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Pricing firms' biodiversity risk exposure

Empirical evidence from audit fees

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Abstract

Our study explores whether and how financial auditors—one of the most important information intermediaries of financial markets—consider firms' (i.e., their clients') exposure to biodiversity risks when making audit pricing decisions. Based on the risk-oriented audit approach, we hypothesize that auditors price firms' exposure to biodiversity risks if these risks have an impact on firms' future economic conditions. Using a firm-specific biodiversity risk measure based on textual analyses of firms' 10-K statements, we find that firms' biodiversity risk exposure is associated with higher audit fees. However, this positive association is concentrated among firms operating in industries with high physical and transition biodiversity risks. Further tests reveal that auditors do not increase their audit efforts due to firms' higher biodiversity risk exposure but rather charge an audit fee risk premium. We also find that this audit fee risk premium is only charged (i) by auditors located in US counties with heightened environmental awareness, (ii) when public attention to biodiversity is high, and (iii) after the implementation of a biodiversity policy initiative. Overall, our findings suggest that auditors have started to charge a biodiversity risk premium. Therefore, our study not only contributes to the academic (industrial ecology) literature but also has important implications for biodiversity advocates, policymakers, regulators, auditors, and managers.

KEYWORDS
audit fees, biodiversity accounting, biodiversity finance, biodiversity risk, industrial ecology, sustainable development

1 | INTRODUCTION

Biodiversity—the variety of genes, species, and ecosystems—is declining at an alarming and unprecedented level. Since 1970, the global wildlife population has declined by almost 70% (WWF, 2022). Without any action to combat biodiversity loss, the global extinction rate—which is already 10 to 100 times higher than those observed over the past 10 million years—will increase faster than ever (IPBES, 2019). Currently, more than 44 thousand animal and plant species are threatened with extinction (IUCN, 2024). From a socio-economic perspective, biodiversity loss is one of the top five risks in terms of impact and likelihood (WEF, 2020). This is an existential threat to the global economy since half of the world's gross domestic product (GDP) is highly or moderately dependent on nature (WEF, 2020). Among the world's 1200 largest public firms, 85% are highly dependent on nature across their *direct* operations (S&P, 2023).[1] However, even firms with less dependence on nature in their *own* operations face considerable biodiversity risks through their supply chains (Ali et al., 2024; PwC, 2023; WEF, 2020).[2]

The theoretical concept of ecosystem services provides a valuable lens for explaining the economic dependence on nature. Rooted in economics and the natural sciences, this concept posits that a well-functioning ecosystem provides the following services: provisioning services (e.g., food and water), regulating services (e.g., control of diseases), and supporting services (e.g., nutrient cycles) (Millennium Ecosystem Assessment, 2005). The "ecological production function" determines the supply of these services (i.e., the flows derived from ecosystems), and estimating the monetary value of these flows allows for the identification of trade-offs among services and their impact on (economic) well-being (Díaz et al., 2018).[3] Biodiversity loss significantly reduces the provision of ecosystem services, thereby imposing severe physical risks on firms that depend on them.

Besides these *physical* risks from the actual loss of biodiversity, firms also face *transition* risks from pressure by stakeholders—such as regulators or consumers—to reduce biodiversity loss and transition to more biodiversity-friendly business practices (Giglio et al., 2023; KPMG, 2023; PwC, 2023).[4]

Since firms face (physical and transition) biodiversity risks, financial markets do too. In fact, more than half of the market value of the major stock exchanges is subject to biodiversity risks (PwC, 2023). Hence, underestimating or neglecting biodiversity risks may have dramatic financial consequences (CISL, 2021; Garel et al., 2024; Junge et al., 2023; Potdar et al., 2016). Therefore, it is crucial to understand whether and how biodiversity risks are priced by financial markets (Karolyi & Tobin-de la Puente, 2023; Starks, 2023).

Our study aims to contribute to this understanding by exploring how *financial auditors* (auditors hereafter) price firms' exposure to biodiversity risks. We focus on auditors for two main reasons. First, as the independent party to check the financial statements of firms, they are one of the most important specialized information intermediaries of financial markets (Leyens, 2011). Second, they are legally obliged to consider any business risk—such as environmental risks—that may deteriorate their client's economic condition (Hartlieb & Eierle, 2024; PCAOB, 2022).

Using a firm-specific biodiversity risk measure based on textual analyses of firms' 10-K statements (Giglio et al., 2023), we find a positive association between firms' biodiversity risk exposure and audit fees. However, this positive association is only observed for firms operating in industries characterized by high physical and transition biodiversity risks. Further tests suggest that auditors do not increase their audit efforts due to firms' higher biodiversity risk exposure but rather charge an audit fee *risk premium*. We also find that this audit fee risk premium is only charged if: (i) the general public's attention to biodiversity is high, (ii) auditors are located in US counties with high environmental awareness, and (iii) after the implementation of the California Biodiversity Initiative.

Our study contributes to the literature in three distinct ways.[5] First, we contribute to the sparse literature on biodiversity finance (Ali et al., 2024; Bassen et al., 2024; Flammer et al., 2025; Garel et al., 2024; Giglio et al., 2023; Hoepner et al., 2023; Kulionis et al., 2024; Nedopil, 2023; Rossberg et al., 2024; Velte, 2023; Coqueret et al., 2025). By providing evidence on how auditors—as important financial intermediaries—price firms' biodiversity risk exposure, we directly address recent calls for research on "how [biodiversity] risk is priced by financial markets" (Starks, 2023, p. 1855). More specifically, our study extends the work of Bassen et al. (2024), Garel et al. (2024), and Giglio et al. (2023), who investigated whether and how investors consider firms' biodiversity (risk) exposure in terms of equity prices. By showing that auditors also consider and price biodiversity risk, our study helps further quantify the economic costs of this risk. This, in turn, enhances our understanding of the pressure firms face to address biodiversity risk, such as by improving their environmental performance (Wu et al., 2025). Consequently, audit pricing can have real effects on biodiversity. Second, our study contributes to the audit pricing literature, which has primarily focused on climate change—so far—but neglected biodiversity loss as a potential business risk (Hartlieb & Eierle, 2024; Keller et al., 2024; Tan et al., 2023; Truong et al., 2020). By identifying firms' biodiversity risk exposure as an important component of business risk that auditors price, we directly respond to calls for research on "[w]hat kind of new business risks are emerging as a consequence of the degradation and transformation of ecosystems?" (Winn & Pogutz, 2013, p. 222). Specifically, we answer this question by employing a firm-specific biodiversity risk measure and examining the moderating effects of industry-specific physical and transition biodiversity risks. Third, our study engages with the long-standing literature in industrial ecology—and related fields—on the financial implications of firms' environmental performance (Bendig et al., 2023; Busch & Lewandowski, 2018; King & Lenox, 2001). We add to this stream of literature by documenting negative financial implications of biodiversity risk exposure, as firms with greater exposure pay higher audit fees—particularly when (i) the auditor is located in a US county with high environmental awareness, (ii) the general public's attention to biodiversity is high, and (iii) a biodiversity policy initiative was implemented. Overall, our study directly addresses the mission of the International Society for Industrial Ecology (ISIE) to enhance the integration of environmental concerns with economic activities (ISIE, 2024).

