

# Corporate Biodiversity Risk and Concern: Evidence from Indian Firms and Industry-Level Insights

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## Abstract

This study presents time-series indices that measure biodiversity risk exposure and concern among publicly listed Indian firms within the BSE 500 index, covering the period from 2000 to 2023. Using text-as-data techniques, we analyse annual reports to construct two indices- the Biodiversity Risk Index and the Biodiversity Concern Index. These indices capture the frequency and emphasis on biodiversity-related terms, reflecting firms' exposure to biodiversity risks and the level of concern expressed. Our findings reveal an upward trend in attention to biodiversity, with notable variations across industries. Sectors such as energy & utilities and materials & chemicals exhibit higher exposure to biodiversity risks. Additionally, the alignment between the biodiversity indices and the Climate Policy Uncertainty Index underscores the growing interconnectedness between climate policy uncertainties and biodiversity risks.

*Keywords:* Biodiversity; Indian corporate finance; Risk exposure *JEL Code:* Q3

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## 1. Introduction

Global economies are facing ecosystem risks from human-induced biodiversity loss ([Cabirol et al., 2023]), with a lack of commitment leading to financial setbacks for firms and increasing the risk of new pandemics. As stated by [Kulionis et al., 2024], firms incur financial losses by ignoring biodiversity risks, as they depend on natural resources for their economic stability. Approximately \$7.2 trillion of enterprise value is exposed to biodiversity risks ([Carvalho et al., 2023]). Biodiversity risks pose challenges to supply chains, as production inputs from one region impact natural ecosystems elsewhere, necessitating industry-specific strategies to mitigate these risks ([Kulionis et al., 2024]). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has called for coordinated global action to maintain biodiversity balance ([Stokstad, 2019]). Studies by [Dasgupta, 2024] and [Giglio et al., 2023] highlight the economic impact of biodiversity loss on firms' performance. Firms focusing on biodiversity conservation efforts often experience enhanced reputations ([Roberts et al., 2021]), and those managing risks achieve better financial outcomes, such as improved stock performance during biodiversity-related policy events ([Kalhor and Kyaw, 2024]). Impact investing through bonds provides financial returns alongside biodiversity benefits ([Thompson, 2023]). Investors increasingly rely on metrics to evaluate and reward firms for their biodiversity efforts ([Layman et al., 2024]). Additionally, institutional investors are now seeking biodiversity-related disclosures to monitor firms' environmental commitments ([Ali et al., 2024]). Although significant progress has been made in assessing firms' commitments to mitigating biodiversity risks, most of these efforts have focused on developed countries. Recently, [He et al., 2024] developed biodiversity-related indices for China; however, in India—a country under significant biodiversity pressure due to economic growth ([Farooq et al., 2023]; [Ritu and Kaur, 2024]), there is still a lack of metrics to measure firms' biodiversity commitments. [Zhu et al., 2024] has highlighted the need for more and better micro level data, such as corporate biodiversity risk indices, to assist in ecological management. Our study addresses this gap by focusing on Indian firms in the BSE 500 index, analysing annual reports to develop two indices: the biodiversity risk index and the biodiversity concern index. These indices quantify firms' biodiversity risks and concerns, providing tools for stakeholders to guide sustainability strategies. Our research highlights biodiversity risk exposure among Indian companies, emphasizing

the need to incorporate biodiversity into corporate strategies, supporting broader efforts to mitigate biodiversity loss and promote sustainable development. The paper is organized as follows: Section 2 outlines the data sources. Section 3 describes the method for constructing the biodiversity risk indices, Section 4 presents the empirical findings, discussing key trends, industry-specific patterns, and temporal changes observed in the data. Section 5 presents the conclusion followed by Section 6 discussing policy implications.

## 2. Data

This study uses data obtained from the annual reports of publicly listed Indian companies, specifically those within the BSE 500 index, bridging the years 2000 to 2023. The choice to analyse these annual reports is based in their ability to disclose a company’s strategic focus towards biodiversity-related concerns. Given that businesses are key contributors to biodiversity conservation and play a critical role in promoting sustainability, the importance they place on biodiversity in these reports functions as an indicator of their commitment to biodiversity. This methodology is uniform with prior research that leverages annual reports to evaluate firms’ commitment with biodiversity issues

