

Nature is too big to fail

**Biodiversity: the next frontier
in financial risk management**



“ Together, the loss of nature and climate change are the “twin emergencies” facing humanity; turning a blind eye to either can leave businesses vulnerable and exposed to risks.”

The Nature of Risk Report, WWF, 2019

Foreword

Climate stability and biodiversity are ultimately two sides of the same coin. President Macron and President Xi emphasized this in their “Beijing Call” in autumn 2019, highlighting the crucial role of private and public financial flows to combat climate change and halt biodiversity loss.

Never in human history has biodiversity declined as fast as it does today. We are facing the 6th mass extinction and could witness up to 1 million species being wiped out by the end of the century. Land-use change, overexploitation, ocean acidification and pollution are bringing many ecosystems to the brink. Climate change is further accelerating the extinction of species and leading to rapid changes in ecosystems. This in turn is drastically limiting natural carbon sequestration by ecosystems, which is further worsening climate change. The result is a negative feedback loop, which decision-makers, the financial sectors and regulators have so far almost completely ignored.

Recently, awareness of the climate crisis we face has increased. In the wake of this, willingness has been growing to regulate the financial sector and align financial flows in order to limit global warming to no more than 1.5°C. Three initiatives highlight this trend: 1) the EU has set out an Action Plan for Sustainable Finance, adapting several pieces of financial regulation; 2) central banks and financial regulators have come together in the Network for Greening the Financial System (NGFS) and have started measuring the implications of climate change on financial stability; and 3) the Coalition of Finance Ministers to combat climate change intends to reduce the risks of climate change. All these initiatives focus foremost on climate change. The deep interconnection and feedback loop that exist between biodiversity loss and climate change are unfortunately not yet recognised by these and similar initiatives. As a result, the financial risks related to climate change are systematically undervalued.

Luckily, some actors have started to recognise biodiversity-related financial risks. The French Parliament recently amended Article 173, which requires the disclosure of biodiversity impacts. The Taxonomy of the EU Action Plan on Sustainable Finance is a further indication that the next frontier of environmental risk is biodiversity loss. The NGFS is committing additional resources to analysing environmental risks, while some central banks are starting to measure the impact of biodiversity loss on financial stability.

However, the steps announced so far remain too slow and not far-reaching enough. Biodiversity holds key solutions to mitigate and adapt to climate change, but current investments in biodiversity are ten times less than what is needed. There is still no widely accepted tool to evaluate biodiversity-related financial risks, nor a broadly accepted reporting standard for biodiversity-related financial risks and impacts. Lastly, the magnitude of biodiversity loss, its relevance for all economic sectors and how it translates into financial risks are still insufficiently understood.

Governments have an unprecedented opportunity in 2020 to address this problem and take action. At PwC and WWF, we believe 2020 will be a decisive period, with the adoption of the new Global Framework on Biodiversity in Kunming (China). This offers governments a unique opportunity to send a strong signal to the financial system to bring financial flows in line with the need for biodiversity conservation and restoration. A crucial first step is to create a task force on nature-related financial disclosures and to acknowledge the current funding gap – of over half a trillion US dollars per year – for biodiversity conservation and restoration. A further essential step is to ask all financial actors and regulators to disclose their biodiversity-related financial risks and biodiversity impact, and specify that the fiduciary duty of every financial actor includes the need to conserve and restore biodiversity.

If we think back to the autumn of 2008 and the aftermath of the near meltdown of the financial sector, it was impressive how quickly governments and central banks reacted in a coordinated manner – and what sums were made available at short notice to save the financial industry from a self-inflicted problem. However, at this very moment we are facing a crisis which is far more dangerous and will impact our lives but also the lives of our children, grandchildren and all subsequent generations.

Why were the decision-makers back then able to save one single industry? Because they knew that the crisis, if uncontained, would have severe and potentially catastrophic effects on the rest of the world economy. We need the same determination in 2020 as we saw in 2008 if we are to enable our economies, our societies, and not least nature, to thrive.

Facing the worst man-made crisis ever, humanity is in urgent need of a “New Deal for Nature and People”. All market, governmental and civil society actors are needed to make this a reality. Nature is too big to fail. Biodiversity is the foundation for all human activity, and thus also the foundation of the financial system.



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1. Introduction

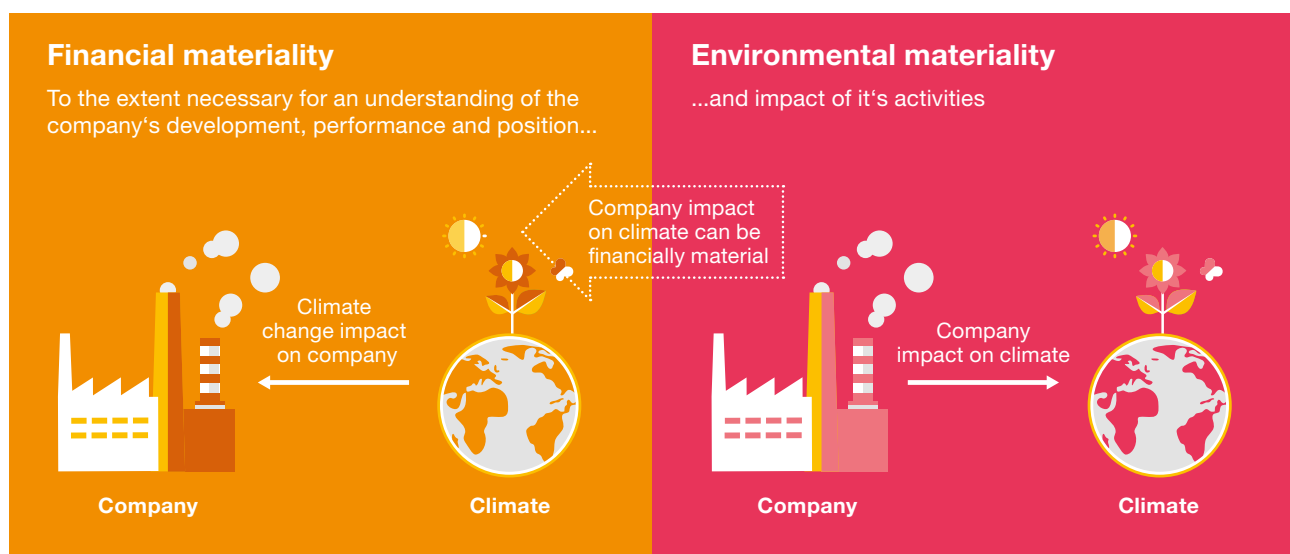
“Climate-related risks are a source of financial risk”, stated the Network on Greening Financial Systems (NGFS) – a group of over 40 central banks and financial regulators. Climate-related financial risks are recognised as being part of their mandate. This is also a signal for financial actors such as banks, insurers, pension funds and asset managers to take these risks into account – as it is part of the state-of-the-art risk management process. Furthermore, climate alignment of financial flows and reduction of climate-related financial risks are increasingly becoming a regulatory request. The EU Action Plan on Sustainable Finance is the best example of how the financial sector can become the key sector to achieve the Sustainable Development Goals (SDGs) or the Paris Agreement on Climate Change. The EU Action Plan is also an indicator of the willingness of policymakers to utilise the power of financial flows to transform the real economy for “good”. All these initiatives acknowledge the “double materiality”, indicating that sustainability issues are firstly a risk and/or an opportunity for the financial sector, and secondly, that financial flows either positively or negatively influence climate change and biodiversity (see graph below).

The relationship between sustainability themes and financial flows has been particularly well discussed and researched regarding climate change. But it is just one of many relevant and important environmental issues. This is also recognised by the EU Commission within the EU Action Plan on Sustainable Finance and by the NGFS, as they both indicate that the reflections on environmental risks and opportunities must begin with climate change and then be subsequently

expanded to other environmental and social issues. The last G7 Conference, held in France in 2019, underlined that biodiversity is most certainly the next frontier for financial market policy and regulation. Bringing together biodiversity and financial flows is, however, nothing new. The United Nations Environment Programme Finance Initiative held a workshop in 2007 on “Biodiversity risks and opportunities in the financial sector”, and the International Union for Conservation of Nature published a report in 2008 entitled “Biodiversity, the next challenge for financial institutions?”.

Despite this rather long-lasting interest in biodiversity loss, it seems that 2020 will be a pivotal year, with a particular focus on the nexus between biodiversity loss and financial flows. First signals are apparent. French President Macron and Chinese President Xi announced in November 2019 the “Beijing Call on Biodiversity Conservation and Climate Change”, expressing the need to “make finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development, as well as for the conservation and sustainable use of biodiversity”. Furthermore, the work on the EU Taxonomy for sustainable activities by the European Commission has focused mainly on climate change mitigation and adaptation and is likely to extend to biodiversity as the next topic. Lastly, a number of business leaders like Paul Polman (Unilever), Thomas Lingard (Unilever), Zhao Xin (Yili Group) have indicated that biodiversity is of particular interest given its extensive risks and opportunities.

Interaction between financial sector and environment: double materiality



Source: adapted from https://ec.europa.eu/finance/docs/policy/190618-climate-related-information-reporting-guidelines_en.pdf

“Climate-related risks are a source of financial risks.”

Network on Greening Financial Systems (NGFS), 2018

With the UN Biodiversity Conference in Kunming (China) coming up in autumn 2020, it is very likely that the next frontier of sustainable finance will be biodiversity, including water and air pollution, deforestation, land degradation, desertification, pollution, overfishing, unsustainable offtake of wild animals or plants, and the extinction of species (see also Environmental Finance, 2019). Governments will discuss how to halt biodiversity loss and reduce the effects of climate change on ecosystems, focusing particularly on the role financial flows play, which will in turn result in a set of new requests for the financial sector.

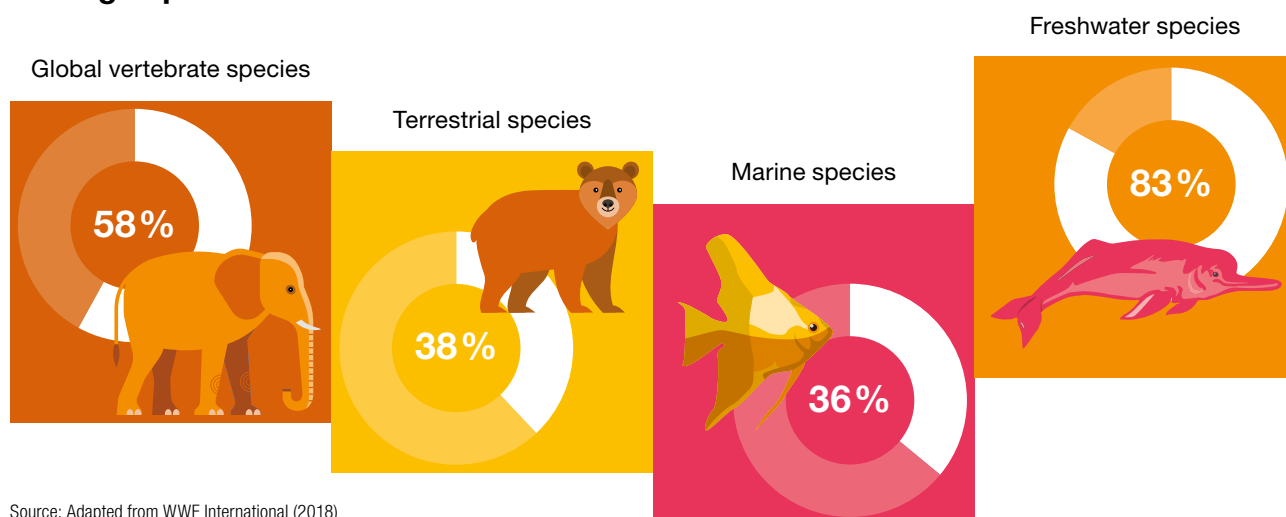
This report focuses particularly on the financial risks stemming from biodiversity loss, as it is the primary role of the financial sector to assess, evaluate and manage financial risks. Opportunities regarding biodiversity loss are briefly alluded to. The first chapter defines the concept of “biodiversity”, provides examples of how biodiversity relates to economic and financial value and, lastly, provides a typology of biodiversity-related financial risks – inspired by the concept of climate-related financial risks. The second chapter analyses how climate change and financial flows got interconnected and became one of the most pressing issues on the international agenda, and then compares it to the current status quo regarding biodiversity. This chapter aims to draw lessons from the climate debate in order to find leverage points to make biodiversity loss and financial flows a key priority for policy-makers and decision-makers in the financial sector. Chapter 3 provides insights into how financial actors could already start managing and potentially reducing their exposure to biodiversity-related financial risks today. Chapter 4 comprises concluding remarks and chapter 5 provides a set of recommendations for policymakers and decision-makers in the financial sector on how to adequately manage biodiversity-related financial risks.

1.1. Definition of biodiversity

Biodiversity means all life on earth. The most commonly used definition of biodiversity – from the Convention on Biological Diversity (CBD) – defines it as diversity of species, variation of genes and different ecosystems. In the 1990s there were conflicting views on how to define and measure biodiversity. Initially, only species abundance was referred to, without encompassing genetic variation or ecosystem diversity. The greater the biodiversity, the better – for any ecosystem. A healthy ecosystem like a forest or a coral reef with a rich level of biodiversity is more resilient to external shocks, like extreme weather events, wildfires, pests or diseases. Lakes, wetlands, rivers and other ecosystems can restore themselves faster after a single shock event if they have rich biodiversity. In this report, we use the term biodiversity to encompass ecosystems that are often referred to as nature/natural systems. However, biodiversity also means species variation and genetic variation, which is broader than just the features of ecosystems.

There are more than 10 million different species of animals, plants, fungi and micro-organisms living on earth. While humans use only around 40,000 plants and animals for food, shelter, clothing or medicine on a daily basis, thousands of species are yet to be discovered and their purpose and use for human society is still unknown (CIFOR, 2019). All societies depend on biodiversity for their very survival, but the biosphere is declining faster than at any time in human history (IPBES, 2019). In the last 50 years, global wildlife populations have declined by 60 %, leading to a global environmental crisis which is often referred to as the 6th mass extinction. The massive degradation of oceans, forests, freshwater bodies and other ecosystems is undermining nature’s ability to provide vital goods and services for all societies to thrive.