2 | HYPOTHESES DEVELOPMENT

In the 1990s, the auditing profession developed a risk-oriented approach to improve both the effectiveness and efficiency of the auditing process (Bell et al., 2008; De Martinis & Houghton, 2019; Eilifsen et al., 2001). This risk-oriented audit approach is now codified in auditing standards,[6] requiring auditors to assess firms' (i.e., their clients') business risk. In this context, business risk can be defined as any risk that may deteriorate firms' future financial condition and results in material misstatements of financial statements (De Martinis & Houghton, 2019; Johnstone, 2000; PCAOB, 2022). According to Simunic's (1980) audit pricing framework, auditors respond to an increase in firms' business risk by extending their audit work (i.e., increasing their audit effort) and/or charging a risk premium. Both result in higher audit fees.

To set audit fees that accurately reflect firms' business risk, auditors must thoroughly understand the business environment and identify potential factors that impact firms' business risk.[7] Previous studies on audit pricing identified several such factors, such as industry affiliation, economic development, listing status, cyber security, business strategy, CEO tenure, political corruption, and litigation environment (Bentley et al., 2013; Choi et al., 2008; Chung & Narasimhan, 2002; Jha et al., 2021; Leventis et al., 2013; Mitra et al., 2020; Niemi, 2002; Rosati et al., 2019). As extensively discussed in our literature review (see Supporting Information S1), recent research also indicated that climate change risks are a significant determinant of firms' business risk, which auditors factor into their pricing (Hartlieb & Eierle, 2024; Keller et al., 2024; Tan et al., 2023; Truong et al., 2020; Yang et al., 2023; Yu et al., 2023).

Building on this literature, we conjecture that biodiversity loss has become a relevant business risk that auditors need to consider when making audit pricing decisions. The World Economic Forum (WEF), the Natural Capital Protocol, as well as the Taskforce on Nature-related Financial Disclosures (TNFD) have identified biodiversity as a critical source of business risk (NCC, 2016; TNFD, 2022; WEF & PwC, 2010), as biodiversity loss poses substantial challenges to firms' competitiveness, profitability, and long-term viability (Velte, 2023; Ali et al., 2024; WEF, 2020). Firms *depend* on biodiversity for their business processes to function, as biodiversity is essential for providing key ecosystem services (NCC, 2016).[8] This dependence creates vulnerabilities in earnings and cash flow, transmitting a broad range of short-, medium-, and long-term financial risks (TNFD, 2022).[9] These financial risks may arise from asset devaluation, supply chain disruptions, reputational damage, loss of license to operate, or demand shifts (TNFD, 2022). Hence, auditors are obliged to price biodiversity risks if they deteriorate firms' financial situation.

The natural resource dependence theory (NRDT) offers a theoretical lens for understanding why auditors should consider firms' biodiversity risk exposure in their pricing decisions. The theory emphasizes firms' external dependence on scarce natural resources and the uncertainties this creates (Tashman, 2021; Tashman & Rivera, 2016). As biodiversity loss drives resource scarcity and degrades ecosystem services, it heightens uncertainty in natural resource dependence (Millennium Ecosystem Assessment, 2005; Tashman, 2021; Unter et al., 2024). These uncertainties impact financial and organizational performances (Bergmann et al., 2016; Unter et al., 2024), underscoring the need for auditors to consider them when assessing firms' business risk.

From an industrial ecology perspective, auditors may adopt life cycle thinking to better assess firms' exposure to biodiversity risks. Conducting a formal life cycle assessment (LCA) enables auditors to evaluate biodiversity risks throughout firms' value chains more comprehensively (D'Amato et al., 2024; Winter et al., 2017). If biodiversity risks are detected within a firm's value chain, this may negatively impact the firm's financial performance.

Building on these insights, we argue that biodiversity is a significant contributor to business risk, which, in turn, affects audit pricing. Specifically, higher (biodiversity-induced) business risk increases the probability of material misstatements in financial statements, as firms are more likely to engage in earnings management to conceal their poor financial performance (Johnstone, 2000; Stanley, 2011). Thus, auditors may increase their *audit effort* (e.g., allocating more experienced staff or increasing auditing hours) to decrease the audit risk that such material misstatements are not detected (Bell et al., 2008). Additionally, auditors are expected to *charge a risk premium* to cover potential economic and reputational losses from litigation claims due to a (biodiversity-induced) riskier audit engagement (Niemi, 2002). Taken together, both aforementioned actions lead to increased audit fees (Simunic, 1980). Thus, we formally state our first hypothesis (H1) as follows.

> Hypothesis 1: There is a positive association between firms' exposure to biodiversity risk and audit fees.

Thus far, we have not distinguished between different types of biodiversity risks. Firms face *physical* biodiversity risk when their production processes or services *directly* depend on nature. For example, declining pollinator diversity leads to a significant long-term reduction in agricultural yields, which directly affects agricultural firms (Ricketts et al., 2008; Wurz et al., 2021). However, even firms that are not directly dependent on nature face *indirect* physical biodiversity risk via their supply chains (Ali et al., 2024; PwC, 2023; WEF, 2020). For example, the pharmaceutical industry relies on the supply of natural compounds found in plants, microorganisms, and animals, which are essential for many medicines and drugs (Giglio et al., 2023; Newman & Cragg, 2020). This can lead to deteriorating supply chains and increased raw material costs. A recent report showed that all industries are indirectly exposed to physical biodiversity risk due to dependence on nature somewhere in the value chain, with some industries being particularly exposed, as 100% of their direct operations are highly dependent on nature (PwC, 2023). Consequently, industry-specific physical biodiversity risk can substantially impact firms' financial performance and even challenge their economic viability (PwC, 2023; Carvajal et al., 2022).[10] Prior research on audit pricing also demonstrated that industry characteristics (e.g., belonging to a "sin" industry) are an important determinant of firms' business risk and, hence, matter for audit fees (Leventis et al., 2013). Accordingly, we posit that *industry-specific physical biodiversity risk* amplifies the audit pricing of firm-specific biodiversity risk. Therefore, we formally state our next hypothesis (H2a) as follows.

> Hypothesis 2a: The positive association between firms' exposure to biodiversity risk and audit fees is stronger for firms operating in industries characterized by high *physical* biodiversity risk.