## 3. Methodology

We employ a text analysis method to measure the extent of firm’s focus on biodiversity. Our method commences by referencing the biodiversity dictionary developed by ([He et al., 2024], [Giglio et al., 2023]) which covers terms such as biodiversity, ecosystems, ecology/ecological, habitats, species, (rain)forests, deforestation, fauna, flora, marine, tropical, freshwater, wetlands, wildlife, coral, aquatic, desertification, carbon sinks, ecosphere, and biosphere. Next, we executed text mining on the annual reports from BSE 500 index firms, calculating the occurrences of these biodiversity-related terms. To create the biodiversity risk index, we allotted a value of 1 if the term appeared more than twice in a report and 0 otherwise. Additionally, we calculated the total character count of these keywords and calculated the biodiversity concern index by dividing the biodiversity keyword character count by the total character count of the report. These methods allowed us to determine biodiversity indices at the firm-year level. We provide a downloadable set of indices [here](#), conditional on citation of this paper.

### 3.1. Data description

Table 1 presents descriptive statistics for biodiversity risk and biodiversity concern across industry types, highlighting the mean and standard deviations (SD) for both indices. The number of firms (N) within each industry type is also reported. The Energy Utilities industry shows the highest average biodiversity risk (0.163, indicating 16% of companies on average report risk), accompanied by the largest variability. Similarly, the Materials & Chemicals sector shows a relatively high biodiversity risk (13%) with substantial variability. On the lower end, Media & Communication reports the smallest biodiversity risk with only 2% of companies reporting. In terms of biodiversity *concern*, Transportation Logistics shows the highest average value with considerable variation followed by Energy Utilities. Meanwhile, service-oriented sectors like Media Communication and \*Financial Services show lower biodiversity risks and concern. Chinese data ([He et al., 2024]) suggest Agriculture and then Water related industries to have the highest risk reportage, at significantly higher percentages ranging to 80%, and US data ([Giglio et al., 2023]) show significantly lower rates, the average never more than 5%. Indian levels sit between the USA at the lower bound and the Chinese at the higher.

### 3.2. Results

Figure 1 presents the trend of two biodiversity-related indices, namely the biodiversity risk index and the biodiversity concern index, over time from 2000 to 2023. The left y-axis displays the values for the biodiversity risk index, while the right y-axis shows the values for the biodiversity concern index, with both indices plotted against time on the x-axis. From the figure, it is evident that both indices exhibit a gradual upward trend, indicating an increasing emphasis and potential risk associated with biodiversity over the years. The biodiversity concern index, represented in blue, follows a relatively steady path between 2000 and 2015, with minor fluctuations. However, a notable surge is observed after 2015, particularly from 2018 onwards, where the growth becomes more pronounced, peaking sharply by 2023. This trend suggests that corporate discourse around biodiversity concerns has gained significant traction in recent years. This mirrors the Chinese data, albeit as noted at a lower level, and to some extent the USA, at a much lower level. Similarly, the biodiversity risk index, depicted in red, shows a relatively flat trend with modest increases up until 2015. Following this period, there is a discernible upward trajectory, with the rate of growth accelerating around 2018 and aligning closely with the rise of

the biodiversity concern index. The concurrent rise in both indices highlights a growing integration of biodiversity-related concerns into corporate strategies and disclosures. The alignment of the trends post-2018 suggests a convergence between recognizing biodiversity risks and actively reporting on related concerns. This pattern aligns with global trends emphasizing environmental, social, and governance (ESG) principles, as well as the increasing adoption of frameworks such as the Task Force on Nature-related Financial Disclosures (TNFD). In the particular Indian context the adoption of the Business Responsibility Reporting Framework which rolled out over that period can also be seen as a contributory factor (see [Aggarwal and Singh, 2019])

Figure 3 illustrates the biodiversity risk and Figure 4 biodiversity concern indices across various industry types. energy & utilities has the highest biodiversity risk, followed by materials & chemicals and transportation & logistics. other industry types, including retail & consumer goods and miscellaneous industries, exhibit moderate biodiversity risk. on the lower end, media & communication, financial services, and machinery & equipment show the least biodiversity risk. Transportation & logistics display the highest level of biodiversity concern, closely followed by energy & utilities and others. materials & chemicals, construction & infrastructure, and food & beverages show moderate concern levels. the lowest biodiversity concern is recorded for media & communication and miscellaneous industries. Again all show significant J-shapes, with the indices showing low levels until the 2015-2018 period then rising significantly.

