of our time, reshaping ecosystems and altering the delicate balance of life on Earth [15]. However, biodiversity is not static; it is in a constant state of flux. While many species are disappearing, new ones are emerging, and in some cases, extinct species are making a surprising return, presenting a success story in the face of environmental damage [18]. These changing baselines caused by the dynamics of nature complicate a simple narrative of decline, or rise. Due to their potential public health hazards, the emergence of invasive species like ragweed and tiger mosquitoes have received significant media attention lately [20]. As species arrive, adapt, or vanish, human health remains intricately tied to these changes, as outlined in the One Health framework [38].

These ongoing ecological changes not only have direct implications for human health, but also shape how people perceive and emotionally respond to biodiversity over time. To gain insights into current perceptions of biodiversity change, we conducted a cross-sectional online study assessing self-reported changes in species richness and abundance across various species groups. In this context, we introduce the concept of drifting baseline syndrome (DBS), which describes short-term shifts in individuals' perceptions of nature, shaped by personal experiences and recent environmental changes. Unlike preexisting concepts such as shifting baseline syndrome (SBS), lifting baseline syndrome (LBS), or generational amnesia, which focus on long-term, cross-generational shifts and lifts, DBS captures both short-term increases and decreases in how biodiversity is perceived [14,16,18]. By addressing these more immediate changes, DBS complements existing models and serves as a valuable tool for understanding and communicating how the public perceives ecological change over time.

4.1. Perceived Changes of Species Richness and Abundance

In the present study, species were grouped into broader species categories: insects, birds, plants, fish, fungi, mammals, viruses, and bacteria. The results indicate notable differences in perceived species richness and abundance changes. Vertebrate groups, such as fish and birds, as well as insects, a critical species group for ecosystem functions, were most frequently reported as having decreased [21]. In contrast, mammals and fungi were perceived as more stable, with a high percentage of respondents indicating no change. As for viruses and bacteria, the response pattern differed. The vast majority saw these two species groups increasing significantly, both in terms of species richness and abundance.

This phenomenon could be due to the COVID-19 crisis, which had and still has a major impact on society, changing the awareness of the existence of viruses and probably also bacteria during this phase [39]. However, to be able to make scientifically founded statements as to whether the actual diversity or amount per species has increased or decreased, basic research is needed that aims to encode the entirety of viral and bacterial diversity. Such work already exists, such as the Global Virome Project [40] or the Earth Microbiome Project [41]. This finding underscores the profound influence of current events, such as a global pandemic, on public perceptions of biodiversity, speaking volumes about the influence of societal events on environmental awareness [15,23].

These novel insights push the boundaries of biodiversity change research, emphasizing the importance of continued exploration into how human perception intersects with ecological reality. The high number of “not specified” responses for microbial species we observed in our study likely reflects a limited public familiarity with microbial biodiversity. However, as claimed by the International Microbial Literacy Initiative, “microbes govern our planet” (cited in Ramos et al. [42]). Our finding highlights a broader challenge in biodiversity communication, where invisible or less tangible organisms are often under-represented in public awareness. As such, these results point to the need for enhanced microbial literacy as part of biodiversity education and engagement efforts.

Understanding species perceptions might be crucial in any attempt to measure concepts that touch theoretical frameworks such as the SBS, since different species groups evoke varying levels of awareness and concern. This study explored public perception of biodiversity, distinguishing species richness from abundance. As participants rated both similarly, the distinction might be unnecessary in further studies, reflecting limited public awareness of ecological complexity, as seen in forest biodiversity perceptions [43]. We referred to broad categories like birds and insects rather than specific species, differing from previous research. For instance, Jones et al. focused on ten bird species found in the United Kingdom [37]. In a New Zealand study, Lyver et al. verified the presence of SBS within the Māori community, focusing on six New Zealand-based indicator species, with statistical significance found specifically for three species: a bird (New Zealand pigeon), a fish (long-finned eel), and a mammal (Australian brush-tailed possum) [21]. Our approach was designed to capture a broader understanding of biodiversity changes across various species groups, rather than getting into the specifics of individual species.

4.2. Impact of Age and Gender on Biodiversity Perceptions

This study investigated whether demographic factors such as age and gender play a role in shaping these perceptions, ultimately informing targeted conservation efforts and public awareness campaigns. While our regression models did not identify significant effects of age or gender on perceived biodiversity change, we interpret this as meaningful in itself. It suggests that, within our sample, perceptions of biodiversity change may be shaped more strongly by other factors. These might include media exposure or local ecological contexts, rather than demographic variables like age or gender. This reflects

biodiversity perceptions' complex, multi-dimensional nature beyond sociodemographic factors. The lack of predictors suggests hidden patterns requiring broader frameworks like DBS to capture environmental perception's nuanced dynamics.