In addition to physical risks, firms encounter *transition* risks from pressure by stakeholders—such as regulators, consumers, and suppliers—to combat biodiversity loss and transition to more biodiversity-friendly business practices. For example, more stringent biodiversity regulations may necessitate adaptation costs or lead to asset impairments, impacting firms' financial stability (von Zedlitz, 2023; WEF & PwC, 2020). Biodiversity-induced changes in consumer preferences lead to changes in their buying behavior, such as the shift away from products containing palm oil (von Zedlitz, 2023; WEF & PwC, 2020; Giglio et al., 2023). This makes certain products outdated, which affects firms' competitive positions due to increased innovation costs, elevated marketing activities, and product quality uncertainties. Public concerns over biodiversity loss further expose firms to reputational and liability risks, as they are (now) held accountable for ecological impacts, which could translate into lower brand value, litigation costs, or even jeopardize their license to operate (Rijk et al., 2019; WEF & PwC, 2020; Carvajal et al., 2022).[11] From an industry perspective, Giglio et al. (2023) provide evidence that biodiversity transition risk varies across industries. For example, the food and agricultural industry is about to experience changing consumer preferences, such as an increased preference for meat and fish alternatives that substitute for traditional products (WEF & PwC, 2020).[12] Furthermore, firms in the energy industry face high biodiversity transition risks due to their drilling, exploration, and refining activities, which not only pose substantial legal and reputational risks but also attract increasingly stringent regulation (Giglio et al., 2023). Similarly, materials industries—such as timber, construction, and mining—face significant biodiversity transition risks as regulations on habitat and species protection can restrict their operational scope by increasing costs, limiting harvests, reducing land availability, and disrupting supply and demand in broader markets (Giglio et al., 2023). These industry-specific biodiversity transition risks can profoundly affect firms' financial conditions, including their survival (WEF & PwC, 2020). Prior research also showed that auditors charge higher audit fees to firms in heavy-polluting industries following the implementation of more stringent environmental regulations, reflecting heightened business risks from an increase in climate change transition risks (Liu et al., 2018). Based on this discussion, we formally state our last hypothesis (H2b) as follows.

> Hypothesis 2b: The positive association between firms' exposure to biodiversity risk and audit fees is stronger for firms operating in industries characterized by high *transition* biodiversity risk.

3 | DATA AND METHODOLOGY

3.1 | Sample and data

Our empirical analysis builds on public US firms for the financial years 2001 to 2020. We collect data on firm fundamentals from Compustat North America (NA) and audit-related data from Audit Analytics. These two data sources are widely used in finance and accounting research. From this initial database (178,040 firm-years from 20,793 firms), we exclude 63,111 firm-years from financial institutions due to their industry-specific regulatory requirements that might impact audit pricing. Next, we drop 84,676 firm-years due to missing biodiversity data as developed and provided by Giglio et al. (2023). Last, we exclude 6077 firm-years because of missing data on audit fees or any of the control variables. The final unbalanced panel sample comprises 24,176 firm-years from 2317 firms. For a detailed overview of the sample selection and sample distribution, please refer to Supporting Information S2.

3.1.1 | Outcome variable: Audit fees

To measure audit pricing, we follow prior literature and use the natural logarithm of audit service fees paid by the firm to its auditor (*ln_audit_fees*) (Hartlieb & Eierle, 2024; Jha et al., 2021). Audit fees cover all fees associated with conducting the financial statement audit, excluding any fees for non-audit services, such as consulting or tax advice.

3.1.2 | Test variable: Firm-specific biodiversity risk exposure

We measure firms' biodiversity risk exposure using novel firm-level data from Giglio et al. (2023).[13] Specifically, we employ their "10K-Biodiversity-Negative Score." This score is based on the number of biodiversity-related sentences a firm discloses in its regulatory 10-K statement filed to the Securities and Exchange Commission (SEC).[14] These sentences can capture risks as well as opportunities associated with biodiversity loss. To isolate the risk component, Giglio et al. (2023) perform a sentiment analysis using BERT—a deep learning model for natural language processing (NLP)—to classify each sentence into positive, negative, or neutral.[15] Afterward, they construct the biodiversity risk measure by subtracting the number of positive from negative biodiversity-related sentences. They perform several tests to validate this proxy. We rely on this measure that captures firms' biodiversity risk exposure to test our hypotheses. A higher score for the variable *biod_risk* indicates greater exposure to biodiversity risk.

By employing this innovative text-based variable, we build on recent studies that use textually decomposed variables to measure corporate phenomena for which firm-specific or disaggregated data are unavailable, such as firms' exposure to epidemic diseases, focus on artificial intelligence, digital transformation, and exposure to specific climate change risks (Chen & Srinivasan, 2024; Hassan et al., 2023; Li et al., 2024; Mishra et al., 2022; Sautner et al., 2023). Firm-specific biodiversity risk measures are similarly scarce. While some data providers offer historical information on firms' biodiversity (reporting) activities,[16] such measures do not capture firms' biodiversity *risk* exposure. Recently, the CDP Climate Change Questionnaire introduced a survey component to assess firms' biodiversity *risks*.[17] However, since this question was added only in 2023, the CDP data are not feasible for our panel-data analysis. Therefore, at present, using a validated text-based variable offers the most effective approach for measuring firm-specific biodiversity risk exposure.

3.1.3 | Moderator variables: Industry-specific physical and transition biodiversity risks

Our moderator variables are based on Giglio et al.'s (2023) industry measure that explicitly distinguishes between physical and transition biodiversity risks at the industry level.[18] Specifically, the measure captures the share of survey respondents,[19] who selected an industry as particularly affected by physical or transition biodiversity risks, respectively. Building on this measure, we construct the variable *physical_high* (*transition_high*)—coded 1 if industry-specific physical biodiversity risk (transition biodiversity risk) is higher than or equal to the median, and 0 otherwise. Correspondingly, we construct the variable *physical_low* (*transition_low*), coded 1 if the industry-specific physical biodiversity risk (transition biodiversity risk) is lower than the median, and 0 otherwise. We construct both variables (i.e., high and low) for each risk dimension (i.e., physical and transition) since we apply the partition approach in our moderation analysis (Goettsche et al., 2016; Yip & Tsang, 2007).[20]

3.1.4 | Control variables

Consistent with prior studies, we control for several observable, time-varying firm and auditor characteristics that might influence the pricing of audit services (Hartlieb & Eierle, 2024; Hay et al., 2006; Li et al., 2020). With regards to firm-specific characteristics, we control for firm size (*size*), leverage (*debt*), profitability (*roa*), negative income (*loss*), asset structure (*invrec*), and whether the firm reports any special items in their financial statements that might affect audit pricing (*item*). We also consider the timing of the firm's fiscal year-end in relation to the audit industry's "busy season" (*busy*). The "busy season" refers to the period during which auditors experience the highest demand for their services, typically coinciding with common fiscal year ends. Additionally, we control for a CEO-specific variable (*ceo_change*), a litigation variable (*litigation*), and a technology variable (*cyber*), since these factors have also been recognized as key determinants of firms' business risk. Our auditor-related control variables include the auditor type (*big4*), the occurrence of auditor changes (*auditor_change*), the type of audit opinion (*opinion*), economies of scale (*scale*), and whether the auditor is an expert in the industry of the focal firm (*specialist*). Specific to this study, we control for firms' general exposure to biodiversity—not focusing on the risk component—by including an indicator variable equal to one if a firm discloses at least two biodiversity-related sentences in its 10-K statement, and zero otherwise (*biod_exp*). Table 1 defines the control variables in detail.