Average species decline 1970–2018



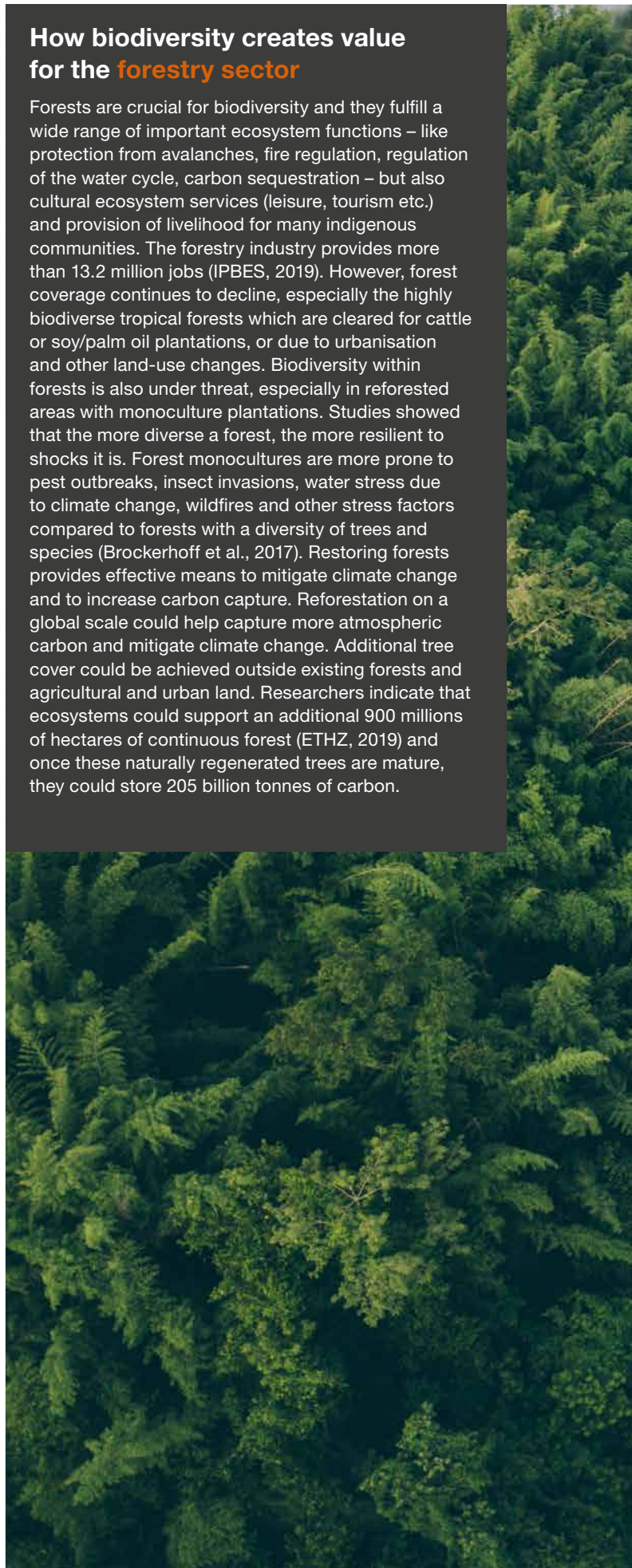


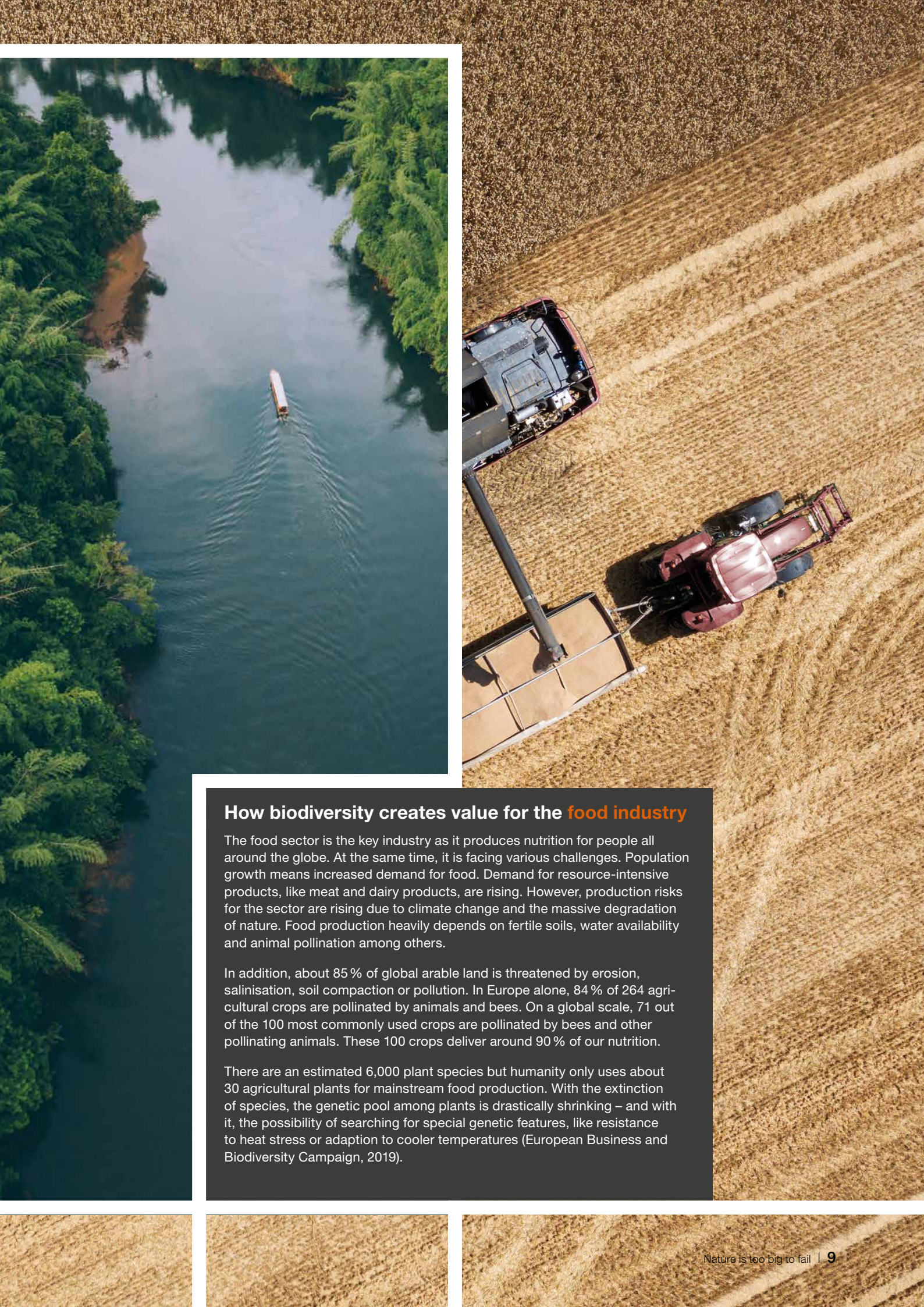
How biodiversity creates value for the **pharma sector – gene diversity**

Many therapeutic drugs have been derived from plants, animals, fungi or bacteria. For the modern pharmaceutical industry, biodiversity equals chemical diversity. Biomass diversity is essential for the screening and development of new drugs: roughly 70 % of all cancer drugs have a natural origin. 118 of the 150 most prescribed medications in the US (for example, antidepressants, antibiotics and antiplatelets) are developed from natural resources (European Business and Biodiversity Campaign, 2019). The sales volumes of the top 15 drugs in the US in 2018 was nearly USD 117 billion (GENENG News, 2019). With the loss of biological diversity, the potential to develop new drugs is dramatically shrinking, with costs increasing to replace these substances by screening large-scale synthetic products (Young, 1999). Natural products offer a vast source of chemical diversity and yield unusual and unexpected lead structures.

How biodiversity creates value for the **forestry sector**

Forests are crucial for biodiversity and they fulfill a wide range of important ecosystem functions – like protection from avalanches, fire regulation, regulation of the water cycle, carbon sequestration – but also cultural ecosystem services (leisure, tourism etc.) and provision of livelihood for many indigenous communities. The forestry industry provides more than 13.2 million jobs (IPBES, 2019). However, forest coverage continues to decline, especially the highly biodiverse tropical forests which are cleared for cattle or soy/palm oil plantations, or due to urbanisation and other land-use changes. Biodiversity within forests is also under threat, especially in reforested areas with monoculture plantations. Studies showed that the more diverse a forest, the more resilient to shocks it is. Forest monocultures are more prone to pest outbreaks, insect invasions, water stress due to climate change, wildfires and other stress factors compared to forests with a diversity of trees and species (Brockhoff et al., 2017). Restoring forests provides effective means to mitigate climate change and to increase carbon capture. Reforestation on a global scale could help capture more atmospheric carbon and mitigate climate change. Additional tree cover could be achieved outside existing forests and agricultural and urban land. Researchers indicate that ecosystems could support an additional 900 millions of hectares of continuous forest (ETHZ, 2019) and once these naturally regenerated trees are mature, they could store 205 billion tonnes of carbon.





How biodiversity creates value for the food industry

The food sector is the key industry as it produces nutrition for people all around the globe. At the same time, it is facing various challenges. Population growth means increased demand for food. Demand for resource-intensive products, like meat and dairy products, are rising. However, production risks for the sector are rising due to climate change and the massive degradation of nature. Food production heavily depends on fertile soils, water availability and animal pollination among others.

In addition, about 85 % of global arable land is threatened by erosion, salinisation, soil compaction or pollution. In Europe alone, 84 % of 264 agricultural crops are pollinated by animals and bees. On a global scale, 71 out of the 100 most commonly used crops are pollinated by bees and other pollinating animals. These 100 crops deliver around 90 % of our nutrition.

There are an estimated 6,000 plant species but humanity only uses about 30 agricultural plants for mainstream food production. With the extinction of species, the genetic pool among plants is drastically shrinking – and with it, the possibility of searching for special genetic features, like resistance to heat stress or adaption to cooler temperatures (European Business and Biodiversity Campaign, 2019).

“Is it just me,
or is it getting crazier out there?”

Joker, 2019

1.2 Climate change and biodiversity

Climate change, with its increase in temperatures and shifts in precipitation, is a key driver of biodiversity loss. Even a small increase in average temperature affects ecosystems: species must either adapt or migrate elsewhere, or they will go extinct. In addition, the loss of biodiversity substantially reduces the capacity of ecosystems to sequester carbon. Marine and terrestrial ecosystems are the sole sinks for anthropogenic carbon emissions, with a gross sequestration of 5.6 gigatonnes of carbon per year – the equivalent of 60 % of global anthropogenic emissions (IPBES, 2019). The more the climate changes, the more biological diversity will be lost, which advances further climate change. The perfect negative spiraling loop. Climate change combined with a decline in species also results in more land degradation, reduced agricultural productivity and decreased water quality (Australian Academy of Science, 2015). As extreme weather events get more intense, more frequent and more disturbing, wildfires, cyclones, drought and flooding will take a heavy toll on ecosystems that are already under stress. Climate change thus further decreases ecosystems' resilience and hence makes them even more vulnerable to pests and diseases.

Biodiversity risks have been ignored in current financial risk models. Not taking biodiversity loss into account

Implications for biodiversity of global warming: **1.5°C**

One ice-free
Arctic summer per
100 years

Limiting warming to **1.5°C** rather
than **2°C** would prevent the thawing
over centuries of **1.5–2.5 million km**
of permafrost

70–90%
decline of
coral reefs

Source: IPCC (2018)

massively undervalues the negative implications of climate change for human wellbeing, including substantial financial consequences. If the financial sector wants to minimise climate risks, and thereby contribute to climate change mitigation and adaptation, it needs to consider biodiversity restoration and conservation. Current climate risk models, which neglect financial risks related to biodiversity loss, considerably undervalue the financial implications of climate change.

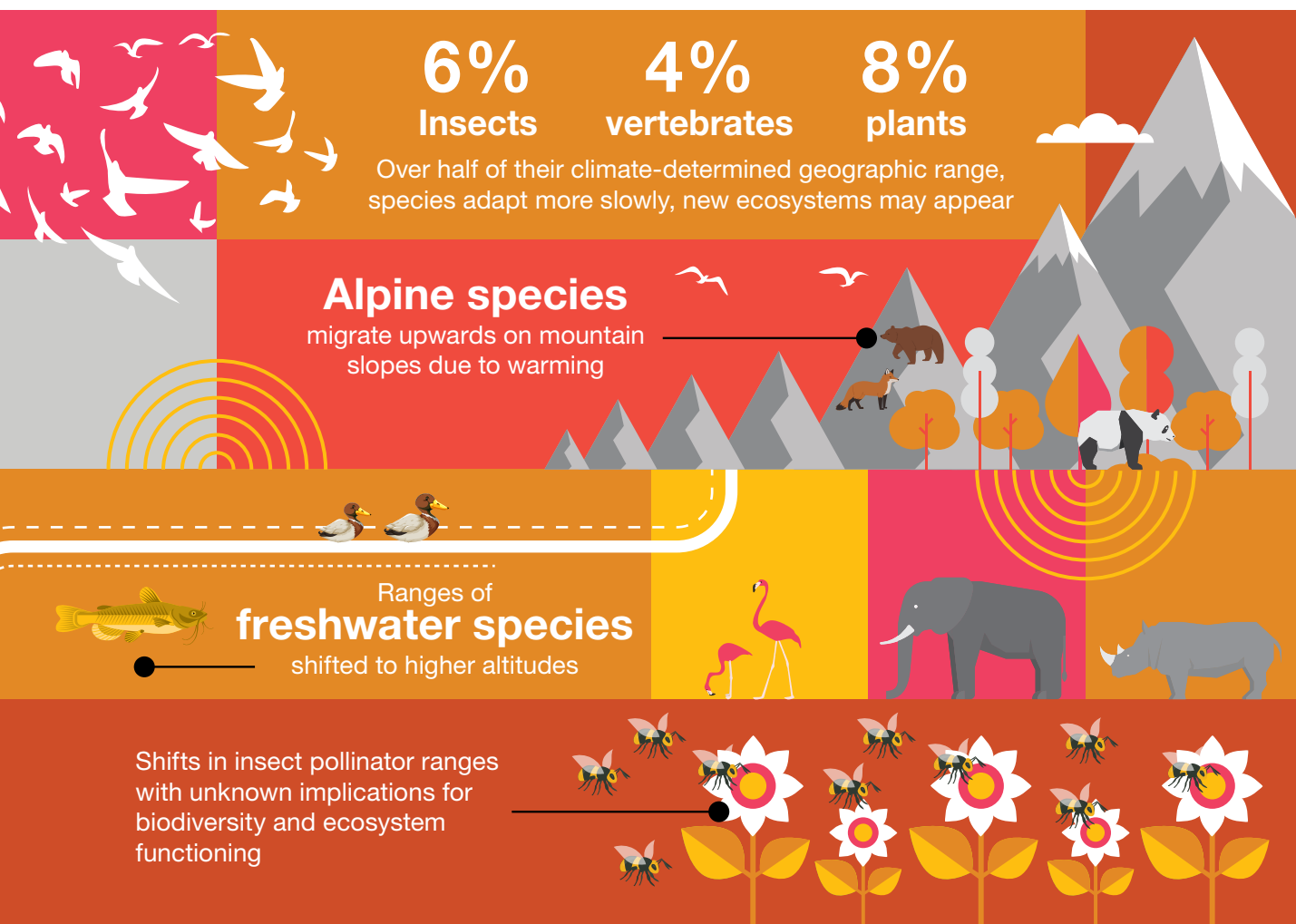
Finance Watch (2019) states this clearly: “Recent reports by the IPCC and IPBES leave little doubt: the combination of climate change and the depletion of biodiversity and ecosystems puts our societies on the path to environmental collapse.”

In order to limit global warming, decisive action is needed to protect and enhance carbon sinks on land and in the oceans through ecosystem-based approaches. Recent science shows that natural climate solutions could provide around 30 % of climate mitigation by 2030 (Griscom et al., 2017). Natural climate solutions – meaning the sustainable production of forest and agricultural practices along with conserving and restoring forests, grasslands and wetlands – could increase carbon storage or avoid greenhouse gas emissions in landscapes across the globe.

1.3 Biodiversity loss equals economic loss and is thus a financial risk

Attempts to quantify economic losses due to biodiversity decline have increased in the last 30 years. In addition, many empirical studies have estimated the monetary value of the benefits provided by ecosystem services at the local, regional and global scale. These initiatives include the Economics of Ecosystems and Biodiversity programme (TEEB), the Millennium Ecosystem Assessment (MEA), the Natural Capital Finance Alliance and more recently the OECD and various other national ecosystem assessments.

Biodiversity and ecosystem destruction can jeopardise the supply chain and operations of businesses. Interruptions to production and distribution of goods and services have surged by 29 % due to nature risks (WEF, 2019). The TEEB programme estimated that the economy is losing land-based ecosystem services worth around USD 50 billion each year. It is further assumed that if these ecosystem losses continue over time, the associated costs could mount to 7 % of global GDP by 2050 (Braat et ten Brink, 2008). More recently, Robert Costanza has estimated the annual value of global ecosystem services at USD 125 trillion dollars, including drinking water, fresh air, heat absorption, forests and oceans, food and pollination. Assuming that natural



pollination by insects needs to be replaced by artificial pollination (labour and technology) this would cost about EUR 153 billion every year (WWF/AXA, 2019). Overall, such scenarios would put a high pressure on the profitability of business and consequently would result in high financial and investment risks. Therefore, it is vital to mobilise the necessary capital now, to help mitigate these economic risks. Ecosystem valuation has demonstrated that the benefits from ecosystem services far exceed the cost of investment in conservation (Costanza et al., 2014).

Current measurement tools for climate-related financial risks significantly undervalue environmental financial risks because they do not integrate other sources of environmental risk besides climate risks – i.e. they do not integrate the negative spiralling loops created by the loss of biodiversity.

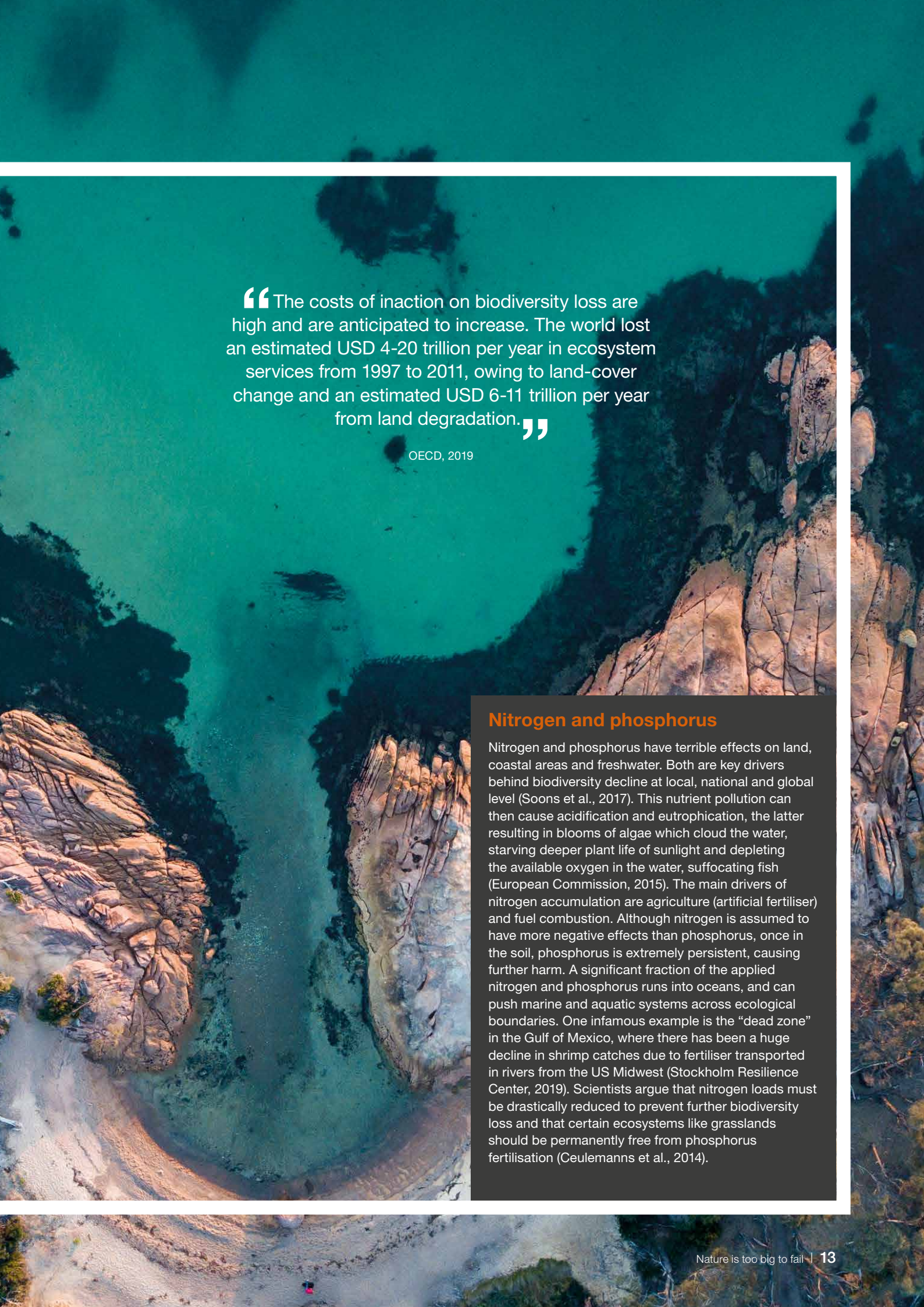
Biodiversity loss and its implications for the real economy are well known and documented. However, the financial risks emerging from biodiversity loss are still not sufficiently understood. In a first systematic academic literature review, the Hamburg University's Research Group on Sustainable Finance assessed more than 150 scientific articles and concluded that, overall, nature loss translates to financial risks. Further academic studies are needed to better understand these effects. Also the OECD pointed out that the loss of biodiversity and destruction of the ecosystem can affect the business of financial institutions, indicating that it can increase their operating cost and risks, directly affecting their performance (OECD, 2019).