Evidence for the SBS, suggesting that older generations are more aware of biodiversity loss due to their longer observations of ecological shifts, was already described globally [13,14,22]. Notably, a study from the Austrian Grosswalsertal found that younger participants had less knowledge about the use of wild plants as medicinal remedies than the older ones. This observation might be attributed to the lack of passing on of traditional knowledge and thus the existence of the SBS can be assumed [44]. A similar study from Bolivia interviewed 300 hunter-gatherers in the Amazon jungle about environmental changes [31]. The authors observed the presence of the SBS, with each generation's perception shaped by its own experiences, often overlooking broader ecological changes.

Our study found significant perception differences between younger and middle-aged groups, with older generations showing greater awareness. However, no significant difference was observed between the two older groups. We observed that individuals aged 61+ years demonstrated the highest awareness. Younger participants (18–40 years) reported fewer changes in species richness and abundance. Interestingly, no difference was found between the two younger groups, challenging the idea that younger individuals are less aware of biodiversity changes. This suggests that generational context, along with psychological and social factors, might play a role in shaping biodiversity perceptions [37]. Previous research supports the notion that younger individuals often possess lower environmental baselines across various contexts, including biodiversity loss [21,22,37]. However, our findings diverge from this pattern, as the middle-aged group did not significantly differ from the older age group in their perceptions, while the youngest group still perceived the lowest biodiversity change.

The interpretation could be manifold. The absence of a statistically significant difference between the 41–60 and 61+ age groups might reflect a convergence in environmental perception that emerges by late middle age. By this point in life, individuals with a distinct geospatial background are likely to have accumulated a broad range of comparable environmental experiences, resulting in similar perceptual baselines [17,22]. This might be particularly true in relatively stable sociocultural contexts, where childhood and adult exposures to nature are shared across adjacent generations. Such a cohort effect could explain the alignment of responses. Additionally, common cultural, educational, and societal influences that shape environmental attitudes in older age may further contribute to this similarity [45]. These findings suggest that beyond a certain age, baseline environmental perceptions may plateau, and additional aging may not significantly alter retrospective assessments.

Factors such as local environmental changes, cultural importance of biodiversity, or recent conservation efforts could influence how different age groups perceive biodiversity [14,17,18,21,37]. Younger individuals might not have been exposed to previous, richer biodiversity levels, shaping their perceptions differently. Perception studies are inherently subjective [13]. Variations in study design, question framing, or respondent interpretation could contribute to differences in the findings across studies. To further investigate these patterns, future research should explore the underlying causes of these intergenerational perception differences.

While prior biodiversity perception research primarily focuses on generational changes in environmental perceptions, there is limited direct examination of gender differences within this context [46]. In this study, we found no significant gender differences in perceptions of biodiversity change, despite existing literature suggesting that women generally exhibit stronger pro-environmental attitudes and behaviors [46–48]. However, our findings suggest that gender may not be a key factor in shaping perceptions of environmental

changes. One possible explanation for this is that the age effect in environmental awareness, a central element of the concepts SBS, LBS, and generational amnesia, may be a more universal phenomenon across genders [17,22]. So, the DBS might be a highly suitable conceptual framework for covering research questions beyond age effects.

Participants in our study could have been equally influenced by exposure to environmental information, regardless of gender. This suggests that the awareness of biodiversity change might be driven more by shared experiences, such as educational outreach or media exposure, rather than by gender-based differences in environmental attitudes [46–48]. Additionally, the context of acute or visible environmental change such as biodiversity loss or high-profile conservation issues may prompt a convergence of concern and awareness across genders, overriding the typical pattern of higher female environmental engagement.

This hypothesis is supported by social psychology literature, which suggests that strong situational cues or widespread environmental threats can reduce demographic differences in perception and behavior. For instance, framing biodiversity loss as a public health risk increased individuals' motivation to engage in sustainable behaviors, regardless of demographic factors [49]. This suggests that when biodiversity loss is perceived as an immediate and personal threat, it can lead to more uniform behavioral responses across different demographic groups. Additionally, individuals with greater contact with nature perceive biodiversity loss as a more immediate threat, which can influence conservation behaviors across diverse populations [50]. This further supports the notion that strong environmental cues can diminish demographic differences in perception and behavior.

In the aforementioned Austrian study on traditional medicinal plants, women were found to have a significantly higher knowledge of their use than men [44]. A 2022 study analyzing climate attitudes across 60 countries found that in wealthier nations, women were more likely than men to express concerns about climate change [51]. This trend is linked to perceptions of mitigation policy costs and benefits, which vary by gender. These studies highlight that while gender can influence environmental perceptions, the effects are not uniform across all contexts. Factors such as cultural background, study population, and specific environmental issues examined can modulate the relationship between gender and environmental perceptions [46,47,51]. If both genders showed similar environmental engagement and the broad biodiversity measures used did not elicit gender-specific response patterns, this may explain the absence of significant differences [21].