3.2 | Model specifications

To test the association between firms' exposure to biodiversity risk and audit fees (H1), we use the following widely established audit fee model (Simunic, 1980; Yang et al., 2018):

$$ln\_audit\_fees_{ijt} = \beta_1 biod\_risk_{ijt} + \gamma' X_{ijt} + \delta_i + \varphi_t + \varepsilon_{ijt} \tag{1}$$

where *i* indexes firms, *j* indexes industries, and *t* indexes years. *ln_audit_fees* is the outcome variable, denoting audit pricing. The test variable is *biod_risk*, denoting firms' biodiversity risk exposure. ***X*** is a vector of control variables. δ are firm fixed effects, which account for time-invariant unobservable heterogeneity across firms.[21] φ are year-fixed effects, which account for unobservable time trends.[22] ε is the error term. Standard errors are robust standard errors adjusted for clustering at the firm level (Petersen, 2009).

To examine the moderating effect of industry-specific biodiversity physical and transition risks (H2a and H2b), respectively, we extend regression Equation (1) as follows:

$$ln\_audit\_fees_{ijt} = [\beta_1 biod\_risk_{ijt} \times physical\_high_{jt} + \beta_2 biod\_risk_{ijt} \times physical\_low_{jt}] \textbf{ or}$$

TABLE 1 Variable definitions.

Variable	Definition	Source(s)
Outcome variable		
ln_audit_fees	Natural logarithm of audit fees paid to the auditor.	Audit Analytics
Test variable		
biod_risk	Number of negative biodiversity sentences minus the number of positive biodiversity sentences in firms' 10-K statements.	Giglio et al. (2023)
Moderator variables		
physical_low	Indicator variable coded 1 if the industry-specific physical biodiversity risk is lower than (<) the median, and 0 otherwise. It is the share of the survey respondents that rate the industry as being particularly affected by physical risk.	Giglio et al. (2023)
physical_high	Indicator variable coded 1 if the industry-specific physical biodiversity risk is higher than or equal to (≥) the median, and 0 otherwise.	Giglio et al. (2023)
transition_low	Indicator variable coded 1 if the industry-specific transition biodiversity risk is lower than (<) the median, and 0 otherwise. It is the share of the survey respondents that rate the industry as being particularly affected by transition risk.	Giglio et al. (2023)
transition_high	Indicator variable coded 1 if the industry-specific transition biodiversity risk is higher than or equal to (≥) the median, and 0 otherwise.	Giglio et al. (2023)
Control variables		
biod_exp	Indicator variable coded 1 if a firm mentions biodiversity in at least two sentences in the 10-K statement, and 0 otherwise.	Giglio et al. (2023)
size	Natural logarithm of total assets.	Compustat NA
debt	Ratio of total liabilities to total assets.	Compustat NA
roa	Ratio of net income to total assets.	Compustat NA
loss	Indictor variable that equals 1 if *roa* is negative, and 0 otherwise.	Compustat NA
invrec	Ratio of the sum of inventories and receivables to total assets.	Compustat NA
item	Indicator variable coded 1 if the firm reports special items, and 0 otherwise.	Compustat NA
busy	Indicator variable coded 1 if the fiscal year ends in December, and 0 otherwise.	Compustat NA
big4	Indicator variable coded 1 if a firm is audited by one of the Big4 auditing firms, and 0 otherwise.	Compustat NA; Audit Analytics
opinion	Indicator variable coded 1 if the auditor does not issue an unqualified opinion, and 0 otherwise.	Compustat NA; Audit Analytics
auditor_change	Indicator variable coded 1 if the auditor has changed in the fiscal year, and 0 otherwise.	Compustat NA; Audit Analytics
specialist	Indicator variable coded 1 if the ratio of total audit fees collected by an auditor for the industry (2-digit SIC classification) to the total audit fees collected is the highest, and 0 otherwise.	Compustat NA; Audit Analytics
scale	This variable measures how large-scale the auditor is from an industry and county perspective. It is calculated by ranking auditors by the total number of firms they audit in each 2-digit SIC industry by county-year. These rankings are then converted into percentiles for each year. Finally, we divide the values by 100.	Compustat NA; Audit Analytics
litigation	Sum of the following indicator variables: (i) 1 if the firm has any open litigation pertaining to regulatory issues in the fiscal year, and 0 otherwise; (ii) 1 if the firm has any open litigation pertaining to employment and labor in the fiscal year; (iii) 1 if the firm has any open litigation pertaining to environmental issues in the fiscal year, and 0 otherwise; (iv) 1 if the firm has any open litigation pertaining to corrupt or illegal activities, and 0 otherwise; and (v) 1 if the firm has any open litigation pertaining to civil rights, and 0 otherwise.	Audit Analytics
ceo_change	Indicator variable coded 1 if the CEO has changed in the fiscal year, and 0 otherwise.	Audit Analytics
cyber	Indicator variable coded 1 if the firm reports a cybersecurity breach, and 0 otherwise.	Audit Analytics

(Continues)

TABLE 1 (Continued)

Variable	Definition	Source(s)
Variables used in auxiliary analyses		
biod_attention_low	Indicator variable coded 1 if the Google Biodiversity Attention Index is lower than (<) the median, and 0 otherwise.$The Google Biodiversity Attention Index is the sum of the search index series for "biodiversity loss," "ecosystem services," and "species loss" in each month, aggregated at the annual level.	Google Trends; Giglio et al. (2023)
biod_attention_high	Indicator variable coded 1 if the Google Biodiversity Attention Index is higher than or equal to (≥) the median, and 0 otherwise.	Google Trends; Giglio et al. (2023)
biod_risk_low	Indicator variable coded 1 if the variable biod_risk has a negative value or a value of 0, and 0 otherwise.	Giglio et al. (2023)
biod_risk_high	Indicator variable coded 1 if the variable *biod_risk* has a positive value, and 0 otherwise.	Giglio et al. (2023)
california	Indicator variable coded 1 if the firm is located in California, and 0 otherwise.	Compustat NA
env_aware_low	Indicator variable coded 1 if the auditor is located in a US county with societal awareness of protecting the environment being lower than (<) the median, and 0 otherwise.$Societal awareness of protecting the environment is measured as the percentage of people living in the US county who think that protecting the environment is more important than economic growth, even if it reduces economic growth.	Yale Climate Opinion Maps
env_aware_high	Indicator variable coded 1 if the auditor is located in a US county with societal awareness of protecting the environment being higher than or equal to (≥) the median, and 0 otherwise.	Yale Climate Opinion Maps
ln_audit_delay	Natural logarithm of the lag between the signature date of the audit opinion and the fiscal year-end.	Compustat NA; Audit Analytics
post-2018	Indicator variable coded 1 for fiscal years ending 2018 to 2020, and 0 otherwise.	Compustat NA

Note: All firm-level variables with no natural upper and lower bounds are winsorized at extreme percentiles.

$$[\beta_1 biod\_risk_{ijt} \times transition\_high_{jt} + \beta_2 biod\_risk_{ijt} \times transition\_low_{jt}]+$$

$$\gamma' X_{ijt} + \delta_i + \varphi_t + \varepsilon_{ijt} \quad (2)$$

where we interact *biod_risk* with either (i) *physical_high* and *physical_low*, respectively, or (ii) *transition_high* and *transition_low*, respectively.