Figure 6 examines whether the climate policy uncertainty (CPU) index ([Lin and Zhao, 2023]) indices here display similar trends over time. initially, between 2000 and 2015, the three indices displayed distinct patterns, with the CPU index (green line) exhibiting greater volatility and fluctuations, while the biodiversity indices (black and grey lines) remained relatively stable. however, from 2015 onward, a clearer synchronization emerges, as all three indices begin to rise steadily. The alignment becomes particularly evident post-2020, where the upward trajectories of the CPU, biodiversity concern, and biodiversity risk indices are closely aligned, suggesting a growing interconnection between climate policy uncertainty and corporate attention to biodiversity. this convergence indicates that as climate-related policies become more uncertain, companies are increasingly factoring biodiversity risks and concerns into their reporting and strategies, implying that these two dimensions are moving in tandem over time.

## 4. Conclusion

This study underscores the growing importance of biodiversity risks and concerns in the corporate strategies of Indian firms. through the development of two indices we provide quantifiable insights into how businesses are integrating biodiversity-related issues into their operations and disclosures. the results reveal a steady rise in both indices over the years, with an accelerated upward trend after 2018, suggesting that biodiversity has become a focal point in corporate sustainability efforts. our findings also highlight significant variations across industry types, with sectors such as energy & utilities, materials & chemicals, and transportation & logistics exhibiting higher biodiversity risks and concerns compared to service-oriented industries like media & communication and financial services. The synchronization observed between the biodiversity indices and the climate policy uncertainty (CPU) index further emphasizes the interconnected nature of climate policies and biodiversity commitments. this alignment suggests that firms are increasingly responding to both environmental risks and policy uncertainties by adopting a more integrated approach to sustainability. as businesses face mounting pressure from stakeholders, investors, and regulators to disclose biodiversity-related risks, the importance of comprehensive reporting and active mitigation strategies becomes more pronounced. While this study provides new insights into biodiversity reporting practices among Indian firms, it also identifies key challenges. India, with its rapid economic growth and considerable biodiversity pressures, lacks a standardized framework for biodiversity disclosures comparable to global benchmarks. This research bridges that gap by offering firm-level biodiversity indices, which can serve as a starting point for stakeholders seeking to evaluate biodiversity risks and guide sustainability strategies.

### *4.1. Policy Implications*

This study offers actionable insights for various stakeholders, including regulators, policymakers, investors, and external stakeholders. Firstly, having a standardized metric related to biodiversity is a step toward transparent reporting and better risk assessment. Regulators can use this metric to formulate industry-wise policies to promote biodiversity disclosures and ensure that industries with higher biodiversity risk and concern are aligned with sustainability goals. Policymakers can integrate these metrics (biodiversity risk and concern) into environmental governance frameworks to monitor progress toward

ecosystem conservation. For investors and institutional investors, it is crucial to assess a firm's environmental risk and guide their ESG investments. These metrics can serve as reliable tools for sound decision-making, rewarding firms that demonstrate stronger performance, and lastly, India-specific biodiversity indices are a way forward to showcase corporate India achievements in achieving the SDG goals, as these metrics help firms to showcase their tangible achievements in biodiversity conservation efforts, building trust among various stakeholders.