Our qualitative analysis suggests that the participants perceived environmental challenges as both systemic and personal, with a strong demand for political actions. This aligns with findings showing widespread public support for climate policies [52]. This is consistent with studies highlighting global biodiversity loss and its long-term ecological consequences, affecting human health via concepts such as One Health or Planetary Health [23,53]. Overall, these findings underscore the need for integrated approaches that combine policy interventions with public engagement [23]. Integrating qualitative and quantitative findings reveals that while statistical models did not yield significant predictors of biodiversity concern by age or gender, the open-ended responses capture nuanced, experience-based insights. Themes such as biodiversity loss were substantiated through direct personal observation, while younger respondents' narratives reflected more individualized and ambivalent forms of engagement. These patterns suggest that quantitative non-significance may stem from high within-group variability.

Our survey revealed an intriguing finding: respondents reported divergent biodiversity trends. Some species groups (e.g., bacteria, viruses) were perceived as increasing, while others (fish, birds) were seen as declining. Potentially reflecting media reports of declining fish populations with global aquatic biodiversity trends, fish showed the steepest declines in our data [14,54]. To account for both upward and downward shifts in perceptions, re-

flecting fluctuating biodiversity trends, throughout an individual's lifetime, we introduced the concept of the drifting baseline syndrome (DBS). Building on the well-established SBS, the DBS emphasizes the continuous evolution of biodiversity perceptions across generations [22]. This concept spans socioeconomic differences, such as age and gender, making it a more holistic framework that does not suggest a tendency towards biodiversity loss and generational amnesia [16].

4.3. Implications of the Drifting Baseline Syndrome

The DBS emphasizes that reference points for evaluating biodiversity swing not only between generations, but also continuously evolve within an individual's lifetime or across short societal timescales [55]. This is particularly true when species become rarer over time: future generations might not realize the loss, as they never experienced an ecosystem where these species were abundant [17]. Ecological change also occurs in the opposite direction, with invasive species spreading and previously lost species, such as wolves and lynxes, recolonizing their former habitats, often leading to massive and complex ecological and societal challenges [20,23]. Similarly, urbanization shapes expectations of nature [56]. As more people grow up in urban environments with limited nature spaces, their understanding of a thriving habitat is also limited [8]. Climate change adds another impactful layer to drifting baselines [57]. As species shift their ranges due to warming temperatures, such as mosquitos, novel ecosystems emerge, which are often accepted as the new normal rather than recognized as signs of disruption [58]. People may perceive these altered ecosystems as stable or natural, even though they reflect profound ecological changes.

To address the DBS, several measures can be implemented. Long-term ecological monitoring could provide objective data on biodiversity changes, reducing reliance on subjective perceptions [1,59]. While the conceptual value of intergenerational learning is well established, practical implementation requires more targeted strategies. To enhance the operability of this recommendation, we suggest integrating best practices from successful case studies. For example, in Canada, the "Etuaptmumk Two-Eyed Seeing" approach has been effectively used to blend Indigenous and Western ecological knowledge across generations in environmental monitoring programs [60]. Biosphere reserves serve as dynamic models for intergenerational knowledge transfer, with initiatives such as the Memories of Biosphere Reserves project exemplifying how storytelling and traditional ecological practices enrich socioecological resilience and foster participatory conservation [61]. Digital tools further support this process by preserving and sharing biocultural heritage across generations. These initiatives illustrate that intergenerational education can be operationalized through structured, place-based learning experiences that foster long-term engagement with biodiversity conservation. Incorporating DBS into conservation strategies enhances the responsiveness of education, monitoring, and policy to the realities of how environmental baselines shift within individuals and societies [54]. Environmental education initiatives should be designed to address not only generational knowledge loss but also the rapid, episodic shifts in perception that characterize the DBS [62]. Integrating longitudinal social monitoring into conservation projects can help identify when and why public baselines drift, enabling timely interventions to counteract complacency or misperceptions. This phenomenon is described as conservation complacency, where conservation actions are undertaken without sufficient consideration of evidence or a lack of systematic decision-making processes [63].

DBS-informed strategies can support the EU Biodiversity Strategy's objectives by ensuring that restoration targets, protected area management, and ecological connectivity efforts are matched by sustained public understanding and support [64]. Embedding

DBS awareness into policy frameworks can help maintain ambition and avoid the pitfalls of changing baselines undermining conservation goals [18,63]. Interventions such as intergenerational storytelling and citizen science can help bridge perception gaps caused by drifting baselines [62,65]. By fostering intergenerational dialogue, these programs raise awareness about the historical context of environmental changes and encourage a deeper connection to the natural world [66]. Similarly, citizen science projects like long-term butterfly or bird counts engage participants in collecting and comparing data year after year [66]. These experiences make environmental change tangible and foster a shared understanding of ecological trends [67]. Citizen science plays a crucial role in monitoring biodiversity and fostering public engagement in conservation, aligning with EU initiatives, emphasizing the importance of public participation in ecological monitoring and knowledge transfer [64].