4 | RESULTS

4.1 | Descriptive statistics

Table 2 reports the descriptive statistics. Consistent with prior audit pricing studies covering large US-listed firms, the median (mean) of *ln_audit_fees* is 14.196 (14.197), which translates to a median (mean) of 1,463,000 USD (1,464,463 USD) paid for audit services in our sample. Our test variable *biod_risk* ranges from −6 to 8, with a mean of 0.028. This suggests that firms, on average, report more negatively about biodiversity-related issues in their 10-K statements. Turning to the control variables, the descriptive statistics are comparable to those of prior audit pricing studies covering large US-listed firms.[23]

4.2 | Main results

Table 3 reports the results of our test of H1. Column 1 shows the estimates for all control variables, which are largely consistent with prior audit pricing studies (Hay, 2013; Hay et al., 2006; Li et al., 2020).[24] Looking at the coefficient for *biod_exp*, we find that biodiversity exposure does not explain audit fees, suggesting that auditors do not price the mere exposure to biodiversity. Turning to column 2, we find that biodiversity risk exposure (*biod_risk)* is positively associated with audit fees (coef. = 0.0206, p-value < 0.05), indicating that auditors do consider firms' exposure to biodiversity

TABLE 2 Descriptive statistics.

	Mean	SD	Min	Q1	Median	Q3	Max
ln_audit_fees	14.197	1.144	11.258	13.479	14.196	14.921	17.050
biod_risk	0.028	0.315	−6.000	0.000	0.000	0.000	8.000
biod_exp	0.036	0.185	0.000	0.000	0.000	0.000	1.000
size	7.236	1.717	3.741	5.966	7.100	8.355	11.671
debt	0.514	0.241	0.062	0.336	0.515	0.671	1.253
roa	0.095	0.157	−0.631	0.070	0.117	0.169	0.407
loss	0.125	0.331	0.000	0.000	0.000	0.000	1.000
invrec	0.230	0.168	0.000	0.094	0.202	0.327	0.749
item	0.732	0.443	0.000	0.000	1.000	1.000	1.000
busy	0.700	0.458	0.000	0.000	1.000	1.000	1.000
big4	0.879	0.327	0.000	1.000	1.000	1.000	1.000
opinion	0.342	0.474	0.000	0.000	0.000	1.000	1.000
auditor_change	0.063	0.243	0.000	0.000	0.000	0.000	1.000
specialist	0.112	0.315	0.000	0.000	0.000	0.000	1.000
scale	0.173	0.183	0.010	0.010	0.010	0.350	0.480
litigation	0.205	0.510	0.000	0.000	0.000	0.000	4.000
ceo_change	0.102	0.303	0.000	0.000	0.000	0.000	1.000
cyber	0.013	0.111	0.000	0.000	0.000	0.000	1.000

Note: This table reports the mean, standard deviation (SD), minimum, first quartile, median, third quartile, and maximum for each variable. Please see Table 1 for variable definitions.

risk when making audit pricing decisions. The coefficient for *biod_risk* remains positive and statistically significant in our full model (coef. = 0.0258, p-value < 0.05), as reported in column 3. The magnitude of the coefficient is also economically sizable. The disclosure of one additional net negative biodiversity sentence is associated with a 2.61% increase (= [exp(0.0258)−1] × 100) in audit fees, ceteris paribus.[25] According to the sample median, this translates into 31,184 USD (= 1,463,000 × 0.0261) in additional audit fees. These results support H1, implying that firms' biodiversity risk exposure is a relevant determinant of business risk that auditors consider when making audit pricing decisions.

Table 4 presents the findings from our test of H2a. In column 1, the estimate of the interaction term *biod_risk* × *physical_high* shows that firms' biodiversity risk exposure is priced by auditors if the industry-specific physical biodiversity risk is high (coef. = 0.0267, p-value < 0.05). Conversely, if the industry-specific physical biodiversity risk is low (*biod_risk* × *physical_low*), auditors do *not* price firms' biodiversity risk exposure. This indicates that industry-specific *physical* biodiversity risk is an important moderator of firms' biodiversity risk exposure, providing support for H2a.

Column 2 of Table 4 displays the results of our test of H2b. The estimates of the interaction term *biod_risk* × *transition_high* show that firms' biodiversity risk exposure is priced by auditors if the industry-specific transition biodiversity risk is high (coef. = 0.0285, p-value < 0.05). In contrast, if the industry-specific transition biodiversity risk is low (*biod_risk* × *transition_low*), auditors do *not* price firms' biodiversity risk exposure. This suggests that also industry-specific *transition* biodiversity risk is an important moderator of firms' biodiversity risk exposure, which supports H2b.[26]

5 | AUXILIARY ANALYSES

5.1 | Is firms' biodiversity risk exposure associated with higher audit efforts?

An increase in audit fees might stem from a higher audit effort and/or a risk premium (Simunic, 1980). To identify the channel through which firms' exposure to biodiversity risks affects audit fees, we examine whether our test variable *biod_risk* is associated with audit delay (*ln_audit_delay*), a widely accepted proxy for the level of audit effort (Keller et al., 2024). *ln_audit_delay* is calculated as the number of days between the firms' fiscal year and the signature date of the audit opinion (Lobo & Zhao, 2013). If auditors respond to firms' increase in biodiversity risk exposure by increasing their audit efforts, we expect the time between the end of the firms' fiscal year and the issuance of the audit opinion to be longer. Otherwise, the positive association between firms' biodiversity risk exposure and audit fees is largely driven by a risk premium that the auditor charges.

TABLE 3 The effect of firm-specific biodiversity risk exposure on audit fees.

	(1) *ln_audit_fees*	(2) *ln_audit_fees*	(3) *ln_audit_fees*
biod_risk		**0.0206****	**0.0258****
		[2.00]	**[2.35]**
biod_exp	−0.0145		−0.0298
	[−0.54]		[−1.05]
Size	0.4044***	0.4040***	0.4040***
	[33.56]	[33.48]	[33.50]
Debt	0.2470***	0.2483***	0.2481***
	[8.07]	[8.12]	[8.11]
Roa	−0.2040***	−0.2030***	−0.2031***
	[−3.85]	[−3.83]	[−3.83]
Loss	−0.0038	−0.0044	−0.0042
	[−0.21]	[−0.24]	[−0.23]
Invrec	0.5381***	0.5358***	0.5361***
	[6.70]	[6.66]	[6.67]
Item	0.0554***	0.0555***	0.0555***
	[7.35]	[7.36]	[7.36]
Busy	0.0359	0.0351	0.0355
	[1.54]	[1.51]	[1.52]
big4	0.2305***	0.2301***	0.2303***
	[7.31]	[7.30]	[7.30]
Opinion	0.0438***	0.0440***	0.0440***
	[6.22]	[6.25]	[6.24]
auditor_change	−0.0668***	−0.0666***	−0.0668***
	[−4.83]	[−4.82]	[−4.83]
Specialist	−0.0608	−0.0608	−0.0608
	[−1.25]	[−1.25]	[−1.25]
Scale	0.0777	0.0787	0.0786
	[1.11]	[1.13]	[1.12]
Litigation	0.0213**	0.0214**	0.0214**
	[2.12]	[2.13]	[2.13]
ceo_change	0.0359***	0.0358***	0.0358***
	[4.64]	[4.63]	[4.63]
Cyber	0.0556***	0.0560***	0.0557***
	[2.89]	[2.92]	[2.90]
Firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
R^2	0.73	0.73	0.73
Highest VIF	2.66	2.66	2.66
Observations	24,176	24,176	24,176

Note: This table reports coefficients and *t*-statistics [in brackets] from OLS regressions. Fixed effects are included as indicated. Standard errors are robust standard errors adjusted for clustering at the firm level.
Abbreviation: VIF, variance inflation factor.
Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively. Please see Table 1 for variable definitions.