Finance Watch (2019) indicates that “the risk of environmental collapse, resulting from natural capital depletion, is more and more described as a systemic risk: i) intrinsically systemic because of complex mapping of interdependence and interconnectedness between elements of the ecosystem, but also (ii) potentially financially systemic because the financial system shares similar characteristics and risks of contagion. Consequently, there is a need to assess risks at the aggregate level, requesting central banks and supervisory authorities to map these risks, model their interactions with the economic and financial system, and, most of all, to mitigate them by finally acting on the causes.”

Biodiversity loss can also have adverse effect on collateral properties hence worsening the losses of default, or translate to financial risks resulting in a decline in property prices, stock prices (market valuation) as well as bank defaults (Klomp, 2014; Schüwer et al., 2019). The following non exhaustive list of financial risks (WWF, Nature of Risk Report, 2019) can be associated to biodiversity loss:

- increased cost of capital or lending requirements;
- write-downs of asset value and write-offs of assets;
- increased insurance claims;
- higher premiums; loss of insurance value Increased risk of default;
- loss of investment value related to reputational risks;
- changes in market value of the business





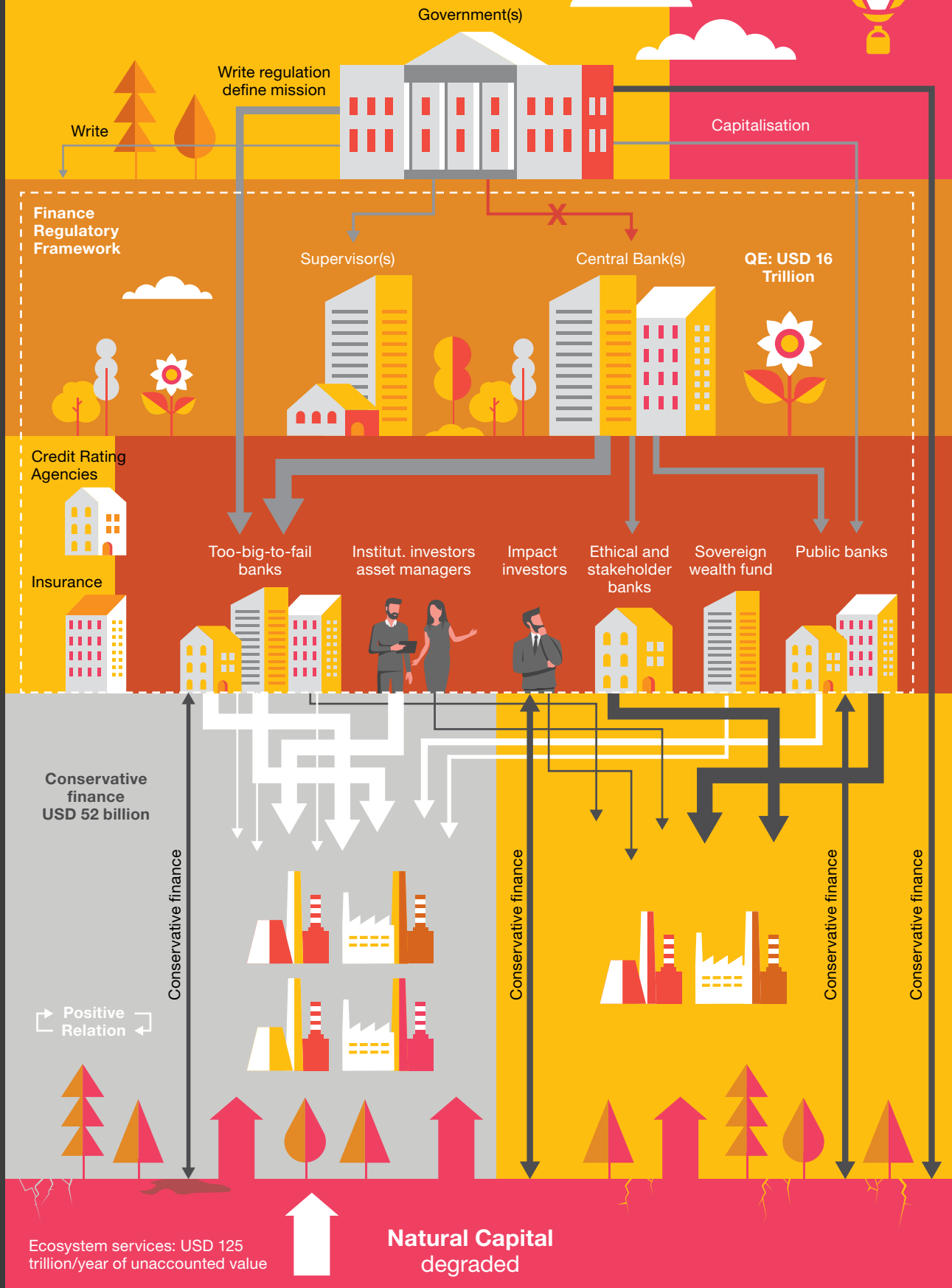
“The costs of inaction on biodiversity loss are high and are anticipated to increase. The world lost an estimated USD 4-20 trillion per year in ecosystem services from 1997 to 2011, owing to land-cover change and an estimated USD 6-11 trillion per year from land degradation.”

OECD, 2019

Nitrogen and phosphorus

Nitrogen and phosphorus have terrible effects on land, coastal areas and freshwater. Both are key drivers behind biodiversity decline at local, national and global level (Soons et al., 2017). This nutrient pollution can then cause acidification and eutrophication, the latter resulting in blooms of algae which cloud the water, starving deeper plant life of sunlight and depleting the available oxygen in the water, suffocating fish (European Commission, 2015). The main drivers of nitrogen accumulation are agriculture (artificial fertiliser) and fuel combustion. Although nitrogen is assumed to have more negative effects than phosphorus, once in the soil, phosphorus is extremely persistent, causing further harm. A significant fraction of the applied nitrogen and phosphorus runs into oceans, and can push marine and aquatic systems across ecological boundaries. One infamous example is the “dead zone” in the Gulf of Mexico, where there has been a huge decline in shrimp catches due to fertiliser transported in rivers from the US Midwest (Stockholm Resilience Center, 2019). Scientists argue that nitrogen loads must be drastically reduced to prevent further biodiversity loss and that certain ecosystems like grasslands should be permanently free from phosphorus fertilisation (Ceulemanns et al., 2014).

Finance interacts with nature/ Nature interacts with finance



Source: adapted from Finance Watch (2019).

1.4 Biodiversity-related financial risks

The Task Force on Climate-related Financial Disclosure (TCFD) was convened to address concerns that companies are not sufficiently disclosing the impacts that climate change poses to their strategy, businesses and financial plans. Without adequate disclosure markets cannot function efficiently and risks are not appropriately priced. The TCFD was established by the Financial Stability Board in 2015 and has gained tremendous relevance. Since its inception, companies supporting the TCFD recommendations have grown to 960 as of December 2019. The TCFD recommendations have become the leading standard for climate-related financial disclosures and have been adopted and integrated by many sustainable finance initiatives such as UN PRI, UN PRB, CDP, just to name a few. The TCFD agreed to use two categories of climate related risks, namely: 1) risks related to the transition to a lower-carbon economy, and 2) risks related to the physical impacts of climate change. Transition risks refer to policy and legal risks, technology, market and/or reputation risks. Physical risks are categorized between acute and chronic. This typology is simple and effective and helps financial decision-makers to better integrate climate change-related risks.

Regarding biodiversity loss, there are basically two efforts of categorizing biodiversity loss with economic risks. Firstly, the PwC/WEF briefing (2010) “Biodiversity and business risk”, that categorized biodiversity risks as physical, regulatory and legal, market and other risks. The WWF “The Nature of Risk” report published in 2019, which is more granular and differentiates between physical, regulatory and legal, market, reputational, and financial risk.

Based on the positive experience with the TCFD framework and the two initial typologies which relate biodiversity loss to economic risks, the authors at PwC and WWF suggest the following definition of biodiversity-related financial risks. This should help to inform financial institutions and regulators to use a simple but effective framework and could be the basis for a future Task Force on Nature-Related Financial Disclosures (TNFD).¹

Definition of biodiversity related financial risks

1. Risks related to the transition to an economy which conserves and restores biodiversity.
2. Risks related to the physical impacts of biodiversity loss.
3. Risks related to litigation pertaining to biodiversity loss and breach of the underlying legal frameworks.
4. Risks related to systemic impacts of biodiversity loss.

To exemplify these risk categories better, examples are described on the next two pages.

“History proves ... that a smart central bank can protect the economy and the financial sector from the nastier side effects of a stock market collapse.”

Ben Bernanke, Foreign Policy, 2000

¹ It is recommended to review TCFD and to distinguish between four risk categories: physical risk, transitional risk, litigation risk and systemic risk. Such a distinction provides for a clear risk concept and thus better differentiation and assessment of the individual risks.

1. Transition risk

Businesses can face biodiversity risks related to the transition to an economy which conserves and restores biodiversity. These transition risks may entail extensive regulatory, legal, technological and market changes and may lead to reputation risks.

In order to conserve and restore biodiversity, policy-makers respond with regulatory changes such as restrictions on access to land and resources, quotas and thresholds, disclosure requirements, compensation costs and taxes, procurement standards, licensing and permitting procedures, or even prohibitions and bans. For affected businesses this can lead to higher costs and to a higher litigation risk if the requirements are not met.

Technological innovations towards more sustainable technologies can be a risk for fossil-fuel-based systems and disrupt their businesses. The transition to a biodiversity-friendly economy will certainly change consumer preferences (market risks) and go hand in hand with financial risks such as increased costs of capital or lending requirements, asset write-offs, increased insurance claims, higher premiums and loss of insurance value.

The negative perception of a business is a severe reputational risk and negative press coverage can even lead to a business going bankrupt.

Examples

- Image loss resulting from failure to switch to biodiversity management practices. Moreover, potential financial damages are a consequence of the occurrence of specific events, or entities which are exposed to potential damages, independently of any concrete event arising, simply by having a business relationship with an entity that may be exposed to a biodiversity risk (e.g. financial institutions were accused of being directly or indirectly involved in deforestation in the Brazilian Amazon, the Congo Basin and Papua New Guinea).
- Studies have shown a negative correlation with the deepwater oil spill caused by Exxon and its stock price (Heflin & Wallace, 2017; Hsu, Liu, Yang, & Chou, 2013; Humphrey, Carter, & Simkins, 2016; Lee & Garza-Gomez, 2012; Sabet, Cam, & Heaney, 2012). By the end of June 2010, the oil and gas industry had lost about USD 463.1 billion in market capitalisation (Lee & Garza-Gomez, 2012). Based on market-based measures, Lee & Garza-Gomez (2012) estimate that as of 19 September 2010 there had been a loss in market capitalisation of up to USD 562.0 billion. This loss was mainly borne by Exxon itself and some of its partners. Thus, a corporate disaster can adversely affect a firm's market valuation resulting from regulatory or legal issues, technological improvement, fines, clean-up costs or reputation costs (Heflin & Wallace, 2017; Lee & Garza-Gomez, 2012; Sabet et al., 2012), as described in an article by Busch et al. (2019).
- In 2008 the Norwegian Pension Fund withdrew its GBP 500 million stake in the mining giant Rio Tinto and excluded the company from its funds. The decision to withdraw was based on Rio Tinto's mining operations in Indonesia (Global Witness, 2019).

2. Physical risk

Physical biodiversity risks arise from material destruction causing direct economic and financial losses for businesses and investors. The materialisation of biodiversity risks can damage assets and infrastructure or cause a deterioration in supply chains or business operations (resource dependency, scarcity and quality). There are acute risks which are event-driven and risks which are chronic because they materialise over the longer term.

Examples

- A 28 % reduction in mangrove cover between 1980 and 2002 in South East Asia to make way for commercial shrimp farming has contributed to a loss of natural protection against tsunamis and cyclones. This was tragically demonstrated during the 2004 South Asian Tsunami, when coastal areas still covered by mangroves were relatively less affected, as the mangroves acted as a natural defence. In other words, a reduction in biodiversity leads to a higher default risk for financial institutions. In addition to their vital role in coastal protection, these coastal features are critical for many marine food chains, comprising vital nursery areas and habitats for commercially valuable fish and shellfish species. As we look to the future, with the prevalence of denser populations in coastal areas, the human and economic costs of damage to coastal ecosystems are set to grow.
- Studies have shown that the total economic impact of Hurricane Katrina (approximately USD 150 billion) was significantly higher than would have been the case if coastal wetlands in the region had been preserved.
- Millions of tourists and visitors travel to see the wonders of nature in the Maldives, Costa Rica and Australia. Half of all leisure trips are to natural areas rich in biodiversity, such as beaches, coasts and islands, mountains, rivers and lakes. These diverse ecosystems attract millions of visitors. Protected areas alone receive roughly 8 billion visits per year, which resulted in up to USD 600 billion in direct in-country expenditure and USD 250 billion in consumer surplus. The way these ecosystems are managed will impact the sustainability of tourism. Tourists will not come to polluted or degraded destinations (CBD, 2015). The shrinking of the Caribbean coral reefs has resulted in an accumulated yearly loss of around USD 300 million in diving tourism, for example.

3. Litigation risk

Litigation as pertaining to biodiversity loss and breach of the underlying legal frameworks (e.g. case law or reporting breach of biodiversity loss).²

Example

Bond investors filed securities action against PG&E for misrepresenting efforts to address wildfire risks. Investors in bonds issued by the utility Pacific Gas and Electric Company and its parent company (PG&E) filed a federal securities class action in the Northern District of California alleging that investigations into catastrophic wildfires in California in 2017 and 2018 revealed that PG&E had failed to take proper fire mitigation measures and that the company's failure to do so directly contradicted representations made in offering documents for more than USD 4 billion worth of bonds. The complaint alleged that PG&E had been "implicated in directly causing the two most destructive wildfire events in Californian history in a span of only 13 months". The complaint included allegations that PG&E had stated in offering documents that it had taken precautions to address climate change risks, including wildfire risks, but had failed to disclose "the heightened risk caused by PG&E's own conduct and failure to comply with applicable regulations governing the maintenance of electrical lines, and the hundreds of fires that were already being ignited annually by the company's equipment".³

² Reviewing the TCFD is recommended and to distinguish between four risk categories: physical risk, transitional risk, litigation risk and systemic risk. Such a distinction provides for a clear risk concept and thus better differentiation and assessment of the individual risks.

³ See Sabin Center (2019) litigation database: Center for Biological Diversity v. Bernhardt

⁴ The financial system can be affected exogenously, such as through a biodiversity shock, or endogenously due to a failure in banking functions as a result of biodiversity loss.

⁵ See Koumbarakis (2018)

4. Systemic risk

Systemic risk includes the exogenous⁴ biodiversity risk to the smooth functioning of the financial system as well the risk created endogenously by the financial system.⁵

Example

Beyond the circles of the financial industry, biodiversity loss is believed to have a deteriorating effect on food availability, health and socioeconomic development, with repercussions for well-being and productivity (WEF, 2019). All actors in the finance industry are affected by the environmental impact generated by today's economy, and by the financial risks they represent. To exemplify it: the climate transition stress-test run by the Central Bank of the Netherlands (DNB) indicated that the capital adequacy ratio can decrease by more than 4 percentage points for Dutch banks and the solvency ratio by more than 10 percentage points for Dutch insurers. However, these current state-of-the-art financial risk measurements run by the DNB, have three flaws:

- they mostly account for either climate-related physical risks or climate-related transition risks, and not a combination of both, and are based on the 2°C alignment models and not the most recent 1.5°C scenario from IPCC
- they fail to integrate biodiversity-related financial risks (physical and transition), despite clear signals that they are financially material
- they fail to account for second-round effects between biodiversity loss and climate change, which are mutually reinforcing.