We suggest that explicitly tackling drifting baseline perceptions can contribute to more effective biodiversity conservation, improved public engagement, and progress toward the Sustainable Development Goals (SDGs), particularly SDG 14 (Life Below Water) and SDG 15 (Life on Land), which emphasize the conservation, restoration, and sustainable use of marine and terrestrial biodiversity [25]. Furthermore, the connection between biodiversity perceptions, human well-being, and environmental change highlights the importance of SDG 3 (Good Health and Well-being) and SDG 13 (Climate Action), since healthy ecosystems underpin both human health and climate adaptation [57].

4.4. Limitations

Several limitations should be considered when interpreting the results of this online survey. To evaluate sample representativeness, distributions of age, gender, region, and main residence were compared to national statistics [36]. While the sample broadly reflected the age structure of the Austrian population, it overrepresented females and rural residents and underrepresented older adults and urban residents. These deviations are in line with expectations for voluntary, self-selected surveys, but should be taken into account when interpreting the findings and acknowledged as potential sources of bias.

As mentioned, the gender distribution of respondents was skewed, with an overrepresentation of female respondents, as found in other studies [37,68]. This might suggest that women are generally more motivated to respond to surveys than men. This response bias might affect the generalizability of the findings to the broader population, as it is possible that the perceptions of men are underrepresented. As a cross-sectional study, this research captures a snapshot of participants' perceptions at a specific point in time, limiting the ability to draw conclusions about long-term trends or causal relationships [69]. Moreover, since the data were based on self-reported responses, they might be subject to social desirability bias. Misinterpretation of survey questions could also contribute to response errors, introducing a potential measurement bias.

We used a ten-year interval for biodiversity assessment to align with common reporting periods in environmental monitoring and to capture recent trends [19]. While this timeframe enhances comparability and recall accuracy, it does not span a full human generation. So, our intra-individual comparisons are limited to the recent decade, and potential generational shifts in biodiversity perception or experience might not be fully reflected. The sample size of about 900 respondents was substantial, but it may not be fully representative of the broader general population. Rural, older, or less-connected populations might be underrepresented, which could affect the generalizability of baseline perceptions reported here. Selection bias could have occurred if participants with certain characteristics, such as higher awareness or concern about biodiversity, were more likely to participate. The survey's reliance on an online platform could have introduced another

limitation. It may have excluded individuals who are less familiar with technology or who lack internet access, further limiting the representativeness of the sample [70].

Survey validation and qualitative coding procedures were implemented to ensure methodological rigor and transparency. Nevertheless, future research should address the aforementioned limitations by ensuring a more diverse sample, both in terms of gender, geographic location, and other demographic factors. Large-scale longitudinal and mixed-methods studies would provide valuable insights into how perceptions of biodiversity change evolve over time, while strategies to minimize response and selection biases could improve the accuracy of future findings.

5. Conclusions

The present study introduces the novel concept of a drifting baseline syndrome, capturing the dynamic nature of biodiversity perceptions beyond generational shifts. We found that the majority of participants acknowledged a decline in visible species, such as fish, mammals, insects, fungi, birds, and plants. Paradoxically, they perceived an increase in the species richness and abundance of bacteria and viruses. We introduced the concept of the drifting baseline syndrome to account for both increases and decreases in biodiversity over an individual's lifetime. This notion suggests that perceptions of biodiversity across age groups evolve continuously, as biodiversity fluctuates among species and geospatial levels. This ongoing change leads to altered perceptions of what constitutes a “normal” environment, reducing the apparent urgency for conservation.

Public awareness of biodiversity change might not align with ecological realities, especially in the context of urbanization and climate change. To mitigate this, long-term ecological monitoring and intergenerational knowledge sharing through education and citizen science projects are crucial. Future research should explore how biodiversity changes are perceived, while an integrated approach combining individual behavior changes with policy interventions can better support conservation efforts.

Author Contributions: Conceptualization, D.H.; data curation, D.H. and G.W.; formal analysis, G.W.; investigation, G.W.; methodology, D.H.; project administration, D.H.; resources, D.H. and G.W.; software, G.W.; supervision, D.H.; validation, D.H.; visualization, D.H.; writing—original draft, D.H. and G.W.; writing—review and editing, D.H. and G.W. All authors have read and agreed to the published version of the manuscript.

Funding: This research did not receive any funding.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Institutional Review Board of the Medical University Vienna (reference: 2024-04-18/01637251).