## References

- Aggarwal, P. and A. K. Singh (2019). Csr and sustainability reporting practices in india: an in-depth content analysis of top-listed companies. *Social Responsibility Journal* 15(8), 1033–1053.
- Ali, R., I.-M. García-Sánchez, B. Aibar-Guzmán, and R. u. Rehman (2024). Is biodiversity disclosure emerging as a key topic on the agenda of institutional investors? *Business Strategy and the Environment* 33(3), 2116–2142.
- Cabirol, A., T. Gómez-Moracho, C. Monchanin, C. Pasquaretta, and M. Lihoreau (2023). Considering variation in bee responses to stressors can reveal potential for resilience. *Journal of Applied Ecology* 60(7), 1435–1445.
- Carvalho, S. H. C. D., T. Cojoianu, and F. Ascui (2023). From impacts to dependencies: A first global assessment of corporate biodiversity risk exposure and responses. *Business Strategy and the Environment* 32(5), 2600–2614. Accessed: 2024-10-11.
- Dasgupta, P. (2024). *The economics of biodiversity*. Cambridge University Press. Accessed: 2024-10-11.
- Farooq, U., S. Gillani, B. H. Subhani, and M. N. Shafiq (2023). Economic policy uncertainty and environmental degradation: the moderating role of political stability. *Environmental Science and Pollution Research* 30(7), 18785–18797.
- Giglio, S., T. Kuchler, J. Stroebe, and X. Zeng (2023). Biodiversity risk. Accessed: 2024-10-11.
- He, F., B. M. Lucey, and L. Chen (2024). Chinese corporate biodiversity exposure. *Available at SSRN*.
- Kalhor, M. R. and K. Kyaw (2024). Manage biodiversity risk exposure? *Finance Research Letters* 61, 104989.
- Kulionis, V., S. Pfister, and J. Fernandez (2024). Biodiversity impact assessment for finance. *Journal of Industrial Ecology* 28(5), 1321–1335. Accessed: 2024-10-11.
- Layman, H., H. R. Akçakaya, A. Irwin, S. zu Ermgassen, P. Addison, and M. Burgman (2024). Short-term solutions to biodiversity conservation in portfolio construction: Forward-looking disclosure and classification-based metrics. *Business Strategy and the Environment* 33(3), 1778–1793.
- Lin, B. and H. Zhao (2023). Tracking policy uncertainty under climate change. *Resources Policy* 83, 103699.
- Ritu, R. K. and A. Kaur (2024). Towards environmental sustainability: nexus of ecological footprint, human capital, economic growth and energy consumption in india. *Management of Environmental Quality: An International Journal* 35(1), 179–200.



- Roberts, L., M. Nandy, A. Hassan, S. Lodh, and A. A. Elamer (2021). Corporate accountability towards species extinction protection: insights from ecologically forward-thinking companies. *Journal of Business Ethics*, 1–25.
- Stokstad, E. (2019). Can a dire ecological warning lead to action? *Science* 364(6440), 517–518. Accessed: 2024-10-11.
- Thompson, B. S. (2023). Impact investing in biodiversity conservation with bonds: An analysis of financial and environmental risk. *Business Strategy and the Environment* 32(1), 353–368.
- Zhu, Y., G. W. Prescott, P. Chu, and L. R. Carrasco (2024). Glaring gaps in tools to estimate businesses’ biodiversity impacts hinder alignment with the kunming-montreal global biodiversity framework. *Journal of Cleaner Production* 451, 142079.

Table 1: Distribution of Biodiversity Risk and Biodiversity Concern over Industry

		Biodiversity Risk		Biodiversity Concern	
Industry Type	N	Mean	SD	Mean	SD
Media & Communication	10	2.00	14.05	60.00	82.00
Machinery & Equipment	25	3.04	17.19	69.00	111.00
Financial Services	67	4.32	20.35	68.00	123.00
Food & Beverages	15	4.74	21.30	80.00	121.00
Healthcare & Pharmaceuticals	46	5.43	22.68	77.00	110.00
Construction & Infrastructure	24	5.68	23.17	87.00	127.00
Miscellaneous Industries	20	5.95	23.68	50.00	83.00
Retail & Consumer Goods	25	6.34	24.41	73.00	131.00
Others	183	8.31	27.60	119.00	236.00
Transportation & Logistics	9	8.84	28.47	149.00	325.00
Materials & Chemicals	48	13.44	34.13	100.00	171.00
Energy & Utilities	17	16.32	37.02	135.00	182.00

Risk is  $\times 100$ , to be interpreted as percentage of companies in that industry, on average, displaying this feature. Concern is  $\times 1e6$ , for ease of display

