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Nature Risks

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Abstract.

Nature loss is increasingly a financial issue. Companies can be exposed because they depend on ecosystem services or because their activities damage nature and they become subject to regulation, litigation, changing preferences, or other transition forces. I discuss recent research showing that companies already perceive these risks as financially material and that investors have begun to price these risks. I then illustrate how new spatial data can make nature considerations more actionable for investment and lending decisions. I close with some thoughts on future nature-finance research and with implications of the evidence for investors and banks.

Keywords: Nature risks, Biodiversity risks, Renewable energy, Investor engagement

JEL Classification: G12, G30, Q57

1. Why could nature risks constitute investment risks?

Biodiversity, the variability among living organisms, including genetic diversity, is declining at an unprecedented rate. The Living Planet Index, for example, documents a decline in monitored wildlife populations of around 70% over the past 40 to 45 years. Ecological deterioration extends beyond biodiversity loss to changes in non-living features of nature, such as water and soil. In what follows, I use the term “nature risks” to capture risks arising from both the loss of living organisms and the degradation of non-living features.

Nature matters for economics and finance as natural systems provide ecosystem services to businesses that underpin their economic activity, including water supply, soil productivity, pollination, flood protection, climate regulation, and biological resources. The economic consequences of nature loss extend far beyond the often-cited example of declining bee populations that lead to reduced pollination and agricultural productivity. Nature loss can have material economic consequences in sectors where the connection to nature may not be immediately visible. Pharmaceutical companies, for example, are exposed because nature’s genetic diversity provides a critical source of compounds and biological mechanisms for drug discovery. Biodiversity loss in turn can eliminate potential inputs into future medicines before they are even discovered.

For investors, banks, and regulators, the crucial question is how this ecological deterioration translates into financial risks. A useful distinction is between nature-related transition risks and nature-related physical risks. Transition risks start with a company’s impact on nature. A food producer, for example, may contribute to land-use change through the agricultural inputs required to produce milk or meat. Land-use change matters for biodiversity loss because farmed land hosts fewer species and lower species diversity than pristine unfarmed land. Deforestation for meat production can be particularly harmful. If regulation, litigation, technology, consumer preferences, or investor expectations increasingly penalize such impacts, the company can face higher costs, lower demand, or stranded assets.

Physical risks instead start with nature dependency and many sectors beyond agriculture and pharma are exposed to these risks. A tourism company, for example, may depend on healthy coral reefs, an industrial plant may depend on reliable groundwater, an agricultural company may depend on soil quality, and a data center may depend on the availability of water for cooling. When the relevant ecosystem service deteriorates, production and revenues can be affected directly, thereby creating financial risks.

This impact-dependency distinction is useful because it prevents nature risk from becoming an overly broad label. A company can have a large biodiversity footprint without being highly dependent on ecosystem services, or it can be highly dependent on nature without itself having an unusually large footprint. Investors and banks therefore need different measures for the two channels. This is not to say that both risks cannot overlap: for example, electric-vehicle producers may require large amounts of water for battery production, creating physical risk from water scarcity, while their own water use can contribute to declining water levels and thereby generate impacts that trigger transition risks.

2. Do companies view nature risks as financially material?

How important are nature risks from the perspective of companies themselves? In particular, do companies view these risks as financially material? In Gjerde *et al.* (2026), my coauthors

and I survey portfolio companies of a large global asset owner to understand—from the perspective of those that should know—whether nature risks are financially material to businesses. In our survey, we made clear that we are interested only in risks that affect a company’s financial position in *material* ways. Nearly half of our respondents—48%—say that nature risks are financially material for them. Physical risks are considered material by 42% of companies and transition risks by 36%. Notably, among respondents that regard the respective risks as material, 43% say physical risks already have financial effects *today*, compared with 27% for transition risks. At the same time, corporate perceptions reveal considerable uncertainty: 13% of companies answer “do not know” when asked whether transition risks, physical risks, or nature risks overall are financially material.