Thus, even state-of-the-art risk analysis and front-running institutions like the DNB significantly underestimate the risks that emerge from environmental damage. Therefore, it is highly probable that the capital adequacy ratio for banks and solvency ratio for insurers would drop much more if the effective climate-related and biodiversity-related financial risks were integrated into the calculation by the DNB. Given the fact that the Basel III regime requires a minimum capital ratio of more than 4.5 %, the risk is quite significant that biodiversity-related financial risks could result in many banks' capital adequacy ratio falling below the minimum requirement of 4.5 %. This would significantly increase the risk of financial instability. Lastly, the probability of financial instability increases with every day/month/year that passes where climate change and biodiversity degradation are not being tackled simultaneously. The negative spiralling loop will only continue to increase. The graph below illustrates this underestimation.

Current best practice financial risk assessment in 2020:

$$X(\text{total risk}) = x + a$$

x = Financial risks

a = Climate-related transition and/or physical financial risks



Optimal financial risk assessment in 2020:

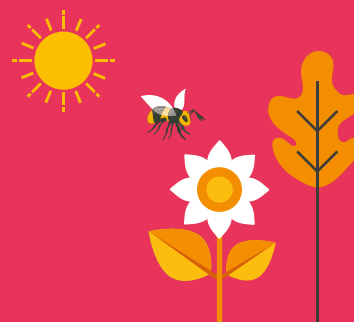
$$X(\text{total risk}) = x + \alpha \cdot (a+b)$$

x = Financial risks

a = Total of physical, transition, litigation and systemic climate-related financial risks – based on 1.5°C IPCC scenario

b = Total of physical, transition, litigation and systemic biodiversity-related financial risks

α = amplifying factor due to feedback loops between climate change and biodiversity loss. $(a+b+c)/(a+b)$ whereas c = Climate- and biodiversity-related financial arising from feedback loops between climate change and biodiversity loss



2. Learning from the climate risk debate: How biodiversity loss is acknowledged as part of conventional financial risks

“The world needs to recognise that loss of biodiversity and human-induced climate change are not only environmental issues, but development, economic, social, security, equity and moral issues as well. The future of humanity depends on action now. If we do not act, our children and all future generations will never forgive us.”

Robert Watson, Chair IPBES, 2019

Climate policy was one of the key global priorities in 2019 for governmental leaders, CEOs and businesses, but also for the financial sector. The WWF/AXA report “Into the Wild” states clearly that there is a lot to learn from the climate change debate in order to mainstream the discussion on biodiversity-related financial risks. According to the authors, the following are the most important factors, which built up the momentum regarding climate change:

International agreement on climate change: The Paris Agreement on climate change, which was signed in 2015 and ratified in 2016, is a game changer. After the failed climate change conference in Copenhagen in 2008, increased international attention, leadership from powerful governments, and rising interest and support from leading corporations and businesses significantly contributed to the successful agreement in Paris. The Paris Agreement became the fastest ratified international environmental agreement. Furthermore, it was the first and remains the only international agreement highlighting the relevance of financial flows in achieving a low carbon economy and keeping global temperature rise well below 2°C. This acknowledgement (in Art. 2.1c) set the expectations for the financial sector and to Governments to ensure that private and public financial flows and subsidies are realigned.

- **Biodiversity status quo:** While there are several conventions and agreements to protect and sustainably use biodiversity, such as the Convention on Biological Diversity (CBD), the Ramsar Convention, the Convention on International Trade of Endangered Species (CITES), the Convention on Migratory Species (CMS), the Berne Convention, the International Whaling Commission (IWC) and the International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA), none of these highlight the fact that private and public financial flows (including subsidies) need to be aligned with biodiversity conservation and restoration.

Climate change is a risk for the economy and the financial sector: The 700-page Stern Review on the Economics of Climate Change, released in 2006, was a huge milestone. The report discussed the effects of climate change on the global economy, stating that climate change is the greatest and widest-ranging market failure ever seen, and estimating the impact of climate change to be equivalent to losing at least 5 % of global gross domestic product (GDP). Since then not only has the economic impact of climate change materialised (disruption of industrial hubs and

global supply chains, more risk-based capital), but the financial sector has also become aware that climate change translates into financial risks. The Government Accountability Office in the United States wrote in their 2017 report that US taxpayers have had to cover costs of more than USD 350 billion over the past decade due to the effects of climate change. The emergence in the 1990s of the concept of sustainable finance as well as the Paris Agreement have been changing the framing of the debate. This framework and the pioneering work of Mark Carney (Governor of the Bank of England) showed that there is a dual interaction between climate change and financial flows. On the one hand, financial flows influence climate change. On the other hand, climate change influences the risks and opportunities associated with financial flows (see page 6). The IPCC states: “Climate change will affect insurance systems (robust evidence, high agreement). More frequent and/or intensive weather disasters as projected for some regions/hazards will increase losses and loss variability in various regions and challenge insurance systems to offer affordable coverage while raising more risk-based capital, particularly in low- and middle-income countries.”⁶

Thus, the financial sector as well as financial regulators and central banks all have a self-interest in proactively managing the financial risks that climate change poses to a single institution or even the whole financial system. Thomas Buberl (CEO, AXA Group) made this clear in 2018 when he said, “we can clearly say that at a scenario between 3 and 4 degrees, it’s not insurable anymore”. This change in the discourse can also be seen in the World Economic Forum’s yearly risk report. Over recent years, climate change has established itself among the most probable and most impactful risks that business leaders fear.

- **Biodiversity status quo:** Academic research on biodiversity loss resulting in financial loss is still limited. Hamburg University’s Research Group on Sustainable Finance found that nature risks indeed translate into some financial risks (November 2019). Earlier in 2019, the NGFS indicated that there are other environment-related risks (credit, market, operational and legal risks, etc.) posed by the exposure of financial firms and/or the financial sector to activities that may potentially cause or be affected by environmental degradation (such as air pollution, water pollution and scarcity of fresh water, land contamination, reduced biodiversity and deforestation)⁷. These environmental risks may influence financial risks and thereby the financial system. The Central Bank of the Netherlands is the first to start actively measuring the impact of biodiversity-related financial risks on the Dutch financial sector – their study will be published some time in 2020. The debate is only just beginning. However, there is a lack of clarity about how high the associated financial risks are, which asset class they hit first, if biodiversity loss is a systemic risk and which methodologies are best suited to measure biodiversity-related financial risks. Furthermore, the concept of “biodiversity-related financial risks” is not yet established in either practice or in academic literature.

Clear quantifiable climate goal: The Paris Agreement on climate change is based on the scientifically accepted assumption that a 2°C increase in the average temperature is the absolute maximum threshold that allows human to continue living on earth. A temperature rise beyond 2°C will result in exceeding tipping points in the climate systems, with irreversible consequences on our planet. The Special Report of the IPCC published in 2018 indicated that a warming of more than 1.5°C above pre-industrial levels is dangerous to humankind and should be avoided at all cost.

- **Biodiversity status quo:** The capacity of the planet to endure environmental damage has a physical boundary. The planetary boundaries project indicates that several of these physical boundaries have already been crossed. Particularly dramatic is the surpassing of the “biodiversity loss”, “phosphorus cycle” and “nitrogen cycle” boundaries. However, a single headline target for biodiversity does not exist and there is no species equivalent or comprehensive methodology to adequately measure biodiversity. Leading scientists Prof. Johan Röckström and Prof. Will Steffen mention that an appropriate and precise apex target still needs to be developed. Regarding the term biodiversity, although the CBD definition is used widely, there are conflicting views on how to define an equivalent to carbon for biodiversity. Different indicators that have been used to indicate biodiversity loss include the extinction per million species per year (E/MSY), the genetic diversity extinction rate and the Biodiversity Intactness Index (BII).

International accounting and reporting standards for the impact of climate change and related financial risks:

In order to report on the impact of financial flows on the environment as well as to establish the financial risks linked to environmental degradation, the access to standardised information is absolutely key. Only information that is consistent, comparable, reliable and clear allows informed decision-making. Regarding climate change, many initiatives emerged in the early 2000s which aimed to measure and account for the effect on climate change or more broadly on the environment. Driven by the aim to be a “good citizen”, many companies started sustainability reporting using standards such as the Global Reporting Initiative, SASB or Integrated Reporting, and/or specifically reported their impact on climate change using, for instance, the Carbon Disclosure Project (CDP). These were important developments that were the foundation of the work by the Task Force on Climate-Related Financial Disclosures, which aims to define a reporting standard that allows companies and financial institutions to measure the financial implications of climate change. As mentioned above, the TCFD recommendations have become the leading standard for climate-related financial disclosures and have been adopted and integrated by many sustainable finance initiatives. Thus, there has been a converging effort to define standards for reporting and measuring the impact of climate change and climate risks, which are becoming more and more recognised or even integrated into international or national law.

⁶ https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap10_FINAL.pdf

⁷ NGFS, 2019 https://www.banque-france.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf

- **Biodiversity status quo:** Regarding biodiversity impact, there is no universally accepted indicator yet but the discussion has picked up pace. A variety of indicators have been developed over recent years, such as: CDC's global biodiversity score, planet tracker, fish tracker, CARE TDL, GRI 304: Biodiversity Standard, Framework for Nature, Aligning Biodiversity Measures for Business, EU LIFE project FinACTION (see also WWF publications in 2019). The EU Commission and the EU@Biodiversity Initiative have started focusing their work on the potential disclosure schemes that companies can use to disclose their biodiversity impact. Tools to assess biodiversity-related financial risks are not yet standardised, which makes informed decision-making and portfolio construction significantly more difficult. It is expected that the development and particularly the uptake of tools for measuring biodiversity-related financial risk and impact will grow preponderant and their quality will thereby increase, due to the extension of Article 173 of the French Energy Transition Law to include biodiversity disclosure requirements. One promising approach to overcoming data gaps on biodiversity is the emerging field of spatial finance, which brings the advantages of air surveillance, big data analysis and finance together. These various disciplines are merged into one discipline. The financial sector can therefore access further data, which is crucial in protecting biodiversity within and outside protected areas.

Translate high-level climate goals into a reference point that can inform portfolio allocation targets or financial stress-testing:

Financial actors need to have information on climate change which can be integrated into general risk management processes or investment procedures. Two different kinds of model exist. On the one hand, some tools aim to evaluate the associated financial risks resulting from climate change. The most known ones are: Carima, carbon impact analysis, Climate Progress Dashboard, Carbon Earning at Risk, Climate Change Coping Readiness, climate-savvy scenarios, Climate VaR, ClimateXcellence, ClimateWise, TRIP Climate Risk Factors, Transition risk-O-meter ET Risk, ViEW Net-Zero Toolkit and XDC. On the other hand, some tools aim to measure the degree of alignment of portfolios and investment, lending or insurance products with given climate change scenarios (1.5°C, 2°C, 3°C, etc.). The best known are: the Paris Agreement Capital Transition Assessment (PACTA), the Transition Pathway Initiative and the Sectoral Decarbonisation Approach. Both types aim to inform and model asset allocations which are sufficiently diversified and thereby balance the investment principles of safety, profitability and liquidity. Based on these models, it could be possible to invest more sustainably. These tools are not only used by individual financial actors, but also by central banks and financial regulators, which are keen to evaluate the risk exposures of their respective financial sectors and the risk of financial instability. The most advanced example is the stress test run by the Central Bank of the Netherlands (DNB), which looked at climate-related transition risks that could be induced by technological and/or policy shocks. The latest stress test revealed that the capital adequacy ratio could decrease by more than 4 percentage points for Dutch banks and the solvency ratio by more than 10 percentage points

for Dutch insurers – not accounting for the physical risks posed by climate change. Given the fact that the Basel III regime requires a capital ratio of more than 4.5 %, many banks would therefore fall below the minimal requirement in the event of a single shock, which would significantly increase the risk of financial instability.

- **Biodiversity status quo:** Due to the lack of an agreed quantifiable goal, a commonly agreed definition to measure “bio-diversity” or specific biodiversity loss scenarios, there are many hurdles in the way of translating biodiversity targets into portfolio allocation targets. The EU Commission summarised this issue like this: “At the moment, biodiversity is too abstract for most stakeholders in the finance sector to incorporate it into their core business and develop products to invest in biodiversity or opportunities deriving from it. The main reason given for this is the lack of accessible knowledge in a language that is comprehensible for the sector and the lack of communication with the environmental sector. In essence both sectors do not speak each other's language and as such are unable to cooperate in developing sound biodiversity investment opportunities”.⁸ However, there are tools and methodologies that have been developed to focus on a specific subissue, such as forests, water, protected areas, or a combination of several of these issues. The most known ones are: Global Forest Watch, WWF-SIGHT, Aqueduct, Water Risk Filter, Corporate Bonds Water Credit Risk Tool, Drought Stress Testing Tool, ENCORE, SCRIPT, E-RISK and certifications. However, a single widely accepted tool to account for biodiversity-related financial risks is still missing. Regarding the implications of biodiversity loss on financial stability, there is no method available, and no central bank has run a biodiversity-related stress test yet.

Link to legal duty of asset manager and asset owner to climate change:

If climate change and other environmental changes have a significant impact on the financial risks and opportunities associated with financial instruments, financial managers need to account for them as an integral part of their fiduciary duty. In the past, however, many financial actors considered environmental aspects as extra-financial factors with no influence on the risk-return ratio of a financial product. Thus, taking into account environmental risks was not part of the fiduciary duty and some practitioners even mentioned that it is against their fiduciary duty. Thanks to the groundbreaking work by the law firm Freshfields Bruckhaus Deringer in 2005, it became slowly recognised that environmental as well as social issues are hygiene factors, which have improved the general risk management frameworks and thereby are part of the fiduciary duty. This re-interpretation of fiduciary duties was mainly confined to climate change issues, for which the link to financial risks is quite well established. In 2016 the UN PRI launched an initiative to mainstream this interpretation of the fiduciary concept, which also resulted in some regulatory changes such as the EU Action Plan on Sustainable Finance. This linked the fiduciary duty to the duty to inform the investors, general public and regulators. Many disclosure requirements regarding the climate impact of investments and climate-related financial risks were based on the argument that it is part of the fiduciary duty.

⁸ https://ec.europa.eu/environment/archives/business/assets/pdf/sectors/FINAL_Finance.pdf

- **Biodiversity status quo:** The link between fiduciary duty and biodiversity issues is not established and has not attracted much attention. The Freshfields Report (2005) and the UNEP FI's Fiduciary Duty in the 21st Century programme, however, interpret fiduciary duty broadly, mentioning that all environmental and social factors that bear financial risks are, by definition, part of the fiduciary duty. As biodiversity is highly debated, there is no single indicator and there are only a few academic studies indicating the link to financial risks, there remains a long way to go until biodiversity is regarded as part of the fiduciary duty. However, there are many examples of financial institutions that take biodiversity-related issues into account for financial reasons. Thereby, practice could inform the legal interpretation. Furthermore, it could help to not talk solely about the biodiversity concept and rather pick single issues such as freshwater, or agriculture and aquaculture for example. There the link to the fiduciary duty could be established more easily.

Champions for climate change: Climate change became an issue that the financial sector cared about when important figures, decision-makers and respected experts mentioned that it was an important issue. Most notable was the "Tragedy of the Horizon" speech by Mark Carney (Governor of the Bank of England), who was leading the Financial Stability Board at that time. The speech in front of many industry experts had a significant influence as climate change was not perceived anymore as an issue of environmentalists. Furthermore, the strong commitment shown by Michael Bloomberg, Al Gore, Emanuel Macron and Philipp Hildebrand, among others, cannot be underestimated. Lastly, the championing effort of the High-Level Expert Group (HLEG) on Sustainable Finance, which was established by the EU Commission in 2016, further increased acceptance within the financial industry but also indicated that the industry asked for better regulation. HLEG President Christian Thimann was an important figure to further mainstream efforts in Europe and the EU Action Plan of the EU Commission has had a championing effort around the world, as many countries are now trying to copy this effort.

- **Biodiversity status quo:** Biodiversity is an emerging topic for business leaders and, within the financial sector, Thomas Buberl (AXA Group) has taken a leading role in addressing the threats arising from accelerated biodiversity loss combined with climate change. Frank Elderson (Central Bank of the Netherlands), François Villeroy Galhus (Banque de France), Maurice Tulloch (Aviva) and Paul Polman (Imagim) are also prominent advocates.

Make climate change an opportunity for the financial sector:

There are various examples of how the financial industry can react to climate change. An interesting example are BlackRock's "Global Renewable Power" funds. The first of these funds was launched in 2012, the second in 2016 and the latest in 2019. All three funds invest in renewable power, wind and solar or the supporting infrastructure. The projects are located all around the globe, with the United States as the biggest single location. As a gross target yield for the newest fund, BlackRock expects 6–7 %.⁹ Another example is the whole green bond sector. According to a Standard & Poors report, the annual issuance of green-labelled bonds rose from less than USD 10 billion in 2012 to USD 167 billion in 2018¹⁰ and an estimated USD 250 billion in 2019¹¹. The shift of wealth towards the millennial generation can be seen in the growth of impact investing. At the end of 2018 the market had grown to USD 502 billion¹², according to a study by the Global Impact Investing Network. But where there is light, there is also darkness. In November 2019 Influence Map published the report "Asset Managers and Climate Change". The report investigated the 15 largest asset management companies and whether their public engagement and voting behaviour at annual general meetings fit together. The outcome was that not all companies really have compelling results.¹³ This underpins the fear of many that within the industry there is also a lot of greenwashing. In the long run, a full taxonomy could avoid that.