Informed Consent Statement: All subjects provided their informed consent for inclusion before they participated in this study.

Data Availability Statement: The complete dataset is available upon request from the corresponding author. The paper was based on the diploma thesis “Elucidating the shifting baseline syndrome: A cross-sectional online survey” of 2024 by Gerald Wagner, supervised by Daniela Haluza.

Acknowledgments: We would like to thank all pre-testers of the survey and the participants of the for their time and commitment.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Lazar, L.; Spanu, A.; Boicenco, L.; Oros, A.; Damir, N.; Bisinicu, E.; Abaza, V.; Filimon, A.; Harcota, G.; Marin, O.; et al. Methodology for prioritizing marine environmental pressures under various management scenarios in the Black Sea. *Front. Mar. Sci.* **2024**, *11*, 2024. [\[CrossRef\]](#)
2. Jaureguiberry, P.; Titeux, N.; Wiemers, M.; Bowler, D.E.; Coscieme, L.; Golden, A.S.; Guerra, C.A.; Jacob, U.; Takahashi, Y.; Settele, J.; et al. The direct drivers of recent global anthropogenic biodiversity loss. *Sci. Adv.* **2022**, *8*, eabm9982. [\[CrossRef\]](#)
3. Jones, C.G.; Lawton, J.H.; Shachak, M. Organisms as ecosystem engineers. *Oikos* **1994**, *69*, 373–386. [\[CrossRef\]](#)
4. Keck, F.; Peller, T.; Alther, R.; Barouillet, C.; Blackman, R.; Capo, E.; Chonova, T.; Couton, M.; Fehlinger, L.; Kirschner, D.; et al. The global human impact on biodiversity. *Nature* **2025**, *641*, 395–400. [\[CrossRef\]](#) [\[PubMed\]](#)
5. Wang, Z.; Wang, T.; Zhang, X.; Wang, J.; Yang, Y.; Sun, Y.; Guo, X.; Wu, Q.; Nepovimova, E.; Watson, A.E.; et al. Biodiversity conservation in the context of climate change: Facing challenges and management strategies. *Sci. Total Environ.* **2024**, *937*, 173377. [\[CrossRef\]](#) [\[PubMed\]](#)
6. Travis, D.A.; Alpern, J.D.; Convertino, M.; Craft, M.; Gillespie, T.R.; Kennedy, S.; Robertson, C.; Shaffer, C.A.; Stauffer, W. Biodiversity and health. In *Beyond One Health: From Recognition to Results*; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2018; pp. 155–177.
7. Haahtela, T.; Holgate, S.; Pawankar, R.; Akdis, C.A.; Benjaponpitak, S.; Caraballo, L.; Demain, J.; Portnoy, J.; von Hertzen, L. The biodiversity hypothesis and allergic disease: World allergy organization position statement. *World Allergy Organ. J.* **2013**, *6*, 3. [\[CrossRef\]](#)
8. Ruokolainen, L.; Lehtimäki, J.; Karkman, A.; Haahtela, T.; von Hertzen, L.; Fyhrquist, N. Holistic View on Health: Two Protective Layers of Biodiversity. *Ann. Zool. Fenn.* **2017**, *54*, 39–49. [\[CrossRef\]](#)
9. Braun, K.; Haluza, D. Impact of Biodiversity Loss on Pollen Allergies: A Bibliometric Analysis. *Sustainability* **2024**, *16*, 9285. [\[CrossRef\]](#)
10. Bowler, D.E.; Buyung-Ali, L.M.; Knight, T.M.; Pullin, A.S. A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health* **2010**, *10*, 456. [\[CrossRef\]](#)
