The ecosystem service degradation sensitivity indicator (EDSI):

A new framework for understanding the financial risk repercussions of nature degradation
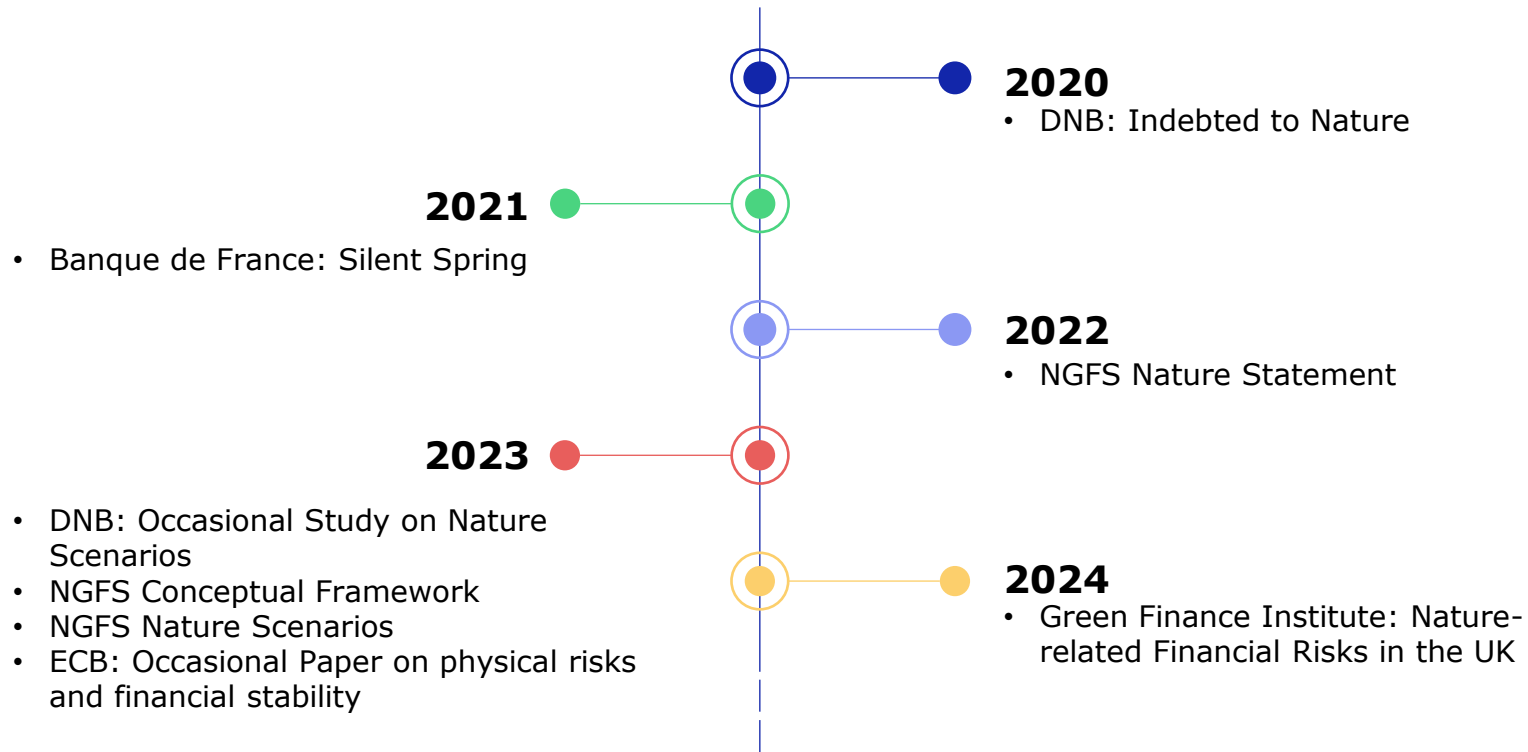
MPPG – 15 October 2024 – Vilnius

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Sébastien Gallet
Antje Hendricks
Julja Prodani

Looking back

2020
- DNB: Indebted to Nature

2021
- Banque de France: Silent Spring

2022
- NGFS Nature Statement

2023
- DNB: Occasional Study on Nature Scenarios
- NGFS Conceptual Framework
- NGFS Nature Scenarios
- ECB: Occasional Paper on physical risks and financial stability

2024
- Green Finance Institute: Nature-related Financial Risks in the UK

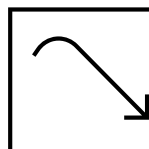DeNederlandscheBank
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Contribution

- Moving beyond popular '**exposure**' analyses to a '**risk/financial loss**' analysis.

- **Integrate nature degradation into credit risk modelling** and its impact on banks' capital.

- We assume that a shock on ecosystem services (ES) **changes the balance sheet of a firm** (depreciates the assets of the firm) proportionally to the level of

  i. dependence of the firm on the ES and

  ii. the degradation of the ES.
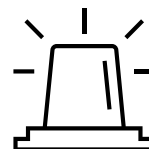
- This subsequently impacts **banks' credit risk.**

Contribution: Intuition & Example
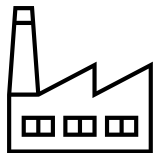
1. Firm A is working in the energy production sector.