The Conservation Fund successfully issued USD 150 million of ten-year bonds in September 2019. The impact measures and project stories highlight the investments of the bond proceeds into projects that will create permanent conservation outcomes and support local communities that depend on forests. In particular, it also addresses the economic impact with almost USD 88 million, while protecting 337 miles of streams and rivers and sequestering almost 30 metric tons of CO₂equiv.¹⁴

- **Biodiversity status quo:** Opportunities emerge by investing in biodiversity and ecosystem resilience. The global economy profits from USD 125 trillion worth of ecosystem services (Costanza et al., 2014) or the equivalent of 1.5 times global GDP, through drinkable water, food and pollination, fresh air, heat absorption and forests and oceans that soak up carbon dioxide. The OECD highlights a variety of investment strategies available for investors and other financial organisations to mainstream biodiversity considerations across asset classes and investment types (e.g. listed or unlisted equity, loans, fixed income – including bonds – and infrastructure) and investment management strategies (e.g. passive index investing or active management). The Biodiversity Finance Initiative estimates that funds needed to protect nature run up to USD 440 billion. Current biodiversity investments reach barely USD 55 billion, which indicates a misallocation of resources and a gap that needs to be filled. But on the other hand, it can also be an important investment opportunity. On the next page are some case studies showing how financial actors are investing in biodiversity conservation and/or restoration, which also offers a potential unique selling point or branding opportunities.

⁹ BlackRock presentation, Global Renewable Power III (GRP III): A Climate Infrastructure Fund, April 2019

¹⁰ <https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/Public-research-resources/SP-Global2019-01-29Green-Finance-Modest-2018-Growth-Masks-Strong-Market-Fundamentals-For-2019-130219.pdf>

¹¹ <https://www.climatebonds.net/>

¹² <https://theiig.org/research/publication/impin-market-size>

¹³ Influence Map, "Asset Managers and Climate Change", November 2019.

¹⁴ <https://www.conservationfund.org/news/press-releases/2079-the-fund-successfully-closes-debut-150-million-green-bond>

ASN Bank in the Netherlands and Caisse des Dépôts et Consignations (CDC) in France are among the financial institutions leading the way in promoting sustainability. They have independently developed methodologies that can be used across all sectors and countries and are designed to calculate the biodiversity footprint of companies and investment portfolios.

ASN Bank has developed the “Biodiversity Footprint for Financial Institutions” (BFFI) methodology, while CDC, together with Club B4B +, has developed the “Global Biodiversity Score” (GBS) methodology¹⁵. Both methodologies express impact in terms of an increase or decrease in the number of species. BFFI uses the *potentially disappeared fraction of species (PDF)*, while GBS uses the *mean species abundance (MSA)*. Both methodologies link this indicator to the area where the impact is felt (spatial factor) and the assessment period (time factor).

ASN Bank

ASN Bank is committed to conserving and protecting biodiversity. Therefore, the bank has set itself a long-term goal of becoming biodiversity positive by 2030. Concretely, by 2030, all of ASN Bank’s investments and loans should have a positive effect on biodiversity.

ASN Bank has been calculating its biodiversity footprint using the BFFI methodology since 2016. The bank’s aim is, on the one hand, to reduce the ecological damage stemming from their loans and investments and, on the other hand, to boost biodiversity, for example by investing in wildlife conservation, sustainable energy and the circular economy. It is a simple calculation: if they add more to biodiversity than they take from it, they will have a positive impact on biodiversity.

In 2017 ASN Bank calculated that it was responsible for a 64,849 hectare loss of biodiversity due to its investments. This corresponds to a biodiversity loss of about 0.05 m² per euro invested (CREM, PRé Consultants and ASN Bank, 2016). It has calculated its biodiversity impact per investment category (government bonds, mortgages, equity, etc.). The footprint results show how the biodiversity impact hotspots relate to the bank’s different investments across its portfolio and where in the corresponding value chains the impact is highest. This allows the bank to get an overview of the material elements that have to be considered when managing its negative and positive impact (ACTIAM, ASN Bank, CDC Biodiversité (2018)).

Caisse des Dépôts

CDC Biodiversité is a direct subsidiary of the Caisse des Dépôts and has been demonstrating for over ten years the group’s desire to innovate in the general interest by creating new economic models that can contribute to conserving biodiversity.

CDC Biodiversité has developed a biodiversity footprint assessment tool called the Global Biodiversity Score (GBS). The GBS aims to measure the impact of economic activities on ecosystems along the value chain. The GBS can be used to evaluate the impact or footprint of companies and investments on biodiversity. The GBS uses a metric – MSA.km² (Mean Species Abundance per km²) – which expresses the intactness of ecosystems as a percentage.

An MSA value of 100 % represents a pristine ecosystem and 0 % a complete lack of any biodiversity. The GBS is a simple indicator measuring the biodiversity destruction score given to a particular economic activity. It is to biodiversity what CO₂e tonnes are to climate change.

According to CDC, the global average MSA was about 63 % in 2018, which means that 37 % of global MSA had already been lost. By 2050, the global average MSA may reach 57 %. Now, the important question is what are the global biodiversity boundaries or the biodiversity budget – to make an analogy to the carbon emission budget in the context of the climate debate.

Lucas and Wilting (2018) calculated the corresponding global MSA boundaries. According to their simulation results, the global biodiversity budget expressed in GBS should be an MSA of 72 % to limit the biodiversity loss and corresponding economic losses. We are already below that threshold (see graph on p. 23).

CDC supported, for example, BNP Paribas Asset Management in calculating the biodiversity footprint of one of its equity portfolios. As a result, BNP Paribas got an overview of its biodiversity impact (expressed in MSA.km²) per EUR 1,000 invested in the company’s portfolios.

Conservation Finance Credit Suisse

According to Credit Suisse there is the potential to create a conservation investment market of USD 200 to 400 billion by 2020.¹⁶ Conservation investments have very little correlation to equity markets and therefore are not exposed to the volatility of that market. Thus, such investments have a reasonable risk-return profile. Since 2018, Credit Suisse has held the Annual Conservation Finance Investor Conference in New York City. Furthermore, Credit Suisse has expanded its role as advisor to UHNW clients in conservation finance, and is one of the founding members of the cross-sectoral Coalition for Private Investment in Conservation (CPIC), which aims to bring more private capital into this space.¹⁷

Case Study: Biodiversity loans from Alternative Bank Schweiz (ABS)

ABS provides the Swiss agricultural sector with loans or credits. The aim is to promote and support sustainable farming practices. Farms which are certified and hold the Bio Suisse “Bud” label or the Demeter label will receive promotional loans. These loans are promoted without any security. The farms could use the loans for various purposes such as sustainable energy production (e.g. solar), social projects, agricultural tourism or the setup of permacultures. These promotional loans are financed by promotional bonds funded by ABS customers.¹⁸

¹⁵ For further details on the GBS, see Club B4B+, “Global Biodiversity Score: measuring a company’s biodiversity foot-print”, available at: <https://www.globio.info/assessments-with-globio/thematic-assessments/161-global-biodiversity-score-measuring-a-companys-biodiversity-footprint>

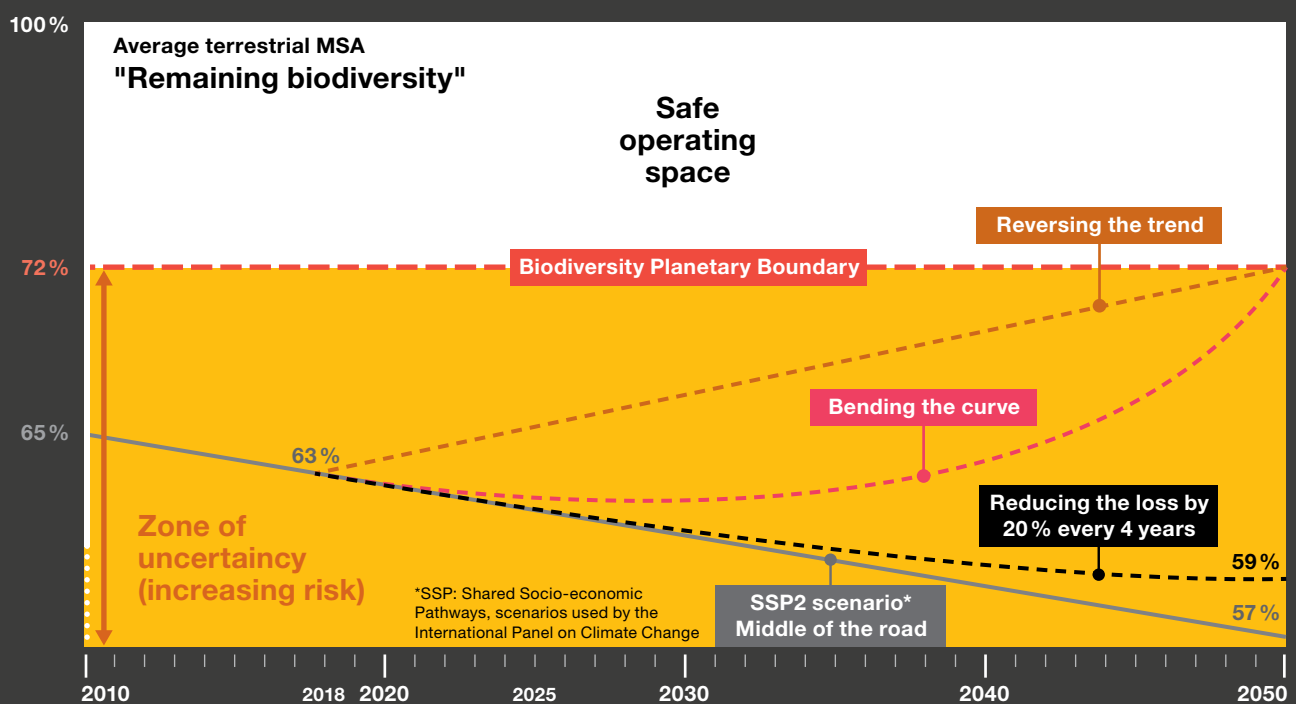
¹⁶ Conservation Finance: From Niche to Mainstream: The Building of an Institutional Asset Class. Available at <https://www.credit-suisse.com/about-us/news/en/articles/news-and-expertise/conservation-finance-an-untapped-investment-opportunity-201601.html>

¹⁷ <https://www.credit-suisse.com/about-us/en/our-company/corporate-responsibility/environment/biodiversity-natural-capital.html>

¹⁸ <https://www.abs.ch/de/firmen-institutionen/kredit-aufnehmen/nachhaltige-landwirtschaft/>



Scenarios to return to biosphere integrity

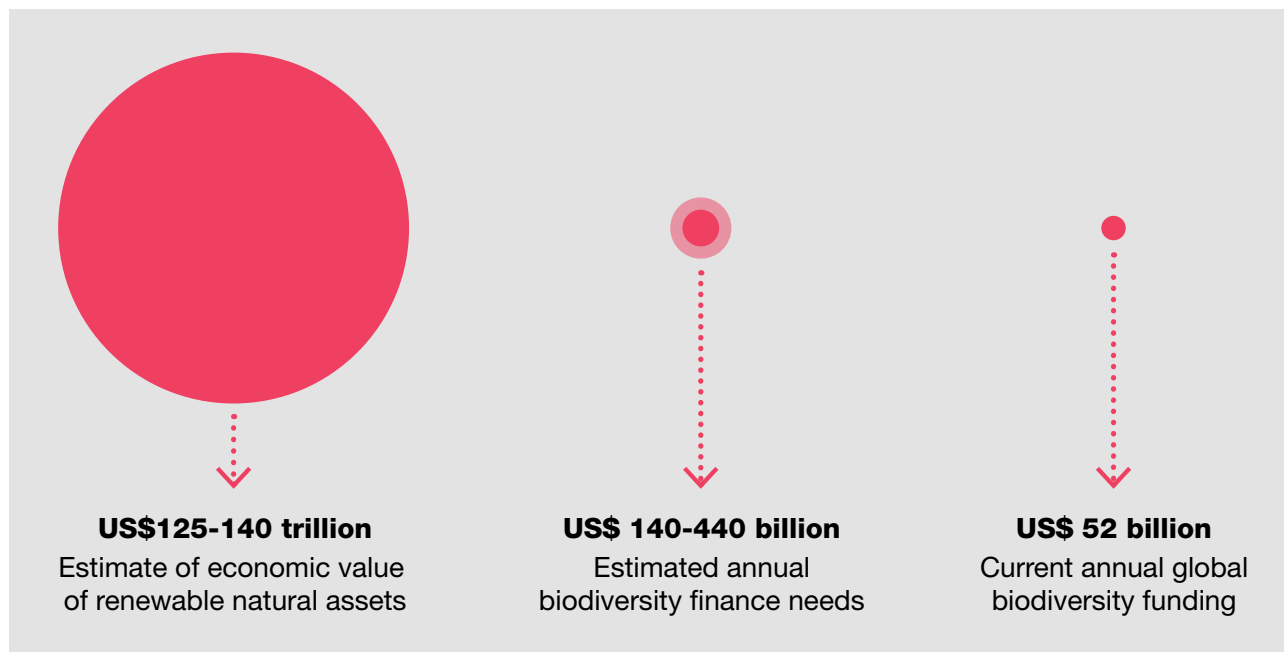


Source: CDC Biodiversité (adapted from Lucas & Wilting, 2018), 2019

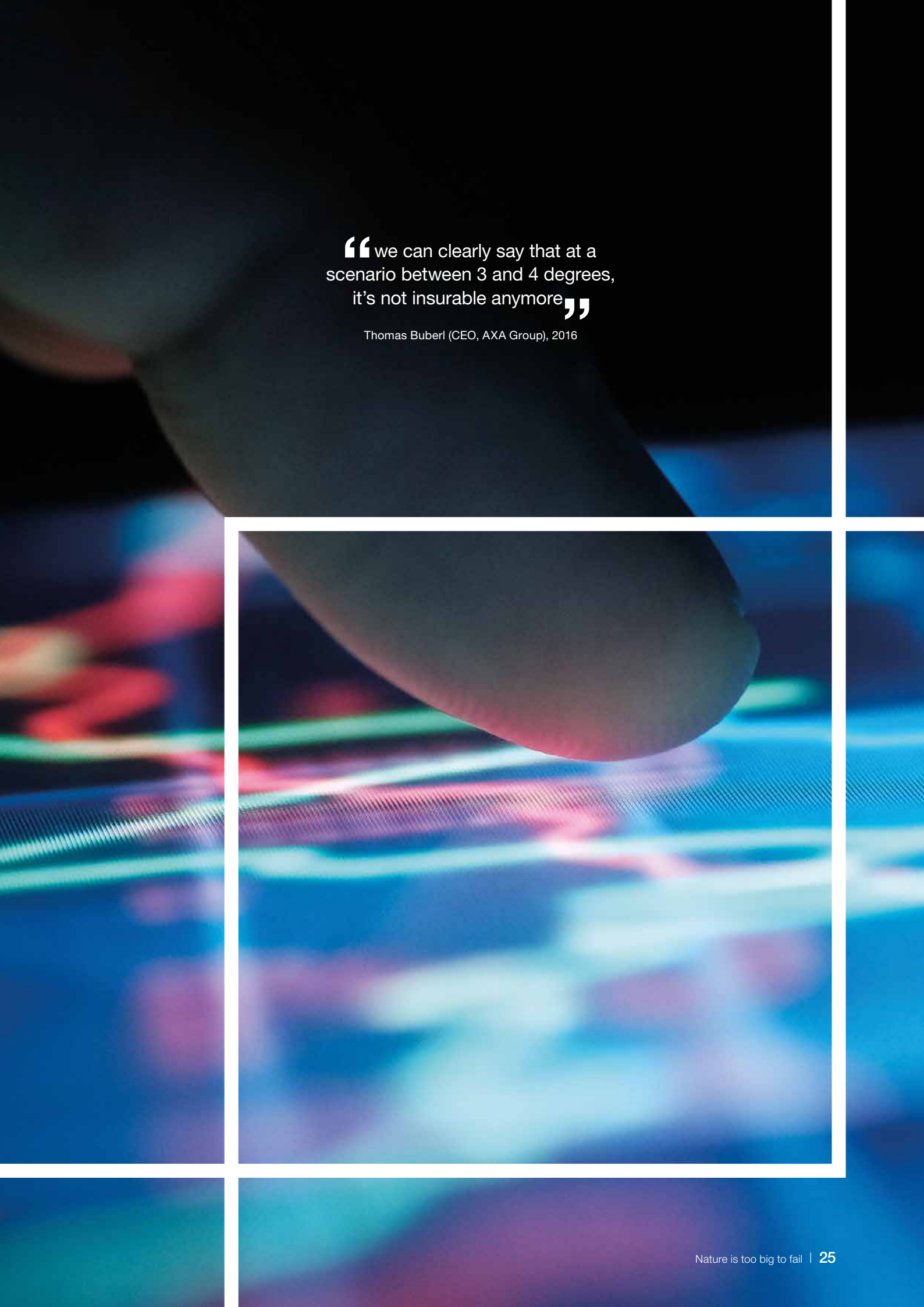
Showcase Funding Gap: The Global Environment Facility (GEF) has served as an operating entity of the financial mechanism since the Convention's entry into force in 1994 and serves also the Kyoto Protocol and Paris Agreement. At Conference of Parties (COP) 16, in 2010, the Parties to the Convention established the Green Climate Fund (GCF) and in 2011 also designated it as an operating entity of the financial mechanism. The financial mechanism is accountable to the COP, which decides on its policies, programme priorities and eligibility criteria for funding. In addition to providing guidance to the GEF and the GCF, the Parties have established two special funds – the Special Climate Change Fund (SCCF) and the Least Developed Countries Fund (LDCF), both managed by the GEF – and the Adaptation Fund (AF) established under the Kyoto Protocol in 2001. At the Paris climate change conference in 2015, the Parties agreed that the operating entities of the financial mechanism – GCF and GEF – as well as the SCCF and the LDCF should serve the Paris Agreement. Regarding the Adaptation Fund serving the Paris Agreement, negotiations are underway in the Ad hoc Working Group on the Paris Agreement (APA). The funding gap determined in relation to climate finance and the redirection of financial flows amounts to up to USD 90 trillion. This figure includes investments in built infrastructure such as urban, transport, water, waste, telecommunications and energy systems, including energy efficiency, but not natural infrastructure, all across a time span of 15 years. The financing areas in relation to biodiversity challenges are certainly different but should be captured with the same base thinking.