11. Marselle, M.R.; Lindley, S.J.; Cook, P.A.; Bonn, A. Biodiversity and Health in the Urban Environment. *Curr. Environ. Health Rep.* **2021**, *8*, 146–156. [\[CrossRef\]](#)
12. Haluza, D.; Kersten, P.; Lazic, T.; Steinparzer, M.; Godbold, D. Unlocking the Power of Nature: Insights from a 20-Minute Forest Visit on Well-Being. *Forests* **2025**, *16*, 792. [\[CrossRef\]](#)
13. Hanazaki, N.; Herbst, D.F.; Marques, M.S.; Vandeboeck, I. Evidence of the shifting baseline syndrome in ethnobotanical research. *J. Ethnobiol. Ethnomedicine* **2013**, *9*, 75. [\[CrossRef\]](#)
14. Pauly, D. Anecdotes and the shifting baseline syndrome of fisheries. *Trends Ecol. Evol.* **1995**, *10*, 430. [\[CrossRef\]](#)
15. Jarić, I.; Roll, U.; Bonaiuto, M.; Brook, B.W.; Courchamp, F.; Firth, J.A.; Gaston, K.J.; Heger, T.; Jeschke, J.M.; Ladle, R.J.; et al. Societal extinction of species. *Trends Ecol. Evol.* **2022**, *37*, 411–419. [\[CrossRef\]](#)
16. Kahn, P.H.; Kellert, S.R. *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations*; MIT Press: Cambridge, MA, USA, 2002.
17. Soga, M.; Gaston, K.J. Shifting baseline syndrome: Causes, consequences, and implications. *Front. Ecol. Environ.* **2018**, *16*, 222–230. [\[CrossRef\]](#)
18. Roman, J.; Dunphy-Daly, M.M.; Johnston, D.W.; Read, A.J. Lifting baselines to address the consequences of conservation success. *Trends Ecol. Evol.* **2015**, *30*, 299–302. [\[CrossRef\]](#)
19. Essl, F.; Latombe, G.; Lenzner, B.; Pagad, S.; Seebens, H.; Smith, K.; Wilson, J.R.; Genovesi, P. The Convention on Biological Diversity (CBD)'s Post-2020 target on invasive alien species—what should it include and how should it be monitored? *NeoBiota* **2020**, *62*, 99–121. [\[CrossRef\]](#)
20. Peller, T.; Altermatt, F. Invasive species drive cross-ecosystem effects worldwide. *Nat. Ecol. Evol.* **2024**, *8*, 1087–1097. [\[CrossRef\]](#)
21. Lyver, P.O.; Timoti, P.; Richardson, S.J.; Gormley, A.M. Alignment of ordinal and quantitative species abundance and size indices for the detection of shifting baseline syndrome. *Ecol. Appl.* **2021**, *31*, e02301. [\[CrossRef\]](#)
22. Soga, M.; Gaston, K.J. Global synthesis indicates widespread occurrence of shifting baseline syndrome. *BioScience* **2024**, *74*, 686–694. [\[CrossRef\]](#)
23. Kleespies, M.W.; Hahn-Klimroth, M.; Dierkes, P.W. Perceptions of biodiversity loss among future decision-makers in 37 countries. *npj Biodiversity* **2024**, *3*, 21. [\[CrossRef\]](#)
24. Cardinale, B.J.; Duffy, J.E.; Gonzalez, A.; Hooper, D.U.; Perrings, C.; Venail, P.; Narwani, A.; Mace, G.M.; Tilman, D.; Wardle, D.A.; et al. Biodiversity loss and its impact on humanity. *Nature* **2012**, *486*, 59–67. [\[CrossRef\]](#)
25. United Nations Sustainable Development Goals. Available online: <https://sdgs.un.org/goals> (accessed on 21 May 2025).
26. SoSci Survey; Version 3.1.06; SoSci: Munich, Germany, 2019. Available online: <https://www.sosicisurvey.de> (accessed on 21 May 2025).