Overall, it is clear from the survey responses that nature risks are not a theme of the distant future anymore; they have arrived in corporate reality. Our respondents are unlikely to be representative of the broader population of companies and may be tilted toward companies for which nature risks are particularly relevant. The survey responses still matter because they come from the companies that ultimately have to manage the exposures, and insights from these companies are particularly relevant. I will discuss further takeaways from our survey below.

3. How to measure nature risks?

A survey is useful to understand nature risk perceptions by companies, but investors and banks need standardized, quantitative, and time-varying metrics to measure and manage these risks for a wide range of portfolio companies. To measure exposure to nature-related transition risk, one can quantify a company’s negative impact on biodiversity, which can become financially relevant through regulation, litigation, or changing preferences. In Garel *et al.* (2024), we use Iceberg Data Lab’s Corporate Biodiversity Footprint (CBF) to illustrate how such a quantification can look like, and whether it ultimately translates into priced risks.

The CBF aggregates biodiversity loss associated with a company’s activities through four major environmental pressures: land use, greenhouse-gas emissions, water pollution, and air pollution. It translates these pressures into a common biodiversity metric based on Mean Species Abundance (MSA), which captures ecosystem intactness relative to an undisturbed benchmark. Many data providers have started to offer biodiversity metrics based on the concept of MSA. The attraction of an MSA-based footprint is that it converts very different environmental impacts into a comparable company-level measure and provides a metric that can be managed.

Physical nature risk requires a different lens. In Garel *et al.* (2026), we construct firm-level scores that reflect how strongly companies depend on ecosystem services provided by nature. To construct the scores, we combine segment-level corporate revenue information with the ENCORE database, which maps economic activities to their dependence on 25 ecosystem services. We create two metrics. Our first metric, $NatureDep^{Overall}$, measures the revenue-weighted average dependence across economically relevant ecosystem services, while our second metric, $NatureDep^{High}$, captures the number of ecosystem services on which a company has particularly high dependence. For both measures, we take into account how large a given business activity is for a company’s overall revenues. The sample for which we construct these

scores covers more than 30,000 listed companies in 117 countries from 2010 onwards. We have made these scores [freely available](#) for other researchers to use them in their own work.

4. Do investors care about nature risks?

A key question for finance is whether nature risks have started to be priced in financial markets. This is not obvious. Consider transition risks. An environmental impact of a company is not automatically a financial risk. A financial channel emerges when investors expect regulation, litigation, disclosure requirements, or changes in preferences to make large footprints costly. In Garel *et al.* (2024), we observe that exactly this has started to occur in equity markets. Using the CBF as the relevant metric, we document for the cross-section of stock returns that since the Kunming Declaration in October 2021—interpreted by many as the biodiversity-equivalent of the Paris Agreement—a biodiversity-footprint premium has emerged: stocks of companies with larger footprints earn higher subsequent returns. In addition, we document that stocks with large footprints also lost value around the Kunming Declaration, and the launch of the Taskforce on Nature-related Financial Disclosures produced a similar pattern. The evidence is consistent with investors beginning to demand compensation for biodiversity transition risk once the prospect of future policy and litigation becomes more salient.

Establishing the financial relevance of physical nature risks is particularly challenging. When considering nature dependence, it is particularly important to make a distinction between exposure and realized risk. Consider our measure: a high NatureDep score says that a company relies strongly on nature. However, losses occur only when the underlying ecosystem service deteriorates, and substitution or adaptation is costly. This is much harder to measure than dependence itself as it requires data on the location of corporate assets and on adaptation measures.

With those caveats in mind, our data show that our NatureDep scores are still informative about financial vulnerability related to nature-related physical risks: we find that *NatureDep^{High}* scores are positively associated with downside risk, with much of the relation driven by high dependencies on water-related ecosystem services. The scores also predict nature-related incidents that arise when companies damage nature, overuse resources, or enter disputes with local communities.