- **Biodiversity status quo:** Currently, most identified biodiversity financing sources are public funds, in particular domestic public budgets, biodiversity-positive agricultural subsidies and international transfers of public funds as well as private financial instruments (impact investing, philanthropy, biodiversity offsets, equity, loans, bonds, Payment for Ecosystem Services), reaching around USD 52 billion per year. Although the largest share of grants and concessional funds from the Global Environment Facility (GEF) are dedicated to biodiversity, BIOFIN estimates that ten times more investment or up to USD 440 billion per year is needed to achieve the Aichi Biodiversity Targets by 2020 (based on estimates by the high-level panel on global investment required for biodiversity conservation, 2014). The authors assume that once a more ambitious biodiversity framework is adopted in Kunming, the investment needs will be higher than stated in the assessments done in 2014. The OECD conservatively estimates that subsidies harmful to biodiversity are around USD 500 billion per year (based on fossil-fuel subsidies and government support to agriculture that is potentially environmentally harmful), ten times more than actual investment in biodiversity conservation and sustainable use. Current financial flows are clearly misallocated, which results in a huge funding gap for a low carbon economy, biodiversity conservation and restoration. The CBD's current Strategic Plan 2011–2020 does not sufficiently address private funds in the 20 Aichi Biodiversity Targets.

Biodiversity asset value versus current annual investments



Source: adapted from BIOFIN and OECD, 2019

A close-up photograph of a person's finger hovering just above a digital screen. The screen displays vibrant, abstract patterns in shades of blue, green, and red, resembling a digital landscape or data visualization. The lighting is dramatic, with the finger and the screen's glow being the primary light sources against a dark background.

“ we can clearly say that at a
scenario between 3 and 4 degrees,
it's not insurable anymore,”

Thomas Buberl (CEO, AXA Group), 2016

3. Methodology: How biodiversity-related financial risks can be integrated into financial actors' conventional risk processes

“Economic assessments that are expressed solely in terms of effects on output (e.g. gross domestic product), or that only extrapolate from past experience, or that use inappropriate discounting, do not provide a clear indication of the potential risks to lives and livelihoods.”

London School of Economics, 2019

It is evident that the incorporation of biodiversity risks and their impact is climbing its way to the top of the agenda. Furthermore, market pressure from clients and peers is increasing. Consequently, attention needs to be paid to regulatory and market developments to establish a robust and forward-looking position on biodiversity-related risks from a risk management perspective.

One of the biggest challenges for the integration of biodiversity risks lies in how to measure them in a concrete and quantitative way. As indicated before, attempts by companies to define and report biodiversity-related financial risks often rely on individually set definitions, thus leaving much space for interpretation. Consequently, quantification, comparability and evaluation of the implications can prove extremely difficult for financial market participants. In turn, financial actors themselves are facing difficulties with their own reporting of biodiversity-related financial risks on corporate level. In the absence of adequate binding accounting and reporting standards for biodiversity-related financial risks, voluntary frameworks have attempted to address this matter.

3.1 Regulatory background

Risk management in financial markets traditionally requires the assessment of any material risks and the respective mitigation with the ultimate aim of ensuring investor protection and resilient financial markets. Biodiversity-related financial risks are thus no excuse. On the other hand, the integration of biodiversity risks can provide benefits and opportunities for financial market participants.

Moreover, recent regulatory initiatives demonstrate the strong determination of legislators to strengthen the consideration of sustainability risks (which include biodiversity-related financial risks) into the existing risk management processes. This is particularly evident from the proposals in the EU Action Plan for Sustainable Finance for amendments in sectoral legislation

such as MiFID II, UCITS / AIFMD, Solvency II and various risk disclosures related to a great variety of financial products.

The envisioned changes have extensive cross-sectoral implications within financial markets. It can also be expected that supervisory authorities will pay extra attention to the implementation of the new requirements. This is already evident, as demonstrated by BaFin, the German supervisory authority, which has issued a guidance notice on dealing with sustainability risks.¹⁹ On the other hand, financial players could obtain further advantages from integrating sustainability risks, for example through more relaxed capital requirements. The EU is currently considering a Green Supportive Factor (GSF) or Brown Penalty (BP) for capital requirements. Furthermore, increased transparency around sustainability (and also biodiversity) issues and risks is expected to raise the interest of investors in products in which such aspects are considered, and this can open up opportunities for financial market participants.

Consequently, biodiversity-related financial risks have to be integrated by different financial market players – credit institutions, investment firms, management companies and insurance companies alike.

3.2 Classification of biodiversity-related financial risks

Biodiversity-related financial risks need to be positioned within the classic risk management framework for financial market participants. As biodiversity-related financial risks form part of the broader sustainability risks, their incorporation should follow the way of consideration of sustainability risks by financial players.

One approach could be to define a new autonomous category – “sustainability risks” – in the existing risk management process and to include any biodiversity risks in this category. However, this is likely to cause severe difficulties in differentiation, as sustainability risks very often materialise in the form of already existing risk types. Therefore, an alternative way of addressing sustainability risks – and thus biodiversity-related financial risks – is by translating them into the existing risk categories in the traditional risk management techniques for financial players, such as credit, market or operational risk.²⁰ This is applicable to physical, transition, litigation and systemic risks related to biodiversity loss.

Financial market participants need to be able to measure their direct and indirect impact on biodiversity. This is especially important when assessing the risks at portfolio or investment level but also plays a role in any assessments at corporate level.

¹⁹ BaFin, Guidance notice on dealing with sustainability risks, 2019.

²⁰ BaFin, Guidance notice on dealing with sustainability risks, 2019.



Classification of biodiversity-related financial risk into current risk types

	Credit risk	Market risk	Operational risk
Transition risk	Investee suffers substantial losses due to sanctions, damages or increased taxes stemming from its negative impact on biodiversity	Long-term price increases as a result of biodiversity change	Image loss resulting from failure to switch to biodiversity management
Physical risk	Revaluation of debt-servicing capacity and collateral	Rating downgrades and share price losses after biodiversity loss	Biodiversity loss affects balance sheet
Litigation risk	<ul style="list-style-type: none"> • Litigation as pertaining to biodiversity loss and breach of the under-lying legal frameworks • New regulatory rules impose limitations on investing in activities with an impact on biodiversity • Damages due to false reporting of biodiversity risks • Damages due to greenwashing 		
Systemic risk	Economy can no longer be insured at reasonable cost	Market-threatening effects from biodiversity loss in an entire region	Reputational losses for entire industries/entire markets

Source: adapted from BaFin (2019)

“The negative feedback loop between climate change and biodiversity loss will only continue to increase”

Thomas Vellacott, CEO WWF Switzerland

3.3 Biodiversity-related financial risk assessment

A financial market participant can consider various approaches when choosing how to assess biodiversity risks within its risk management practices. A selection of these is provided below:

Dimensions for consideration

- Corporate vs. portfolio/financial instrument vs. individual investee level
- Direct vs. indirect impact
- Impact caused by biodiversity loss (dependency) vs. impact causing biodiversity decrease
- Risks related to transactions connected to investments promoting biodiversity

Natural Capital Protocol

A general way to integrate biodiversity-related financial risk into the risk assessment processes is to follow the Natural Capital Protocol²¹ by the Natural Capital Finance Alliance and Global Canopy. It envisions a four-stage framework that can be used by financial institutions and is based upon the concept of natural capital. A short overview can be found in the table below:

Step	Description
Frame: Why?	<ul style="list-style-type: none"> • Consider why an assessment should be carried out
Scope: What?	<ul style="list-style-type: none"> • Define objective and scope of the assessment • Determine the impact and/or dependencies
Measure and Value: How?	<ul style="list-style-type: none"> • Measure the impact drivers and/or dependencies • Measure changes in the state of natural capital • Value impact and/or dependencies
Apply: What next?	<ul style="list-style-type: none"> • Interpret and test the results • Take action

Source: Natural Capital Coalition, Connecting Finance and Natural Capital – A supplement to the Natural Capital Protocol (2018)

The Natural Capital Protocol explicitly does not include any specific methodologies and metrics for the exact measurement of biodiversity-related financial risks. Despite its broad nature, it can be considered as a general way to approach integrating biodiversity-related financial risks. Furthermore, a separate project by the Natural Capital Coalition and the Cambridge Conservation Initiative (CCI) is currently being developed with the aim of supporting the presentation of biodiversity in the Protocol.²² Furthermore, a reporting framework for financial institutions focusing on nature-related disclosures is being envisioned by the NCFA and the NCC, although it is currently at a very early stage.²³

Ultimately, any approach defined for integrating biodiversity-related financial risks needs to be aligned to the base elements of a fully-fledged corporate risk assessment and management. This ensures full integration along the financial materiality as defined by each financial. The following should therefore be considered:

- **Planning and objective setting** – identifying risk assessment priorities and opportunities for correlation between risk themes for compliance and operational risk assessments.
- **Event identification** – identifying and documenting the risk landscape, with reference to a common taxonomy for policies, rules, controls and risk themes.
- **Measurement and risk assessment** – conducting risk assessments and measuring effectiveness using key risk, performance and control indicators.
- **Control activities and development of a risk response** – identifying control gaps, communicating mitigation plans and determining ownership of various initiatives.
- **Monitoring and reporting** – reporting of risk assessment outcomes that help establishing a consistent framework for risk identification, risk rating and alert management.

²¹ Natural Capital Coalition, Connecting Finance and Natural Capital -- A supplement to the Natural Capital Protocol (2018), available at www.naturalcapitalcoalition.org

²² <https://naturalcapitalcoalition.org/projects/biodiversity/>

²³ EU Community of Practice Finance and Biodiversity (2019).

The accounting perspective

Existing binding accounting standards are not sufficient to capture biodiversity loss implications, since they are usually heavily focused on financial performance. At the same time, the financial implications of biodiversity losses are often only evident after the risk has materialised, which hinders their adequate consideration for the future and their management.

One proposed accounting framework addressing this issue is the CARE-TDL model (Comprehensive Accounting in Respect of Ecology – Triple Depreciation Line).²⁴ This concept argues that the classic Triple Bottom Line concept fails to consider human and natural capital and proposes a new accounting framework extending the traditional financial results with monetary representations of human and natural capital. The CARE-TDL model assumes that “human capital” and “natural capital” are necessary for the achievement of a firm’s goals and a firm has an obligation to maintain them. As a consequence, these categories of capital should be reflected as liabilities in financial statements and balance sheets in addition to financial capital, with a monetary value equal to the maintenance costs required in case of the consumption of all the corresponding resources. The maintenance costs incurred during the accounting period are not treated as expenses, but as investments (de-depreciations), while any degradation caused by capital use is considered a depreciation. In relation to natural capital, maintenance costs represent the costs related to the preservation – or maintenance – of the ecological limits.²⁵

In relation to biodiversity-related financial risks, one of the advantages of this accounting method is its potential to provide transparent and comparable information on the company’s use and preservation of its natural capital during the accounting period. In this way, the data can be used to better quantify biodiversity risks using, for example, the allocated required maintenance costs. It also makes it possible to determine the sustainable level of income of a company, described by the authors as “a genuine measure of degradation for all the types of capital used and the firm’s capacity to struggle against them”.²⁶

On the other hand, the CARE-TDL model currently has its limitations, as it requires precise and commonly defined standards and metrics for the monetary evaluation of human and natural capital (in this context, liabilities related to biodiversity as well) and the respective incurred depreciation and investment expenses, and these standards and metrics need to be widely recognised, accepted and used.



Biodiversity footprint approach as a step-by-step practice solution

One approach for the risk assessment of biodiversity-related risks developed by ACTIAM, ASN Bank and CDC Biodiversité²⁷ focuses on the assessment of investment (or loan) impact on biodiversity in four steps, as summarised on the right.

The Biodiversity Footprint Approach integrates ASN Bank’s Biodiversity Footprint for Financial Institutions (BFFI) and the Global Biodiversity Score developed by CDC Biodiversité²⁸, the latter of which aims to quantify a company’s impact on biodiversity.

When comparing it to the Natural Capital Protocol presented on the previous page, the Biodiversity Footprint Approach can be seen as a concretisation of the latter, specifically targeting biodiversity risks.

To support the different aspects of the assessment, there are various initiatives that financial institutions can use, such as:

- disclosure initiatives like the GRI 394 Biodiversity Standard
- sector-specific scores such as:
 - Agrobiodiversity Index (ABD Index)
 - Biodiversity Indicator for Extractive Companies by UNEP-WCMC
 - Biodiversity Impact Metric (CISL) for companies’ upstream value chain
 - SPOTT for tropical forestry and palm oil companies²⁹
- calculating biodiversity return – the Biodiversity Return on Investment Metric (by IUCN)

²⁴ Rambaud, A. et Richard, J. , (2015).

²⁵ See also WWF & Axa (2019).

²⁶ Rambaud, A. et Richard, J. , (2015).

²⁷ See ACTIAM, ASN Bank, CDC Biodiversité (2018).

²⁸ See CDC Biodiversité (2017).

²⁹ <https://www.spott.org/about/>

Step	Description
1. Analysis of the focus of the investment	<p>The first stage concentrates on the analysis of the investee and the economic activities it is involved in. It aims to define and choose the scope of the analysis by differentiating between:</p> <p>Scope 0: the spatial footprint of existing facilities, also known as static footprint, which is independent of any activity done by the investee</p> <p>Scope 1: footprint resulting directly from the activities in the investee's control</p> <p>Scope 2: footprint caused by the investee's energy consumption (such as electricity or heat)</p> <p>Scope 3: footprint caused by upstream and downstream consequences of the investee's activities but beyond its immediate control, such as third-party supply chain³⁰</p> <p>An important aspect of this process is the definition of the attribution of the impact to the respective stakeholder based on chosen factors, such as financial or operation control or affiliated companies.</p>
2. Assessment of the pressures on biodiversity	<p>The second step includes the assessment of the pressures on biodiversity caused by the economic activities of the investee based on data provided by the investee or external data sources (such as Exiobase). Important considerations include the footprint's relevancy and responsiveness to change, as well as the transparency, compatibility, robustness and consistency of the data and methodology used.</p>
3. Assessment of the impact on biodiversity	<p>The next stage aims to assess the impact on biodiversity resulting from the defined pressures. This requires the measurement of the quantitative link between the pressures and the impact, which could be assessed via different biodiversity impact models such as GLOBIO or ReCiPe.</p>
4. Interpretation of the footprint results	<p>The last stage concludes the process with an interpretation of the results and focuses on a supplementing qualitative analysis and addresses the limitations.</p>

Source: ACTIAM, ASN Bank, CDC Biodiversité (2018)

“The loss of biodiversity and interruption of ecosystem services is a material risk for the financial system – certainly in the long-term, even in the short-term for some investments/sectors – and needs to be included in stress tests by institutions and their supervisors. Macro-prudential instruments should be used to penalize nature-depleting investments where relevant.”

Bruno Lallemand, Secretary General of Finance Watch, 2019

³⁰ See also our recommendations in Chapter 5: Recommendations – actions by financial market players.