Figure 1: Biodiversity Indices over time

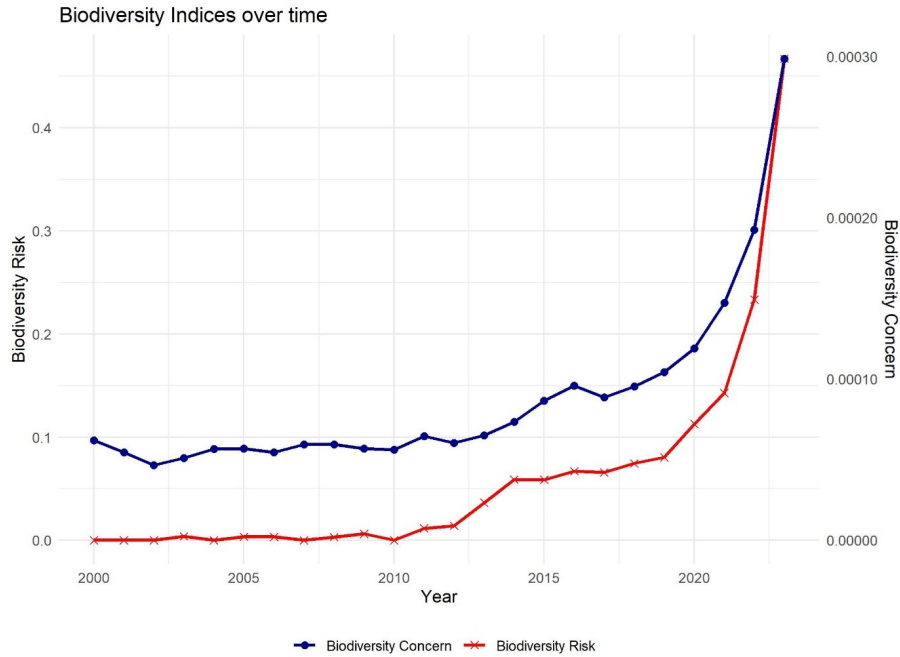


Figure 2: Biodiversity Indices over Industries

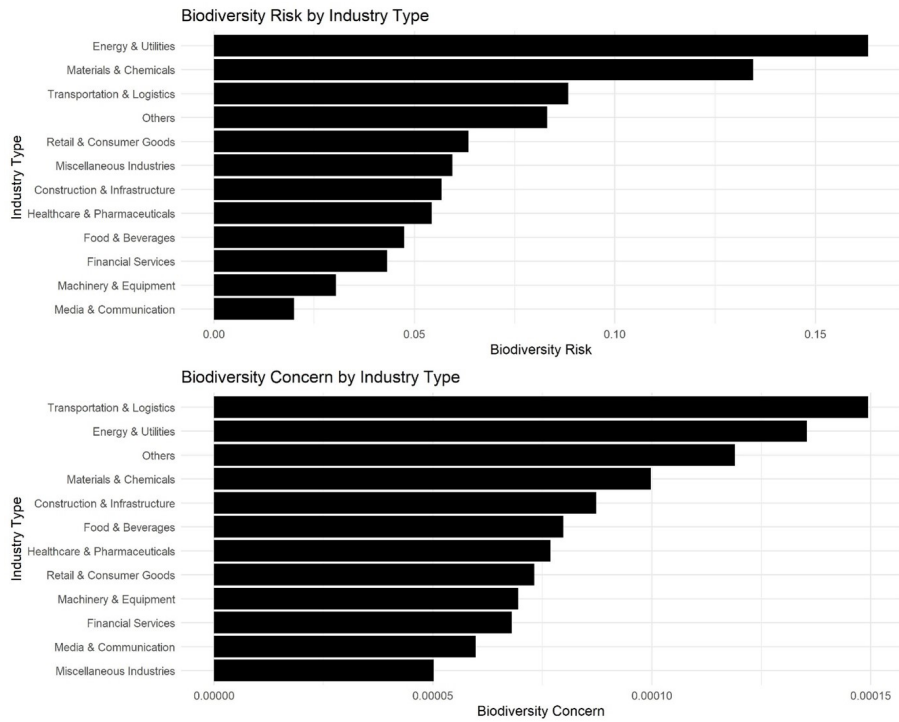


Figure 3: Biodiversity Risk over Industry and Time