27. Kati, V.; Devillers, P.; Dufrêne, M.; Legakis, A.; Vokou, D.; Lebrun, P. Testing the Value of Six Taxonomic Groups as Biodiversity Indicators at a Local Scale. *Conserv. Biol.* **2004**, *18*, 667–675. [\[CrossRef\]](#)
28. Rozario, K.; Oh, R.R.Y.; Marselle, M.; Schröger, E.; Gillerot, L.; Ponette, Q.; Godbold, D.; Haluza, D.; Kilpi, K.; Müller, D.; et al. The more the merrier? Perceived forest biodiversity promotes short-term mental health and well-being—A multicentre study. *People Nat.* **2024**, *6*, 180–201. [\[CrossRef\]](#)
29. IPBES. *Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*; IPBES: Bonn, Germany, 2019; p. 1148.
30. Carr, H.; Abas, M.; Boutahar, L.; Caretti, O.N.; Chan, W.Y.; Chapman, A.S.; de Mendonça, S.N.; Engleman, A.; Ferrario, F.; Simmons, K.R. The Aichi Biodiversity Targets: Achievements for marine conservation and priorities beyond 2020. *PeerJ* **2020**, *8*, e9743. [\[CrossRef\]](#)
31. Fernández-Llamazares, Á.; Díaz-Reviriego, I.; Luz, A.C.; Cabeza, M.; Pyhälä, A.; Reyes-García, V. Rapid ecosystem change challenges the adaptive capacity of Local Environmental Knowledge. *Glob. Environ. Change* **2015**, *31*, 272–284. [\[CrossRef\]](#)
32. Jungwirth, D.; Gahbauer, S.; Haluza, D. Perceived Impact of the COVID-19 Pandemic on Playing Golf: A Qualitative Content Analysis Study. *Hygiene* **2023**, *3*, 45–56. [\[CrossRef\]](#)
33. Tong, A.; Sainsbury, P.; Craig, J. Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. *Int. J. Qual. Health Care* **2007**, *19*, 349–357. [\[CrossRef\]](#)
34. R Core Team. *R: A Language and Environment for Statistical Computing*; R Foundation for Statistical Computing: Vienna, Austria, 2023.
35. SPSS IBM Statistics for Windows; Version 29.0; IBM Corp: Armonk, NY, USA, 2022.
36. myCompiler Python; Version 3.11.4.; Python Software Foundation: Wilmington, DE, USA, 2023. Available online: <https://www.mycompiler.io> (accessed on 21 May 2025).
37. Statistik Austria *Demographisches Jahrbuch 2022*; Statistik Austria: Vienna, Austria, 2023.
38. Jones, L.P.; Turvey, S.T.; Massimino, D.; Papworth, S.K. Investigating the implications of shifting baseline syndrome on conservation. *People Nat.* **2020**, *2*, 1131–1144. [\[CrossRef\]](#)
39. Lapinski, M.K.; Funk, J.A.; Moccia, L.T. Recommendations for the role of social science research in One Health. *Soc. Sci. Med.* **2015**, *129*, 51–60. [\[CrossRef\]](#)
40. Dikken, B. Alles sauber? *Pflegezeitschrift* **2021**, *74*, 22–23. [\[CrossRef\]](#)
41. Carroll, D.; Daszak, P.; Wolfe, N.D.; Gao, G.F.; Morel, C.M.; Morzaria, S.; Pablos-Méndez, A.; Tomori, O.; Mazet, J.A. The global virome project. *Science* **2018**, *359*, 872–874. [\[CrossRef\]](#)
42. Gilbert, J.A.; Jansson, J.K.; Knight, R. The Earth Microbiome project: Successes and aspirations. *BMC Biol.* **2014**, *12*, 69. [\[CrossRef\]](#)
43. Ramos, J.L.; Lal, R.; Colom, F.; Chavarria, M.; Huang, W.; Wang, Y.; Udaondo, Z.; Timmis, K.N. Unlocking the Microbial World: A Global Initiative for Education and Sustainability. *Microb. Biotechnol.* **2025**, *18*, e70124. [\[CrossRef\]](#)
44. Gillerot, L.; Landuyt, D.; Bourdin, A.; Rozario, K.; Shaw, T.; Steinparzer, M.; Stojek, K.; Vanroy, T.; Cuentas Romero, A.G.; Müller, S.; et al. Forest biodiversity and structure modulate human health benefits and risks. *Nat. Sustain.* **2025**, *8*, 485–497. [\[CrossRef\]](#)
45. Schunko, C.; Grasser, S.; Vogl, C.R. Intracultural variation of knowledge about wild plant uses in the Biosphere Reserve Grosses Walsertal (Austria). *J. Ethnobiol. Ethnomedicine* **2012**, *8*, 23. [\[CrossRef\]](#)
46. Mazer, S.E. A Living Trilogy: Aging, Perception, and Environment. *J. Res. Soc. Sci. Humanit.* **2023**, *2*, 7–23. [\[CrossRef\]](#)
47. Xiao, C.; McCright, A.M. Gender Differences in Environmental Concern: Revisiting the Institutional Trust Hypothesis in the USA. *Environ. Behav.* **2015**, *47*, 17–37. [\[CrossRef\]](#)
48. Milfont, T.L.; Sibley, C.G. Empathic and social dominance orientations help explain gender differences in environmentalism: A one-year Bayesian mediation analysis. *Personal. Individ. Differ.* **2016**, *90*, 85–88. [\[CrossRef\]](#)
49. Bosone, L.; Chaurand, N.; Chevrier, M. To change or not to change? Perceived psychological barriers to individuals' behavioural changes in favour of biodiversity conservation. *Ecosyst. People* **2022**, *18*, 315–328. [\[CrossRef\]](#)
50. Joshi, A. Motivating sustainable behaviors by framing biodiversity loss as a public health risk. *J. Risk Res.* **2022**, *25*, 156–175. [\[CrossRef\]](#)
51. Bosone, L.; Bertoldo, R. The Greater the Contact, the Closer the Threat: The Influence of Contact with Nature on the Social Perception of Biodiversity Loss and the Effectiveness of Conservation Behaviours. *Sustainability* **2022**, *14*, 16490. [\[CrossRef\]](#)
52. Bush, S.S.; Clayton, A. Facing Change: Gender and Climate Change Attitudes Worldwide. *Am. Political Sci. Rev.* **2023**, *117*, 591–608. [\[CrossRef\]](#)
53. Andre, P.; Boneva, T.; Chopra, F.; Falk, A. Globally representative evidence on the actual and perceived support for climate action. *Nat. Clim. Change* **2024**, *14*, 253–259. [\[CrossRef\]](#)
54. Dasandi, N.; Graham, H.; Hudson, D.; Jankin, S.; vanHeerde-Hudson, J.; Watts, N. Positive, global, and health or environment framing bolsters public support for climate policies. *Commun. Earth Environ.* **2022**, *3*, 239. [\[CrossRef\]](#)