4. Conclusions

On the state of biodiversity loss and its interaction with the financial sector – January 2020:

- The concept of “biodiversity loss” seems to be much more complex for the financial sector than climate change. Biodiversity encompasses basically all life on earth (diversity of genes, species, ecosystems) and is fundamental to all societies and well-being.
- Biodiversity loss implies multifaceted consequences for society. There is no single widely accepted standard and comprehensive information is lacking, which makes it very complex for banks, insurers, asset managers, pension funds and financial regulators to integrate it into their risk management and decision-making. Furthermore, the interrelations between climate change and biodiversity loss are neither mentioned nor acknowledged in existing financial risk models.
- Biodiversity loss and climate change are highly interconnected. Increased temperatures and shifts in precipitation are key drivers of biodiversity loss, reducing the resilience of ecosystems to withstand shocks. In addition, loss and damage of ecosystems reduces their ability to capture and store carbon, which again reinforces climate change. The more average temperatures increase, the more biological diversity is lost – the perfect negative spiraling loop. Thus, in order to increase the probability of keeping global warming below 1.5°C, it is of utmost importance that biodiversity conservation and restoration become a top priority. By contrast, biodiversity can support efforts to reduce the negative effects of climate change. Nature-based solutions (sustainable production of forest and agricultural products, conserving and restoring forests, grasslands, mangroves and wetlands) can theoretically provide effective climate mitigation measures needed between now and 2030.
- In order to take decisive action, financial institutions can focus first and foremost on forests, oceans, freshwater and agriculture/aquaculture. For these necessary instruments, quantifiable metrics and information already exist, which can be integrated into the investment decision and risk-management processes (see also WWF 2019 reports on tools/methodologies).
- The main focus of financial institutions regarding biodiversity issues has been on the opportunity side (e.g. conservation finance). Several financial products are already on the market which are trying to alleviate certain aspects of biodiversity loss.
- Biodiversity loss results in high economic costs. Between 1997 and 2011 the world lost around USD 4–20 trillion per year in ecosystem services due to land-cover change and USD 6–11 trillion per year from land degradation. The OECD warns that the cost of inaction on biodiversity loss is increasing. Although the benefits from ecosystem services are significant (benefits of USD 125–140 trillion per year), these benefits are undervalued or not valued in business and investment decision-making at all.
- The link between biodiversity loss and financial risks is theoretically and logically sound. However, there is a lack of academic studies and only anecdotal empirical evidence that biodiversity loss and financial risk are linked. Further academic research, and particularly the gathering of compelling practical case studies, are necessary. This is particularly pressing as biodiversity is the key input factor for all economic sectors. Therefore, it is particularly dangerous for the financial sector not to account for biodiversity loss, as all economic sectors in which they invest, they finance or they insure depend on biodiversity. The concept of biodiversity-related financial risks (financial implications of biodiversity loss) is not yet established, nor widely used. This is contrast to the broad recognition of climate-related financial risks by financial regulators, central banks and financial actors.
- The authors at PwC and WWF suggest the following definition of biodiversity-related financial risks:
 1. **physical risk:** risks related to the physical impact of biodiversity loss
 2. **transition risk:** risks related to the transition to an economy which conserves and restores biodiversity
 3. **litigation risk:** risks related to litigation pertaining to biodiversity loss and breach of the underlying legal frameworks
 4. **systemic risk:** risks related to the systemic impact of biodiversity loss – this should help to encourage financial institutions and regulators to use a simple but effective framework and could be the basis for a future task force on nature-related financial disclosures (TNFD).
- Conventional financial risk measurements significantly underestimate the risks that emerge from environmental damage. Even state-of-the-art climate stress tests focusing on climate transition risks, like the one of the Dutch central bank (DNB), largely undervalue and underestimate financial risks because:
 - they mostly account for either climate-related physical risks or transition risks, and not a combination of both, and are based on the 2°C alignment models and not the most recent 1.5°C scenario of the IPCC
 - they fail to integrate biodiversity-related financial risks (physical and transition), despite clear signals that they are financially material
 - they fail to account for second-round effects between biodiversity loss and climate change which are mutually reinforcing.

Current best practice financial risk assessment in 2020:

$$X(\text{total risk}) = x + a$$

x = Financial risks

a = Climate-related transition and/or physical financial risks



Optimal financial risk assessment in 2020:

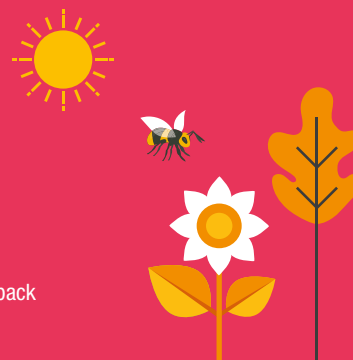
$$X(\text{total risk}) = x + \alpha \cdot (a+b)$$

x = Financial risks

a = Total of physical, transition, litigation and systemic climate-related financial risks – based on 1.5°C IPPC scenario

b = Total of physical, transition, litigation and systemic biodiversity-related financial risks

α = amplifying factor due to feedback loops between climate change and biodiversity loss. $(a+b+c)/(a+b)$ whereas c= Climate- and biodiversity-related financial arising from feedback loops between climate change and biodiversity loss



- In the light of this, the authors at PwC and WWF urgently call on the central banks and financial regulators to assess the financial risks stemming from environmental degradation more thoroughly, as the risks are currently significantly underestimated. This could lead to important negative consequences for overall financial stability. Lastly, the probability of financial instability increases with every day, month or year that passes where climate change and biodiversity degradation is not being tackled simultaneously. The negative spiralling loop between climate change and biodiversity loss will only continue to increase. Therefore, microprudential and macroprudential consequences of biodiversity loss need to be assessed and managed by financial regulators and central banks as soon as possible.
- Despite the “Beijing Call” of President Macron and President Xi, highlighting the importance of biodiversity conservation and restoration, there are indications that biodiversity loss and biodiversity-related financial risks are not yet a key priority. The authors at PwC and WWF argue that they will be by 2021 at the latest:
 - Biodiversity loss: According to the annual WEF Risk Report 2019, it does not seem to be perceived as one of the most impactful or probable risks. Interestingly, in the WEF Risk Report 2011 “biodiversity loss” was one of the top three risks – one year after the Nagoya Conference on Biological Diversity in 2010. Therefore, the authors at PwC and WWF conclude that biodiversity loss will be one of the key priorities after the UN Conference on Biodiversity in Kunming (China) in 2020.
 - Biodiversity-related financial risks: There are clear signs that several financial regulators (e.g. Article 173 in France), central banks (e.g. Dutch central bank stress-test on biodiversity-related financial risks) and policy-makers such as the EU Commission (EU Action Plan) will increasingly demand that the financial sector account for financial risks associated with biodiversity losses.
- Learning from the climate debate, the discussion on biodiversity-related financial risks and opportunities should focus on the following areas, in order to influence decision-makers and their perception of urgency:
 - International frameworks such as the UN Convention on Biodiversity need to align financial flows with biodiversity conservation and restoration.
 - The current misallocation of financial flows leads to a massive funding gap. Currently, at least half a trillion US dollars are needed to meaningfully assure biodiversity conservation and restoration. This funding gap needs to be closed rapidly by all societal actors.
 - Standards, key indicators and methodologies for reporting biodiversity-related financial risks and impact are needed.
 - Spatial finance could be the key tool to better manage environmental risks and help protect biodiversity. The combination of finance and aerial surveillance data and their appropriate analysis will deliver much-needed data for the financial sector that go beyond self-reported and reputation-based data to “what happens on the ground”.
 - The legal duty (fiduciary duty) of financial institutions to account for and reduce biodiversity-related financial risks needs to be specified.
- 2020 provides a unique opportunity to agree a “New Deal for Nature and People”, including an ambitious framework at the UN Conference on Biodiversity in Kunming, China. Decisions need to be taken to ensure the alignment of private and public financial flows with biodiversity conservation and restoration. Investments in natural systems and natural infrastructure are needed, putting nature on the path to recovery and creating prosperity, while simultaneously tackling the twin crises of climate breakdown and catastrophic biodiversity loss.

5. Recommendations

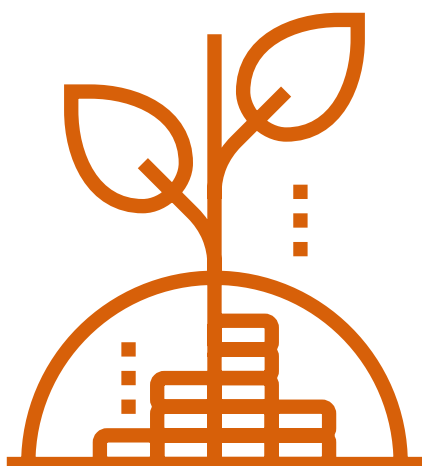
“If we don’t have a planet,
we’re not going to have a very
good financial system.”

James Gorman, CEO, Morgan Stanley, testimony to the
U.S. House Financial Services Committee, 10 April 2019

We need to act now! Despite biodiversity being a complex, multi-layered, correlated issue for which there is no agreed single quantifiable target, no universally accepted indicator and insufficient data, there is enough evidence on the magnitude of the problem and well-established scientific facts to justify taking action yesterday. The biological diversity on earth is declining at an unprecedented rate, which puts the financial sector at a higher risk than it was during the financial crisis in 2007/2008. This again has an important influence on our economic system, our welfare and last but not least, our capacity to survive on this planet. Decisive action is needed in 2020.

Action by states and international organisations

- **Change framing of biodiversity debate:** This report highlights the negative spiralling loop between climate change and biodiversity loss: the loss of biodiversity increases climate change, and climate change further accelerates biodiversity loss. Not considering biodiversity factors within a climate risk analysis massively under-values the climate-related financial risks. Biodiversity preservation and restoration needs to be seen as the key for carbon capture and biodiversity within natural land- and seascapes and will help keep this stored carbon permanently. Climate change mitigation and adaptation need to address how to conserve and restore biodiversity. Only this integrated thinking will allow for fast changes and the implementation of the Paris Agreement on climate change.
- **Declare a state of emergency and agree to a “New Deal for Nature and People” in 2020, including an ambitious framework at the UN Conference on Biodiversity in Kunming (China):** Rapid biodiversity loss, accelerating climate change and the significant risks of financial system instability and economic turmoil that they pose warrant a “New Deal” akin to that declared by Franklin Roosevelt in response to the financial crash of 1929. In response to the 2008 crash, decision-makers swiftly pursued quantitative easing, pouring massive amounts of liquidity into financial markets and shoring up stock-market prices. And ten years later, we once again need a “New Deal” to stabilise the economy – one that invests in natural systems and natural infrastructure, putting nature on the path to recovery and creating prosperity, while simultaneously tackling the twin crises of climate breakdown and catastrophic biodiversity loss.
- **Set up an international framework that aligns financial flows to conserve and restore biodiversity (Article 2.1c for biodiversity):** The current international frameworks for the environment need to acknowledge the crucial role that private and public financial flows and subsidies play. Based on Article 2.1c (making financial flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development) of the Paris Agreement on climate change, we suggest that the following recommendations are adopted within the Convention on Biological Diversity:



- Align financial flows with the conservation, restoration and sustainable use of biodiversity:
 - analyse and define action to mobilise and shift financial flows
 - realign subsidies harmful to biodiversity and invest in biodiversity-friendly activities
 - scale up public and private financial flows for conservation to half a trillion US dollars per year
 - develop finance tracking and reporting frameworks for public and private financial flows that are consistent, robust and allow for comparability across states and across companies.
- All other international frameworks – such as Ramsar, the Convention on International Trade of Endangered Species (CITES), the Convention on Migratory Species (CMS), the Berne Convention, the International Whaling Commission (IWC) – also need to refer to private and public financial flows and subsidies and their realignment.
- **The massive funding gap for biodiversity conservation and restoration needs to be closed in 2020:** the authors at PwC and WWF estimate that at least half a trillion US dollars is needed annually to invest in biodiversity conservation and restoration (based on estimates by the High-level Panel on global investment required for biodiversity conservation, 2014) in order to safeguard the capacity of humans to survive on this planet and reduce the risks of financial instability. Private and public financial flows and subsidies are currently misallocated and need to be reoriented towards a low carbon economy, biodiversity conservation and restoration.
- **It needs to be specified that biodiversity loss and biodiversity-related financial risks are part of the fiduciary duty of financial agents:** Similarly to the discussion on fiduciary duty and climate change, states, law firms and international organisations such as the UNEP FI should highlight the necessity to further specify the fiduciary duty concept. Biodiversity losses are highly financially material and even drive climate-related financial risks. Therefore, they need to be accounted for by financial agents and integrated into financial decisions.
 - The EU Commission should run the same “Fitness Test for the Disclosure Requirements” for biodiversity impacts and biodiversity-related financial risks as they did for climate risks and impacts within the EU Sustainable Finance Action Plan. Based on the experience with Article 173 of the Energy Transition Law in France, they should then amend all of the existing requirements of companies and financial actors, specifying that biodiversity-related financial risks and impacts need to be disclosed.

Action by financial regulators and central banks

Financial risks are currently massively underestimated due to the lack of integration of biodiversity-related financial transition and physical risks. In addition, there is a blind spot in financial risk assessment due to the negative spiralling loop between climate change and biodiversity loss. Financial stability is at risk. Hence financial regulators and central banks need to act now. Thus, the Network for Greening the Financial System (NGFS) and its members should analyse the impact of biodiversity-related financial risks on the microprudential and macroprudential risks in their financial sectors.

- All central banks and financial regulators should demand that regulated entities regularly disclose their biodiversity-related financial risks.
- All central banks and financial regulators should run stress tests based on aligned and common practices, analysing the impact of physical, transition, litigation and systemic risks stemming from biodiversity loss on the whole financial sector and on individual financial institutions.
- All central banks and financial regulators should start reflecting on how biodiversity-related financial risks could be integrated into the capital and solvency requirements, in order to reduce the systematic risk stemming from biodiversity loss.

Action by financial market players

- **Measuring and disclosing biodiversity-related financial risks and positive and negative impact:** The WWF/AXA report has clearly shown that information and data on biodiversity losses are currently lacking. Financial institutions and companies generally do not report on biodiversity loss or biodiversity-related financial risks. This makes it complicated for financial institutions to adequately price risks and take informed decisions. Therefore, we suggest the following non-exhaustive steps:
 - Conduct forward-looking assessments regarding biodiversity risks and opportunities influencing a financial institution’s business. The outcome of the impact analysis should inform the development of strategies, policies and KPIs to address, reduce and mitigate negative impacts and realise opportunities to continuously expand and scale up positive impacts, while putting in place processes and systems to manage risks to people and the environment.
 - Create a task force on nature-related financial disclosures (TNFD) based on the positive experience with the Task Force on Climate-Related Financial Disclosures (TCFD). This should be launched early in 2020 in order to shape the discussions before the UN Conference on Biological Diversity in Kunming (China).
- **Current conventional accounting standards need to value and account for biodiversity loss:** Existing accounting standards like IFRS or Swiss Gap FER have to include the risks of biodiversity loss and their effect on the balance sheet and income statement of a company. Methodologies such as CDC’s Global Biodiversity Score, Planet tracker or CARE TDL could be used. The main goal is to increase transparency for stakeholders and the regulator. Therefore, the existing accounting models have to be adapted and expanded.

- **All financial actors should proactively manage biodiversity-related financial risks:**

Biodiversity risks should be integrated into financial market participants' conventional risk management processes. Financial actors and financial regulators should assess, in a timely manner, risks stemming from the impact and dependency on biodiversity and identify mitigation measures. The biodiversity definition (diversity of genes, species, ecosystems) is complex and makes it rather complicated to integrate it into a financial decision. Furthermore, data quality, availability and standardisation make it even more challenging. However, there are already sufficient tools, instruments and data available for certain ecosystems that help financial actors make informed decisions. Additionally, spatial finance is an important opportunity for the financial sector to better manage environmental risks and help protect biodiversity. The following steps could orient the management of biodiversity-related financial risks by financial actors:

- identify relevant risk management areas affected by the new legislation (e.g. Disclosure Regulation) based on the provided services and products
- determine status quo regarding how biodiversity-related financial risks are considered within an organisation
- analyse in detail existing market practices and mitigation techniques related to the integration of biodiversity-related financial risks
- choose a suitable biodiversity-related financial risk assessment and mitigation approach
- engage with external providers of biodiversity-related financial risk data, such as third-party vendors
- define required amendments to existing internal risk management processes
- implement changes into all affected policies and IT systems
- understand and engage with the whole value chain, upstream and downstream – if a financial institution or large manufacturing or retail company wants to tackle biodiversity problems, the issues often manifest themselves in their upstream activities (e.g. purchasing goods and services) or further downstream (e.g. processing, use and end-of-life of products), where insights and influence are not transparent, so the impact outside the company's own operations needs to be better monitored
- involve all relevant stakeholders, including investees, clients and shareholders, in this conversation.

- **Promote spatial finance as an important tool for the financial sector to reduce financial risks and measure impact.**

The current wave of new technology investment focused first on improving customer experience and reducing costs, but it is now shifting to new business models and addressing key environmental risks resulting from the ongoing pressure on nature assets. The combination of finance and aerial surveillance data and their appropriate GIS analysis will deliver much-needed environmental data for the financial sector. But it will furthermore transform the practices of loss anticipation and compensation, moving them towards more proactive risk detection, intervention and prevention. Going beyond self-reported and reputation risk-based data is key. Based on this information the sector could develop effective sustainability practices. It could, for example, address issues resulting from agricultural monocrop damage risk, devastations due to infertile soil, illegal interventions within conservation areas (e.g. that were financed with green bonds), including ongoing monitoring and deploying integrated real-time data from ground sensors, aerial surveillance and satellite imagery. These are win-win scenarios for policyholders and for investors and insurers as they lower risks and claims. However, to get access to spatial data, the finance industry should put pressure on external data providers so that they develop spatial finance services and tools for the finance industry. First initiatives to develop such tools already exist, such as the Spatial Finance Initiative³² and WWF-SIGHT. These platforms help to integrate geospatial analysis into financial decision-making.