TABLE 4 The moderating effects of industry-specific physical and transition risks.

	(1) *ln_audit_fees*	(2) *ln_audit_fees*
biod_risk* × *physical_high	**0.0267****	
	[2.40]	
biod_risk* × *physical_low	**−0.0177**	
	[−0.37]	
biod_risk* × *transition_high		**0.0285****
		[2.35]
biod_risk* × *transition_low		**0.0051**
		[0.27]
biod_exp	−0.0302	−0.0315
	[−1.06]	[−1.09]
Size	0.4040***	0.4040***
	[33.50]	[33.49]
Debt	0.2481***	0.2482***
	[8.11]	[8.11]
Roa	−0.2030***	−0.2031***
	[−3.83]	[−3.83]
Loss	−0.0042	−0.0043
	[−0.23]	[−0.24]
Invrec	0.5363***	0.5360***
	[6.68]	[6.67]
Item	0.0554***	0.0555***
	[7.35]	[7.36]
Busy	0.0355	0.0355
	[1.52]	[1.52]
big4	0.2302***	0.2302***
	[7.30]	[7.30]
Opinion	0.0440***	0.0440***
	[6.24]	[6.24]
auditor_change	−0.0668***	−0.0667***
	[−4.83]	[−4.83]
Specialist	−0.0608	−0.0608
	[−1.25]	[−1.25]
Scale	0.0790	0.0789
	[1.13]	[1.13]
Litigation	0.0213**	0.0214**
	[2.13]	[2.13]
ceo_change	0.0358***	0.0358***
	[4.63]	[4.63]
Cyber	0.0557***	0.0558***
	[2.90]	[2.91]
Firm fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

(Continues)

TABLE 4 (Continued)

	(1) *ln_audit_fees*	(2) *ln_audit_fees*
R^2	0.73	0.73
Observations	24,176	24,176

Note: This table reports coefficients and *t*-statistics [in brackets] from OLS regressions. Fixed effects are included as indicated. Standard errors are robust standard errors adjusted for clustering at the firm level.
Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively. Please see Table 1 for variable definitions.

Table 5 panel A reports the results. We find no statistically significant association between our biodiversity risk exposure variable (*biod_risk*) and audit effort (*ln_audit_delay*). This suggests that the positive association between firms' exposure to biodiversity risk and audit fees does not stem from increased audit efforts. Hence, we can infer that auditors charge a biodiversity risk premium.[27]

5.2 | Is the association between firms' biodiversity risk exposure and audit fees subject to the general public's biodiversity attention?

We further examine whether the general public's attention to biodiversity risks moderates the association between firms' biodiversity risk exposure and audit fees. In doing so, we classify years as having higher and lower public attention to biodiversity using the Google Biodiversity Attention Index (Giglio et al., 2023). Specifically, we distinguish between years of higher and lower public attention to biodiversity using the sample median of the Google Biodiversity Attention Index as a splitting criterion. We enter the multiplicative interactions between *biod_risk* and both *biod_attention_high* and *biod_attention_low*, respectively, into our model to examine the moderating effect of public biodiversity attention.

Table 5 panel B reports the results.[28] We find a positive and statistically significant association between firms' biodiversity risk exposure and audit fees for years with higher public attention to biodiversity (coef. = 0.0377, p-value < 0.01). In contrast, we do not find such an association for years with lower public attention to biodiversity. This finding suggests that public attention to biodiversity puts pressure on auditors to consider firms' exposure to biodiversity risk as a relevant business risk factor that should not be neglected.[29]

5.3 | Is the association between firms' biodiversity risk exposure and audit fees subject to auditors' location-based environmental awareness?

Next, we investigate whether auditors' location-based environmental awareness moderates the association between firms' biodiversity risk exposure and audit fees. Auditors located in US counties with higher environmental awareness could be more prone to consider firms' biodiversity risk exposure for two reasons. First, local societal environmental awareness may serve as a proxy for the auditors' own awareness. Second, auditors from offices in regions with high environmental awareness may face greater pressure from social norms to prioritize environmental concerns and remain attentive to related risks. Thus, we measure local environmental awareness in the US county of the auditors' office by using survey data from the Yale Climate Opinion Maps (Howe et al., 2015). Specifically, we distinguish between US counties with high and low environmental awareness by using the sample median as a splitting criterion: the percentage of people within a US county who think that protecting the environment is more important than economic growth. We enter the multiplicative interactions between *biod_risk* and both *env_aware_high* and *env_aware_low*, respectively, into our model to examine the moderating effect of auditors' environmental awareness.

The results are reported in Table 5 panel C.[30] We find a positive and statistically significant association between firms' biodiversity risk exposure and audit fees if auditors are located in US counties with high environmental awareness (coef. = 0.0342, p-value < 0.05). Conversely, we do not find such an association if auditors are located in US counties with low environmental awareness. The findings of this auxiliary analysis suggest that auditors located in US counties that prioritize protecting the environment over economic growth price biodiversity risk, while auditors located in US counties with a focus on economic growth do not.

5.4 | Is the association between firms' biodiversity risk exposure and audit fees subject to a biodiversity policy initiative?

Last, we conduct a difference-in-differences analysis (DiD), employing the implementation of the California Biodiversity Initiative (CBI) in 2018 as a natural experiment.[31] To examine how auditors respond to the CBI when auditing firms with high versus low biodiversity risk exposure, we interact

TABLE 5 Auxiliary analyses.