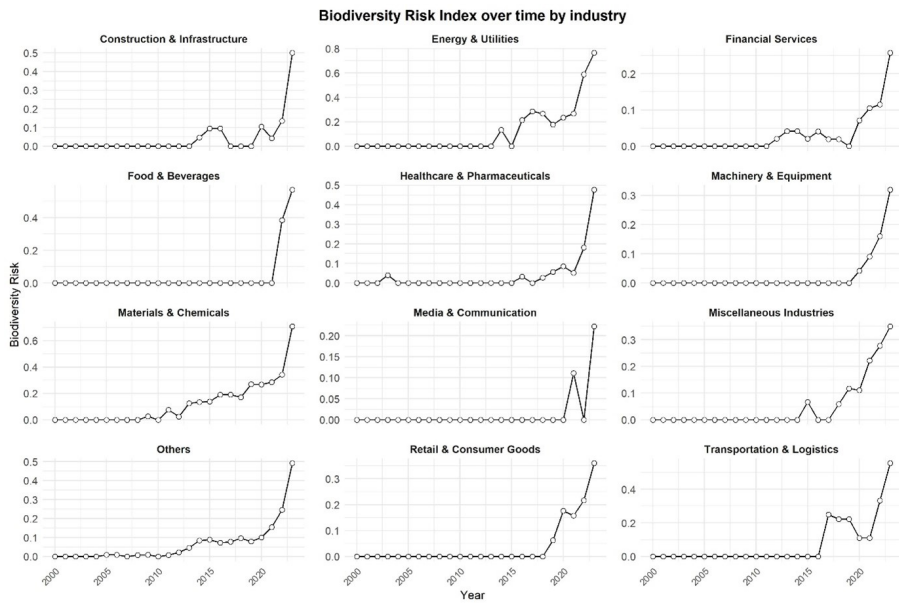


Figure 4: Biodiversity Concern over Industry and Time

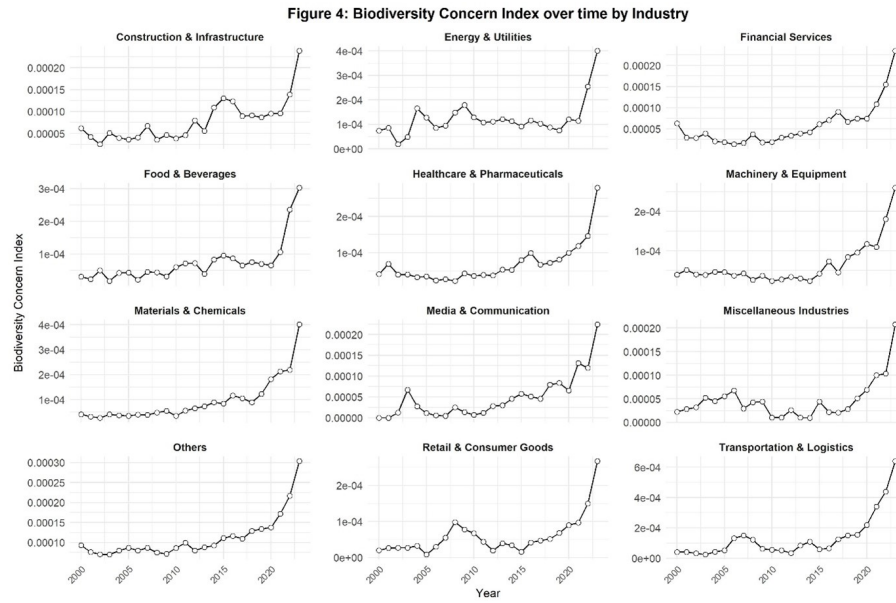


Figure 5: Climate and Biodiversity Risk

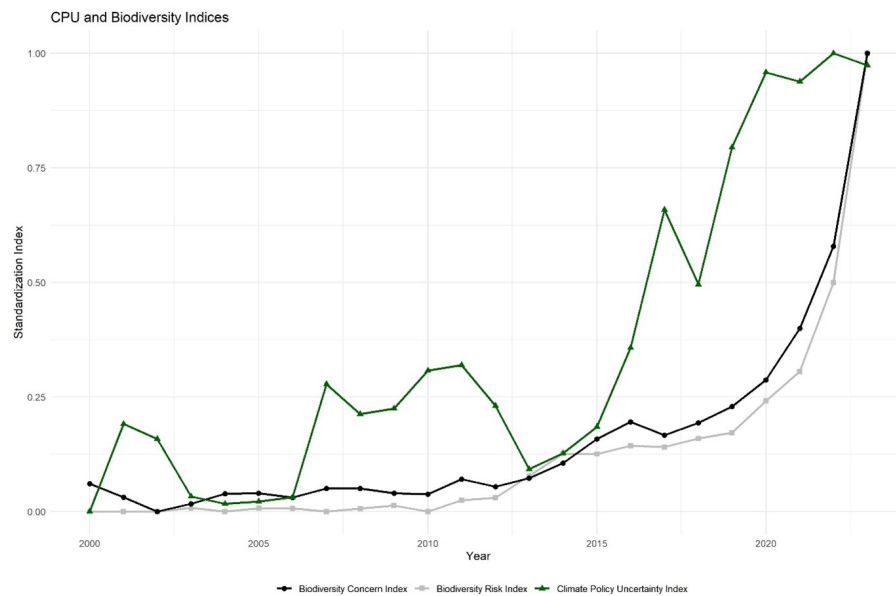


Figure 6: Climate and Biodiversity Risk