“La finance sera verte,
ou elle ne sera plus”

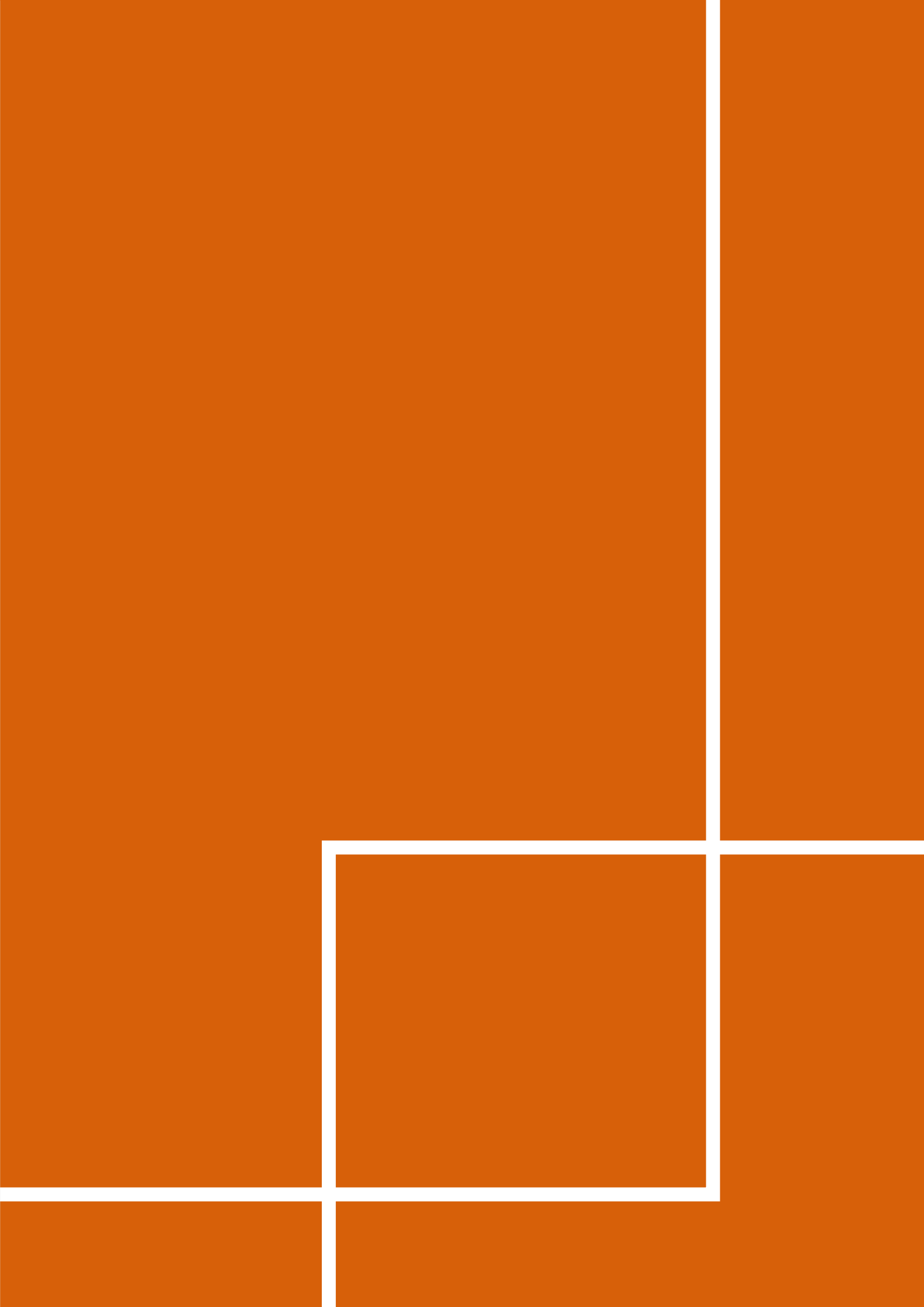
Bruno Le Maire, French Minister for
finance and the economy, 2017

³² <https://spatialfinanceinitiative.com/>

References

- ACTIAM, ASN Bank, CDC Biodiversité (2018), Common ground in biodiversity footprint methodologies for the financial sector <https://www.asnbank.nl/web/file?uuid=b71cf717-b0a6-47b0-8b96-47b6aefd2a07&owner=6916ad14-918d-4ea8-80ac-f71f0ff1928e&contentid=2412>
- Alternative Bank Schweiz, <https://www.abs.ch/de/firmen-institutionen/kredit-aufnehmen/nachhaltige-landwirtschaft/>
- Arent, D.J., R.S.J. Tol, E. Faust, J.P. Hella, S. Kumar, K.M. Strzepek, F.L. Tóth, and D. Yan, (2014), Key economic sectors and services. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change
- Australian Academy of Science (2015) Climate change and biodiversity <https://www.science.org.au/curious/earth-environment/climate-change-and-biodiversity>
- AXA/WWF report (2019), Into the Wild: Integrating Nature in Investment Strategies https://d2ouvy59p0dg6k.cloudfront.net/downloads/report_wwf_france__axa_into_the_wild_may_2019__dv_1.pdf
- BaFin (2019a), BaFin Perspectives Issue 2 https://www.bafin.de/EN/PublikationenDaten/BaFinPerspektiven/AlleAusgaben/BaFinPerspektiven_alle_node_en.html
- BaFin (2019a), Guidance notice on dealing with sustainability risks
- BIOFIN (2019), What is biodiversity finance <https://www.biodiversityfinance.net/about-biofin/what-biodiversity-finance>
- BlackRock presentation, Global Renewable Power III (GRP III): A Climate Infrastructure Fund, April 2019
- Braat, L.C., Brink, P. ten, (Eds.), 2008. The Cost of Policy Inaction: the Case of not Meeting the 2010 Biodiversity Target. Report to the European Commission Under Contract: ENV.G.1./ETU/2007/0044, Wageningen, Brussels, Alterra Report 1718 http://ec.europa.eu/environment/nature/biodiversity/economics/index_en.htm
- Brockerhof Eckehard et al. (2017), Forest biodiversity, ecosystem functioning and the provision of ecosystem services <https://link.springer.com/article/10.1007/s10531-017-1453-2>
- Busch, Timo et al. (2019), Nature Risks equal Financial Risks: A systematic literature review https://www.wwf.ch/sites/default/files/doc-2019-11/Nature_Risks_equal_Financial_Risks_RG_Sustainable_Finance_Hamburg_2019_final.pdf
- CDC Biodiversité (2017), Global Biodiversity Score: measuring a company's biodiversity footprint, Biodiv'2050 Outlook: Club B4B, no. 11 <https://www.globio.info/assessments-with-globio/thematic-assessments/161-global-biodiversity-score-measuring-a-companys-biodiversity-footprint>
- CDC Biodiversité (2019), Global Biodiversity Score: a tool to establish and measure corporate and financial commitments for biodiversity, Biodiv'2050 Outlook: Club B4B +, no. 14 <http://www.mission-economie-biodiversite.com/wp-content/uploads/2019/05/N14-TRAVAUX-DU-CLUB-B4B-GBS-UK-WEB.pdf>
- Center for International Forestry Research (2019), Forests and Biodiversity https://www.cifor.org/Publications/Corporate/FactSheet/forests_biodiversity.htm
- Ceulemans, T. (2014), Soil phosphorus constrains biodiversity across European grasslands <https://www.ncbi.nlm.nih.gov/pubmed/24895112>
- Climate Bonds, <https://www.climatebonds.net/>
- Club B4B, Global Biodiversity Score: measuring a company's biodiversity footprint, <https://www.globio.info/assessments-with-globio/thematic-assessments/161-global-biodiversity-score-measuring-a-companys-biodiversity-footprint>
- Convention on Biological Diversity, CBD (2015) Tourism Supporting Biodiversity <https://www.cbd.int/tourism/doc/tourism-manual-2015-en.pdf>
- Costanza Robert et al. (2014), Changes in the global value of ecosystem services <https://community-wealth.org/sites/clone.community-wealth.org/files/downloads/article-costanza-et-al.pdf>
- Credit Suisse and McKinsey (2016), Conservation Finance: From Niche to Mainstream: The Building of an Institutional Asset Class, <https://assets.rockefellerfoundation.org/app/uploads/20160121144045/conservation-finance-en.pdf>
- Credit Suisse, <https://www.credit-suisse.com/about-us/en/our-company/corporate-responsibility/environment/biodiversity-natural-capital.html>
- CREM, PRé Consultants and ASN Bank (2016) Towards ASN Bank's Biodiversity footprint; A pilot project
- Environmental Finance (2019), Sustainable finance: it's all about transition! Part one <https://www.environmental-finance.com/content/analysis/sustainable-finance-its-all-about-transition!-part-one.html>
- ETHZ (2019), The global tree restoration potential <https://science.sciencemag.org/content/365/6448/76>
- EU Community of Practice Finance and Biodiversity (2019), Minutes to the workshop on Biodiversity disclosure: issues, guidelines and enabling factors https://ec.europa.eu/environment/biodiversity/business/assets/pdf/190912_EU%20CoP%20F@B_Biodiversity%20Disclosure%20Initiatives_Minutes_PUBLIC.pdf
- EU Community of Practice Finance@Biodiversity (2019), Biodiversity Disclosure Public Summary https://ec.europa.eu/environment/biodiversity/business/assets/pdf/190912_EU%20CoP%20F@B_Biodiversity%20Disclosure%20Initiatives_Minutes_PUBLIC.pdf
- European Business and Biodiversity Campaign (2019), Cosmetics and Pharmaceutical <https://www.business-biodiversity.eu/en/cosmetics---pharmaceutical>
- European Business and Biodiversity Campaign (2019), Food Industry <https://www.business-biodiversity.eu/en/food-industry>
- European Business and Biodiversity Campaign (2019), Tourism <https://www.business-biodiversity.eu/en/company/tourism>
- European Commission (2015), Risks of biodiversity loss posed by nitrogen and phosphorus pollution in European freshwaters https://ec.europa.eu/environment/integration/research/newsalert/pdf/risks_of_biodiversity_loss_posed_by_nitrogen_and_phosphorus_418na6_en.pdf
- European Commission Guidelines on reporting climate-related information (2019) https://ec.europa.eu/finance/docs/policy/190618-climate-related-information-reporting-guidelines_en.pdf
- Finance Watch (2019), Making Finance Serve Nature https://www.finance-watch.org/wp-content/uploads/2019/05/Making-Finance-Serve-Nature_Finance-Watch-Report_24May2019_web.pdf
- Freshfield Bruckhaus Deringer (2005) A legal framework for the integration of environmental, social and governance issues into institutional investment: Produced for the Asset Management Working Group of the UNEP Finance Initiative https://www.unepfi.org/fileadmin/documents/freshfields_legal_resp_20051123.pdf
- Genetic Engineering and Biotechnology News (2019), Top 15 Best-Selling Drugs of 2018 <https://www.genengnews.com/a-lists/top-15-best-selling-drugs-of-2018/>
- GIIN (2019), Sizing the Impact Investing Market <https://thegiin.org/research/publication/impinv-market-size>
- Griscom Bronson et al. (2017), Natural climate solutions <https://www.pnas.org/content/114/44/11645>

- High-Level Panel on global assessment of the resources required for implementing the Strategic Plan for Biodiversity 2011-2020 (2012) Resourcing the Aichi Biodiversity Targets: a first assessment of the resources required for implementing the Strategic Plan for Biodiversity 2011-2020. <https://www.cbd.int/doc/meetings/cop/cop-11/information/cop-11-inf-20-en.pdf>
- Hsu, Y.-S., Liu, C. Z., Yang, Y.-J., & Chou, Y.-Y. (2013). Implications of the British petroleum oil spill disaster for its industry peers – evidence from the market reaction and earnings quality. *Asia-Pacific Journal of Accounting & Economics*, 20(3), 281–296. <https://doi.org/10.1080/16081625.2012.739963>
- Humphrey, P., Carter, D. A., & Simkins, B. (2016). The market's reaction to unexpected, catastrophic events. *The Journal of Risk Finance*, 17(1), 2–25. <https://doi.org/10.1108/JRF-08-2015-0072> - Lee & Garza-Gomez, 2012;
- Influence Map (2019), Asset Managers and Climate Change
- IPBES Global Assessment (2019) <https://www.ipbes.net/news/ipbes-global-assessment-summary-policymakers-pdf>
- IPCC (2018) Special Report on 1.5°C global warming
- IUCN <https://www.iucn.org/content/biodiversity-next-challenge-financial-institutions>
- Klomp, J. (2014). Financial fragility and natural disasters: An empirical analysis. *Journal of Financial Stability*, 13, 180–192. <https://doi.org/10.1016/J.JFS.2014.06.001>
- Koumbarakis, A. (2018), *The Economic Theory of Bank Regulation and the Redesign of Switzerland's Lender of Last Resort Regime for the Twenty-First Century*, Schulthess Verlag.
- London School of Economics, The Grantham Research Institute on Climate Change and the Environment (2019) The missing economic risks in assessments of climate change impacts <http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2019/09/The-missingeconomic-risks-in-assessments-of-climate-change-impacts-2.pdf>
- Natural Capital Coalition (2018), *Connecting Finance and Natural Capital – A supplement to the Natural Capital Protocol* www.naturalcapitalcoalition.org
- Natural Capital Coalition, Biodiversity Project Website <https://naturalcapitalcoalition.org/projects/biodiversity/>
- NGFS (2019), A call for action: climate change as a source of financial risk, https://www.banque-france.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf
- Nunez et al. (2019), Assessing the impacts of climate change on biodiversity: is below 2 °C enough? <https://link.springer.com/article/10.1007/s10584-019-02420-x>
- OECD, Biodiversity: Finance and the Economic and Business Case for Action <https://www.oecd.org/environment/resources/biodiversity/G7-report-Biodiversity-Finance-and-the-Economic-and-Business-Case-for-Action.pdf>
- PwC WEF (2010), Biodiversity and business risk- A Global Risks Network briefing <https://www.pwc.co.uk/assets/pdf/wef-biodiversity-and-business-risk.pdf>
- Rambaud, A. and Richard, J. (2015), The “Triple Depreciation Line” instead of the “Triple Bottom Line”: Towards a genuine integrated reporting
- S&P Global Ratings (2019), Green Finance: Modest 2018 Growth Masks Strong Market Fundamentals For 2019, <https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/Public-research-resources/SP-Global2019-01-29Green-Finance-Modest-2018-Growth-Masks-Strong-Market-Fundamentals-For-2019-130219.pdf>
- Sabet, S. A. H., Cam, M.-A., & Heaney, R. (2012). Share market reaction to the BP oil spill and the US government moratorium on exploration. *Australian Journal of Management*, 37(1), 61–76. <https://doi.org/10.1177/0312896211427321> Global Witness 2019
- Sabin Center (2019) litigation database: Center for Biological Diversity v. Bernhardt
- Schüwer, U., Lambert, C., & Noth, F. (2019). How Do Banks React to Catastrophic Events? Evidence from Hurricane Katrina. *Review of Finance*, 23(1), 75–116. <https://doi.org/10.1093/rof/rfy010> Heflin, F., & Wallace, D. (2017). The BP Oil Spill: Shareholder Wealth Effects and Environmental Disclosures. *Journal of Business Finance & Accounting*, 44(3–4), 337–374. <https://doi.org/10.1111/jbfa.12244>
- Soons Merel et al. (2017), Nitrogen effects on plant species richness in herbaceous communities are more widespread and stronger than those of phosphorus <https://www.sciencedirect.com/science/article/pii/S0006320716309831>
- Spatial Finance Initiative, <https://spatialfinanceinitiative.com/>
- SPOTT, <https://www.spott.org/about/>
- Stockholm Resilience Center (2019), The nine planetary boundaries <https://www.stockholmresilience.org/research/planetary-boundaries/planetary-boundaries/about-the-research/the-nine-planetary-boundaries.html>
- The Conservation Fund (2019) Press Release - The Conservation Fund Successfully Closes Debut \$150 Million Green Bond <https://www.conservationfund.org/news/press-releases/2019-the-fund-successfullycloses-debut-150-million-green-bond>
- The European Union Business and Biodiversity Platform (2019), Finance Sector and Biodiversity Conservation Best Practice Benchmarking https://ec.europa.eu/environment/archives/business/assets/pdf/sectors/FINAL_Finance.pdf
- The Nature Conservancy (2017), Lands of Opportunity Unleashing the full potential of natural climate solutions <https://www.nature.org/en-us/what-we-do/our-insights/perspectives/natural-climate-solutions/>
- UNEP FI (2007), Biodiversity Risks & Opportunities in the Financial Sector- A scoping study <https://www.unepfi.org/fileadmin/events/2007/london/4mulder.pdf>
- UNEP FI, PSI, UNESCO, WWF (2019), Protecting our World Heritage, insuring a sustainable future https://www.wwf.ch/sites/default/files/doc-2019-10/2019_10_insuring_sustainable_future.pdf
- UNESCO, PSI, WWF (2019), Protecting our World Heritage, insuring a sustainable future <https://www.unepfi.org/psi/wp-content/uploads/2019/10/PSI-WWF-UNESCO-guide.pdf>
- WEF: Biodiversity and Business Risk (2010) <https://www.pwc.co.uk/assets/pdf/wef-biodiversity-and-business-risk.pdf>
- WWF France (2019), Capital Naturel et stratégies des organisations : une visite guidée des outils https://www.wwf.fr/sites/default/files/doc-2019-10/20191023_Guide_Capital-Naturel-Strat%C3%A9gies-Organisations-Outils-min.pdf
- WWF International (2018) Living Planet Report - 2018: Aiming Higher
- WWF International (2019), Aligning Finance for One Planet https://www.panda.org/our_work/finance/resources/?355935/Aligning-Finance-For-One-Planet
- WWF (2019) Nature of Risk Report <https://www.worldwildlife.org/publications/the-nature-of-risk-a-framework-for-understanding-nature-related-risk-to-business>
- WWF, Aviva Investors, Investec Asset Management, Safeguarding outstanding natural value <https://www.wwf.org.uk/updates/report-safeguarding-outstanding-natural-value-2015>
- Young, R. (1999), Importance of biodiversity to the modern pharmaceutical industry https://www.researchgate.net/publication/228887125_Importance_of_biodiversity_to_the_modern_pharmaceutical_industry



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