The return-based evidence is consistent with an increase in investor attention to nature topics. We corroborate this conclusion in our survey. In Gjerde *et al.* (2026), we not only asked companies about the financial materiality of nature risks but also inquired about whether companies experience more attention to nature topics by investors. This may occur in earnings conference calls or direct investor engagements. We find that 68% of corporate respondents report that investor attention to nature risks has increased. Yet this observation is far from universal: for both transition and physical risks, roughly half of respondents say investors “never” or “rarely” consider the issue. Among those companies, around 40% nevertheless expect investors to pay more attention in the future. This suggests that many investors are still in the process of integrating nature risks into conventional financial analysis. Together, these findings suggest that the integration of nature risks into financial analysis and asset prices may still be incomplete. At the same time, our survey makes clear that nature risks have already become a key theme for many investors when interacting with exposed companies.

Engagement (or active ownership) is one channel through which investors can accelerate the integration of nature risks by companies. Investor engagement related to nature topics has become more prevalent in recent years. Forty percent of companies in our survey report that they have experienced nature-risk engagement by their investors, and the share is substantially higher among companies for which nature risks are financially material. Among engaged companies, 73% describe the engagement as value-generating. Companies report that engagement provides advice, creates awareness and internal attention, improves understanding of investor preferences, and helps identify material issues and blind spots. These responses suggest that nature engagement can contribute to information production and corporate decision-making rather than operating only as an expression of investor preferences.

5. Does addressing nature loss create investment opportunities?

The financial relevance of nature is not confined to risks. There are large financing opportunities associated with the reversal of biodiversity loss and measures to enhance biodiversity and nature more broadly. The estimated financial needs are large. According to estimates by UNEP, developing countries will require more than \$300 billion per year by 2035 to adapt to climate change, which is one driver of biodiversity loss. The estimates further suggest that more than \$600 billion per year will be needed by 2030 to directly reverse biodiversity and nature loss. There are large uncertainties associated with these figures and there is certainly also the problem of double counting. Nevertheless, large financing gaps clearly exist and they create investment opportunities in areas such as ecosystem restoration, regenerative agriculture, water infrastructure, nature-based solutions, and other activities that preserve or rebuild natural capital.

Yet many of these opportunities are difficult to make investable. The reason is that most ecosystem benefits are public goods, cash flows can be difficult to contract upon, and ecological outcomes are hard to verify. Mobilizing private capital therefore requires not only money but also credible measurement, project pipelines, risk-sharing structures, and financial innovation. Better nature data are particularly important because they can help distinguish projects that genuinely improve ecological outcomes from those that merely carry a “nature-positive” label.

6. Where could the next research frontier be?

One of the next frontiers in nature finance, from my perspective, is the shift from broad company-level indicators toward spatially explicit, asset-level measures. Nature is inherently local. Unlike a ton of carbon dioxide, whose climate effect is largely independent of where it is emitted, biodiversity impact depends heavily on location. Converting one hectare of land in an ecologically intact habitat can be far more damaging than converting the same area in a location with low conservation value. The same is true for physical dependencies: water scarcity, habitat condition, and ecosystem services can differ massively across sites.

In Gong *et al.* (2026), we illustrate how such research at the asset level could look like by quantifying the biodiversity impact of renewable-energy plants. Renewable energy is indispensable for climate mitigation, but solar, wind, and hydro plants can destroy habitats, fragment ecosystems, and—in the case of wind—cause wildlife deaths through turbine collisions. In our paper, we combine spatial biodiversity data, satellite imagery, and asset-level

information on more than 45,000 renewable-energy plants around the world to construct a global measure of land-use-induced biodiversity impact.

The biodiversity measure we use is based on the IUCN Species Threat Abatement and Restoration metric, specifically the Threat-Abatement STAR ($STAR_T$), a spatially explicit and species-based metric with high granularity. Based on the measure, each 5×5 km grid cell of land receives a score reflecting the share of species' global habitat located there and the extinction risk of those species. Intuitively, $STAR_T$ captures how much global species-extinction risk could potentially be reduced if current threats were removed. We identify the land area used by each renewable-energy plant and aggregate $STAR_T$ across that footprint. Satellite imagery is crucial for our analysis because the physical footprint of a plant is not reliably captured by installed power capacity alone.