Panel A: Audit effort	
	(1)
	ln_audit_delay
biod_risk	0.0029
	[0.34]
Control variables	Yes
Firm fixed effects	Yes
Year fixed effects	Yes
R^2	0.28
Observations	24,176
Panel B: General public's biodiversity attention	
	(1)
	ln_audit_fees
biod_risk × *biod_attention_high*	0.0377***
	[3.62]
biod_risk × *biod_attention_low*	−0.0006
	[−0.03]
Control variables	Yes
Firm fixed effects	Yes
Year fixed effects	Yes
R^2	0.69
Observations	21,599
Panel C: Auditors' location-based environmental awareness	
	(1)
	ln_audit_fees
biod_risk × *env_aware_high*	0.0342**
	[2.05]
biod_risk × *env_aware_low*	0.0171
	[1.29]
Control variables	Yes
Firm fixed effects	Yes
Year fixed effects	Yes
R^2	0.73
Observations	23,601
Panel D: California's 2018 Biodiversity Initiative	
	(1)
	ln_audit_fees
california × *post-2018* × *biod_risk_high*	0.0560**
	[2.39]
california × *post-2018* × *biod_risk_low*	−0.1362
	[−1.09]
Control variables	Yes
Firm fixed effects	Yes
Year fixed effects	Yes

(Continues)

TABLE 5 (Continued)

Panel D: California's 2018 Biodiversity Initiative	
R^2	0.68
Observations	8,441

Note: This table reports coefficients and *t*-statistics [in brackets] from OLS regressions. Control variables and fixed effects are included as indicated. Standard errors are robust standard errors adjusted for clustering at the firm level.
Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively. Please see Table 1 for variable definitions.

the DiD estimator (i.e., *california* × *post-2018*) with *biod_risk_high* and *biod_risk_low*, respectively. We use the sample median as the splitting criterion for the biodiversity risk exposure variable. The sample for this analysis covers the years 2015 to 2020 (i.e., 3 years before and 3 years after the treatment). Panel D of Table 5 presents the results, showing that the implementation of the CBI leads to an increase in audit fees for firms with high biodiversity risk exposure (coef. = 0.0560, p-value < 0.05), while firms with low biodiversity exposure do not experience an increase in audit fees. This result suggests that biodiversity policy initiatives can amplify auditors' attention to firms' biodiversity risks when determining audit fees.

6 | DISCUSSION

6.1 | Theoretical implications

Our study provides theoretical implications for industrial ecology and related fields. First, our study has implications for the NRDT by demonstrating that the uncertainties associated with biodiversity loss and its impact on ecosystem services constitute a business risk that auditors consider when pricing their services. This finding highlights biodiversity loss as financially material while also emphasizing its broader impact on materiality. Specifically, biodiversity loss negatively affects business operations (e.g., dairy production), which in turn undermines human welfare. Furthermore, firms' actions that exacerbate biodiversity loss can contribute to broader societal harms (e.g., fostering epidemic diseases), thereby further reducing well-being. These findings underscore the relevance of biodiversity loss to the concept of "double materiality," recently embedded in the EU's Corporate Sustainability Reporting Directive but not yet adopted in the United States.

Second, our findings have theoretical implications for the audit pricing model. We show that the pricing effect of biodiversity risks becomes salient only under certain conditions, for example, when auditors' environmental awareness is high. This indicates that firms exposed to high biodiversity risks can get away without having these risks priced if auditors do not pay attention to them (i.e., due to low awareness). Recognizing biodiversity risk as a critical component of firms' business risk enhances our understanding of business risk within the audit pricing model.

Third, our analysis of interactions between firm-specific and industry-specific biodiversity risks reveals that auditors assess not only individual firms' risk exposures but also the broader risk profiles of their industries. Firms in high-risk industries must proactively manage biodiversity risks to mitigate biodiversity-induced audit fee premiums. Additionally, auditors—as critical information intermediaries—often conduct independent risk analyses—such as LCAs—which reduce the likelihood that firms' biodiversity risks are not priced due to greenwashing. However, when firms fail to disclose their biodiversity risks, auditors may request their disclosure, impose even higher risk premiums, or issue adverse going-concern opinions. While our study does not capture this dynamic, its exclusion likely leads to an underestimation of our identified biodiversity risk pricing effects.

Finally, our research contributes to the emerging literature on the financial consequences of biodiversity loss, particularly in the context of industrial ecology (Benetto et al., 2023). While recent studies have focused on customers and investors (Hörisch et al., 2024; Kulionis et al., 2024), we provide evidence on auditors—financial intermediaries with unique insights into firms' operations that inform their pricing decisions.

6.2 | Practical implications

Our findings also have practical implications for biodiversity advocates, non-governmental organizations (NGOs), policymakers, regulators, auditors, and managers. The finding that public attention to biodiversity matters for audit pricing decisions reinforces the efforts of *biodiversity advocates and NGOs* to raise awareness of biodiversity loss. Increased public awareness not only enhances general understanding but also directly influences the pricing of firms' biodiversity risk exposure.

Additionally, this finding informs *regulators*—such as the PCAOB—that public attention and auditors' awareness are key drivers for incorporating biodiversity risks into audit pricing decisions. By mandating that auditors account for material environmental factors—particularly biodiversity—when evaluating firms' business risks, the PCAOB could ensure that firms' biodiversity risk exposures are consistently priced, rather than only under certain conditions (such as heightened public attention, increased auditor awareness, or industry risk exposure).

From a *policymaker*'s perspective, our finding that a biodiversity policy initiative influences auditors' pricing of biodiversity risks demonstrates that such initiatives—aimed at conserving biodiversity—can have broader effectiveness beyond their primary objectives. This evidence should encourage policymakers to design targeted policy initiatives that address firms, industries, and financial intermediaries specifically.

For *auditors*, our findings suggest that employing tools from industrial ecology—such as LCAs—is essential for adequately evaluating firms' biodiversity exposures across their value chains, particularly for industries characterized by high biodiversity risks. Furthermore, as auditors assess biodiversity risks through detailed evaluations of firms' value chains, they are likely to inform the *management* about these risks and recommend improvements—for example—to internal controls.[32] As such, auditors can act as change agents, pushing managers to address biodiversity risks proactively.

6.3 | Limitations and future research

Our findings are subject to certain *limitations*. First, since we are investigating a sample of large, publicly listed firms, our results may not apply to firms of *all* sizes. Second, due to the greater availability of biodiversity data, we have focused solely on the US market. Nonetheless, as civil law countries—like most European countries—are more stakeholder-oriented than the United States, our identified biodiversity risk premium can be regarded as conservative on a global scale. Third, our study may be prone to endogeneity concerns. However, given our relatively large sample size, we were able to include firm fixed effects that mitigate concerns of an omitted variable bias. Furthermore, our DiD analysis in Section 5.4 indicates—to a very limited extent—that the effect might be causal. Nonetheless, we emphasize that our study does not establish causation but provides evidence of a positive association between firms' biodiversity risk exposure and audit fees. Fourth, due to the limited availability of firm- and industry-specific biodiversity risk measures, we rely on text- and survey-based variables. While these measures have been validated by Giglio et al. (2023), the absence of suitable alternative proxies prevents sound robustness testing, making the measurement of our biodiversity risk variables a limitation of this study.

Depending on the evolution of biodiversity metrics and the "life cycle" of biodiversity (finance) research, *future research* could employ more refined biodiversity risk measures. Additionally, future research could adopt more sophisticated identification strategies to address causality. Moreover, we encourage investigations into diverse institutional settings, other information intermediaries, and alternative audit-related outcomes. For instance, scholars might explore how firms' biodiversity risk exposure influences auditors' evaluations of going-concern opinions.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data are subject to third-party restrictions. Data are available from the sources cited in the manuscript.