55. Smit, K.P.; Van Niekerk, L.; Harris, L.R.; McQuatters-Gollop, A.; Shannon, L.J.; Sink, K.J. A Roadmap to Advance Marine and Coastal Monitoring, Biodiversity Assessment, and International Reporting: A Developing Nation Perspective. *Front. Mar. Sci.* **2022**, *9*, 2022. [\[CrossRef\]](#)
56. Monsarrat, S.; Novellie, P.; Rushworth, I.; Kerley, G. Shifted distribution baselines: Neglecting long-term biodiversity records risks overlooking potentially suitable habitat for conservation management. *Philos. Trans. R. Soc. B Biol. Sci.* **2019**, *374*, 20190215. [\[CrossRef\]](#)
57. Haluza, D.; Meyer, I.; Strüver, A.; Exner, A. Introducing a Scale for Measuring Attachment to Urban Green. *Urban. Sci.* **2024**, *8*, 62. [\[CrossRef\]](#)
58. Prober, S.M.; Raisbeck-Brown, N.; Porter, N.B.; Williams, K.J.; Leviston, Z.; Dickson, F. Recent climate-driven ecological change across a continent as perceived through local ecological knowledge. *PLoS ONE* **2019**, *14*, e0224625. [\[CrossRef\]](#)
59. Capari, L.; Wilfing, H.; Exner, A.; Höflehner, T.; Haluza, D. Cooling the City? A Scientometric Study on Urban Green and Blue Infrastructure and Climate Change-Induced Public Health Effects. *Sustainability* **2022**, *14*, 4929. [\[CrossRef\]](#)
60. Damiani, M.; Sinkko, T.; Caldeira, C.; Tosches, D.; Robuchon, M.; Sala, S. Critical review of methods and models for biodiversity impact assessment and their applicability in the LCA context. *Environ. Impact Assess. Rev.* **2023**, *101*, 107134. [\[CrossRef\]](#)
61. Bujold, R.; Fox, A.; Propser, K.; Pictou, K.; Martin, D. Etuaptmumk—Two-eyed seeing: Bringing together land-based learning and online technology to teach Indigenous youth about food. *Can. Food Stud.* **2022**, *8*, 49–63. [\[CrossRef\]](#)
62. Rollo, M.F. Interconnected Nature and People: Biosphere Reserves and the Power of Memory and Oral Histories as Biocultural Heritage for a Sustainable Future. *Sustainability* **2025**, *17*, 4030. [\[CrossRef\]](#)
63. Spellman, K.V.; Cost, D.; Villano, C.P. Connecting Community and citizen science to stewardship action planning through scenarios storytelling. *Front. Ecol. Evol.* **2021**, *9*, 695534. [\[CrossRef\]](#)
64. Lindenmayer, D.; Wood, J.; McBurney, L.; MacGregor, C.; Youngentob, K.; Banks, S. How to make a common species rare: A case against conservation complacency. *Biol. Conserv.* **2011**, *144*, 1663–1672. [\[CrossRef\]](#)
65. Hermoso, V.; Carvalho, S.; Giakoumi, S.; Goldsborough, D.; Katsanevakis, S.; Leontiou, S.; Markantonatou, V.; Rumes, B.; Vogiatzakis, I.; Yates, K. The EU Biodiversity Strategy for 2030: Opportunities and challenges on the path towards biodiversity recovery. *Environ. Sci. Policy* **2022**, *127*, 263–271. [\[CrossRef\]](#)
66. Walker, C.; van Holstein, E.; Klocker, N. Young people at a crossroads: Climate solidarity through intergenerational storytelling. *Geogr. Res.* **2025**, *63*, 153–168. [\[CrossRef\]](#)
67. Dennis, E.B.; Morgan, B.J.; Brereton, T.M.; Roy, D.B.; Fox, R. Using citizen science butterfly counts to predict species population trends. *Conserv. Biol.* **2017**, *31*, 1350–1361. [\[CrossRef\]](#)
68. Bonter, D.N.; Greig, E.I. Over 30 years of standardized bird counts at supplementary feeding stations in North America: A citizen science data report for Project FeederWatch. *Front. Ecol. Evol.* **2021**, *9*, 619682. [\[CrossRef\]](#)
69. Döring, N.; Bortz, J. *Forschungsmethoden und Evaluation*; Springer: Wiesbaden, Germany, 2016.
70. Eysenbach, G. Improving the quality of Web surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *J. Med. Internet Res.* **2004**, *6*, e34. [\[CrossRef\]](#)

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.