We find some surprising results. The top 1% of renewable-energy plants account for about 70% of estimated biodiversity impact while representing only around 3% of capacity. This concentration of biodiversity impact means that large reductions in impact may be possible without sacrificing much renewable-energy deployment. In a hypothetical counterfactual exercise, we illustrate that relocating the highest-impact solar and wind plants to realistic alternative sites within 10 km would lower their estimated biodiversity impact by about 86%.

It is important to emphasize that the message of our analysis is not that renewable energy should be slowed. Instead, it is that the same energy transition can potentially be achieved with substantially less biodiversity damage through smarter siting decisions. Finance matters for these siting choices. We show that biodiversity impacts differ systematically with ownership and financing structures. Plants owned by financial firms have lower impacts than those owned by non-financial firms, and project-financed plants are associated with lower-impact siting than plants financed on corporate balance sheets, after accounting for a rich set of project characteristics. These findings illustrate a broader point: when nature metrics become granular enough to attach to individual assets, they can enter due diligence, project finance, covenants, stewardship, and capital-allocation decisions directly.

Future research could extend this asset-level approach beyond renewable energy and across different dimensions of nature risks. By combining geocoded information on mines, factories, data centers, agricultural assets, or infrastructure with high-resolution measures of biodiversity, water scarcity, ecosystem condition, and species distributions, researchers can identify where corporate activities create the greatest impacts on—and dependencies on—nature. Such data could allow researchers to examine whether these exposures are priced by financial markets, affect lending and investment decisions, or translate into operational and regulatory risks. Some work in this direction already exists, albeit typically not at a global scale and for a large sample of assets.

Most importantly, spatially explicit measures can move nature finance from broad assessments of whether a company is exposed to nature toward identifying which assets create or face risks, where those risks arise, and how companies and financial institutions can mitigate them. As new disclosure standards will increasingly require companies to provide more granular information on the locations of their assets and operations, it will become easier for researchers to link corporate activities to spatially explicit measures of nature impacts and dependencies.

7. What are the implications for investors and banks?

What does this evidence imply for investors and banks? First, nature risk should not be reduced to a single generic ESG score. Transition risk is fundamentally about a company's impact on nature and the economic response to that impact. Physical risk is about dependence on ecosystem services and the consequences of their deterioration. The two require different data and different analytical frameworks.

Second, measurement needs to be connected to financial mechanisms. A biodiversity footprint becomes financially material when it affects expected cash flows or required returns through regulation, litigation, technology, or preferences. A dependence measure becomes financially material when an ecosystem service deteriorates and the company cannot adapt cheaply. Investors and banks therefore need to move beyond measuring exposure toward identifying the shocks that can turn exposure into losses.

Third, nature finance will increasingly become spatial. Company-level measures are valuable for screening portfolios and identifying broad exposures, but the most actionable information often sits at the asset level. Geospatial data, satellite imagery, and science-based biodiversity metrics can show where a project is located, which species and ecosystems are affected, and whether a nearby alternative could achieve the same economic objective with a smaller ecological footprint. That is a much stronger basis for investment decisions than a generic nature score.

Nature loss is therefore becoming part of mainstream financial analysis for a simple reason: it can affect cash flows, risks, and investment opportunities. The data are still developing, and important methodological challenges remain. Despite these limitations, companies already perceive material nature risks, investors are beginning to price and engage on them, and new spatial tools can identify where capital allocation can make the largest difference. The opportunity for finance is to use that information to make better economic decisions. Doing this will require much closer interaction among finance, ecology, conservation biology, geography, remote sensing, and data science.

Where else in finance is the potential for interdisciplinary work—and its contribution to a better world—as great?

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