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ENDNOTES

[1] For example, agricultural products rely on fertile soils to plant crops, cancer drugs and antibiotics are often derived from natural compounds found in plants, and car tires are mostly made from natural rubber (PwC, 2023; Giglio et al., 2023).

[2] For instance, the global cosmetics market depends on the supply of shea butter, which is currently threatened by parasites, deforestation, and pollinator loss (Venturini et al., 2016; Sanou et al., 2004; WEF & PwC, 2020).

[3] Building on the ecosystem services concept, the notion of nature's contribution to people (NCP) adds a social science perspective, considering a wider set of viewpoints and stakeholders (Díaz et al., 2018; IPBES, 2019). Since our study deals with the economic consequences of biodiversity loss, we decided to use the theoretical concept of ecosystem services rather than NCP.

[4] For example, more stringent land-use regulations result in changes to asset values (von Zedlitz, 2023; Giglio et al., 2023, TNFD, 2022).

[5] Supporting Information S1 provides a thorough literature review and positions the study within the existing literature.

[6] Please refer to the following Auditing Standards (AS) of the Public Company Accounting Oversight Board (PCAOB): 1101, 2101, 2110, 2201, and 2301. The PCAOB regulates the audits of public firms in the United States.

[7] Please refer to the following studies for structured literature reviews or meta-analyses on the determinants of audit fees: Eierle et al. (2022), Eierle et al. (2021), Hay et al. (2006), Hay (2013), and Widmann et al. (2021).

[8] Firms also have negative impacts on biodiversity (NCC, 2016). Hence, today's negative impacts on biodiversity may lead to tomorrow's biodiversity risks (TNFD, 2022).

[9] Financial risks include market, credit, and liquidity risks (TNFD, 2022).

[10] We focus on industry-specific physical and transition biodiversity risks for two reasons. First, firm-specific measures that distinguish between physical and transition biodiversity risks are not readily available. Second, industry-specific risks add an additional layer and interesting nuance to our study.

[11] In 2010, Greenpeace launched a campaign against Nestlé to raise awareness about Nestle's sourcing of palm oil from deforested rainforests in Indonesia (Rijk et al., 2019).

[12] Specifically, the demand for cow products will decrease by over 80% until 2035, resulting in a total cost of over USD 100 billion to meat producers and their supply chains (WEF & PwC, 2020; RethinkX, 2019).

[13] These data are publicly available here: www.biodiversityrisk.org/download. We derived the data from this website on December 22, 2023.

[14] Biodiversity-related sentences are identified using the following dictionary: "biodiversity, ecosystem(s), ecology (ecological), habitat(s), species, (rain)forest(s), deforestation, fauna, flora, marine, tropical, freshwater, wetland, wildlife, coral, aquatic, desertification, carbon sink(s), ecosphere, and biosphere" (Giglio et al., 2023, p. 9).

[15] For more (technical) details on BERT, see Devlin et al. (2019).

[16] For instance, Refinitiv provides a yes/no answer to the following question "Does the company report on its impact on biodiversity or on activities to reduce its impact on the native ecosystems and species, as well as the biodiversity of protected and sensitive areas?"

[17] In particular, the CDP added the following question (C15.4) in 2023: "Does your organization have activities located in or near to biodiversity-sensitive areas in the reporting year?" (CDP, 2023).

[18] We use an industry measure since how heavily firms depend on nature and, hence, are affected by physical biodiversity risk is highly industry-specific in nature (PwC, 2023). Similarly, transition biodiversity risk is largely determined by industry factors, such as industry-specific reporting standards (e.g., SASB standards, GRI sector standards). The industry measure from Giglio et al. (2023) is publicly available here: www.biodiversityrisk.org/download. We derived the data from this website on December 22, 2023.

[19] The survey respondents included professionals and academics (Giglio et al., 2023).

[20] Since there is an overlap of industries that score high (low) in both physical and transition biodiversity risk, we also explore the interdependence of these industry-specific risks in Supporting Information S3.

[21] Since firm fixed effects account for all time-invariant firm-specific factors, industry fixed effects are already absorbed by these fixed effects.

[22] To mitigate the concern that our findings are subject to an omitted variable bias, we implement Oster's (2019) bounding methodology, which allows us to estimate how large the impact of unobservables relative to observables needs to be to drive the coefficients for *biod_risk* to zero. We find that it is unlikely that the coefficients for *biod_risk* are driven by omitted variables, as unobservables would need to be more than four times (i.e., 4.05) as important as the included observables to produce an effect of zero ($\beta_1 = 0$). Hence, we are confident that our model does not omit important control variables or fixed effects.

[23] For the sake of brevity, we do not present a correlation matrix of all variables but rather discuss the pairwise correlations among our explanatory variables (i.e., test variable and control variables) to alleviate multicollinearity concerns. The pairwise correlations among all explanatory variables do not exceed |0.50|, except for the pair *loss* and *roa* ($\rho = -0.774$). Removing the variable *loss* does not change the direction and significance of our main findings. Furthermore, the variance inflation factors (VIFs) reported in Table 3 are well below the critical threshold of 10. We conclude that our specified model is unlikely to be subject to multicollinearity.

[24] The negative coefficient for *specialist* might initially seem counterintuitive. However, it is not statistically significant, which indicates that *specialist* does not determine audit fees in our model. This finding aligns with the meta-analysis by Hay et al. (2006), which found that the variable "auditor specialist" was statistically insignificant in six out of nine cases. From a theoretical perspective, this insignificance may be explained by competing arguments: a specialist audit fee premium versus a more efficient audit procedure.

[25] We reran our model with a standardized test variable. Specifically, we calculated the standardized values of *biod_risk* (i.e., *std_biod_risk*) as follows: *std_biod_risk* = (*biod_risk*−*m*)/*sd*, where *m* is the mean of *biod_risk*, and *sd* is the standard deviation of *biod_risk*. The untabulated coefficient for *std_biod_risk* is 0.0081 (p-value < 0.05), indicating that a one standard deviation increase in firms' biodiversity risk exposure is associated with an increase of 0.81% ($= [\exp(0.0081) - 1] \times 100$) in audit fees, ceteris paribus.

[26] Supporting Information S3 provides evidence on a joint moderating effect of industry-specific physical and transition biodiversity risks. It also offers additional analyses—using alternative proxies and estimation approaches—to substantiate the distinct moderating effects of physical and transition biodiversity risks, respectively.

[27] This finding is in line with prior studies on carbon risk (Keller et al., 2024).

[28] The sample size for this analysis is slightly smaller since the Google Biodiversity Attention Index is only available as of 2004.

[29] The findings of this auxiliary analyses are in line with prior studies that show that biodiversity risk is priced when awareness is high (Garel et al., 2024; Coqueret et al., 2025).

[30] The sample size for this analysis is slightly smaller due to missing information on auditor office location for some observations.

[31] In 2018, Governor Brown launched the California Biodiversity Initiative to "secure the future of California's biodiversity by integrating biodiversity protection into the state's environmental and economic goals and efforts" (California Natural Resources Agency, 2018).

[32] Generally, this is done via a so-called management letter, which is issued to the top management but not made public. It includes all recommendations to the management, such as how to deal with certain risks.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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