2. Firm A is highly dependent on the ecosystem service 'surface water provision' for cooling.

3. Firm A borrows money from Bank B.

4. 'Surface water provision' experiences a negative shock.
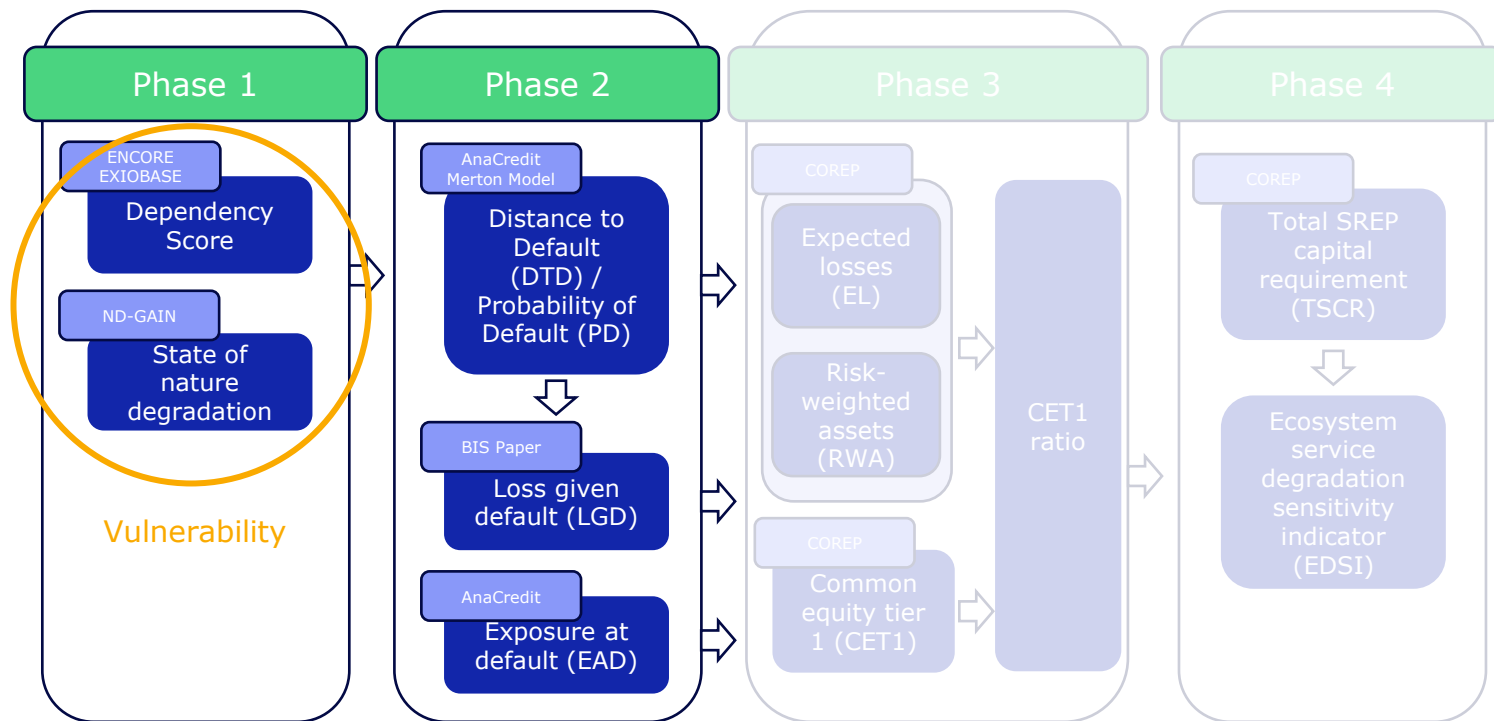
5. The distance to default for firm A decreases, the PD of firm A increases.
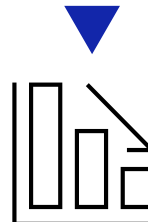
6. Bank B sees an increase in expected losses and RWA, leading to a decrease in the CET1 ratio.

Stylized phases of the Framework - Methodology

Phase 1	Phase 2	Phase 3	Phase 4

Phase 1
- ENCORE EXIOBASE
- Dependency Score
- ND-GAIN
- State of nature degradation

Vulnerability

Phase 2
- AnaCredit Merton Model
- Distance to Default (DTD) / Probability of Default (PD)
- BIS Paper
- Loss given default (LGD)
- AnaCredit
- Exposure at default (EAD)

Phase 3
- COREP
- Expected losses (EL)
- Risk-weighted assets (RWA)
- COREP
- Common equity tier 1 (CET1)
- CET1 ratio

Phase 4
- COREP
- Total SREP capital requirement (TSCR)
- Ecosystem service degradation sensitivity indicator (EDSI)

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The Modified Merton Model: Details on Phase 2

1. The Merton model sets the probability of default (PD) as a function of the distance to default (DTD).
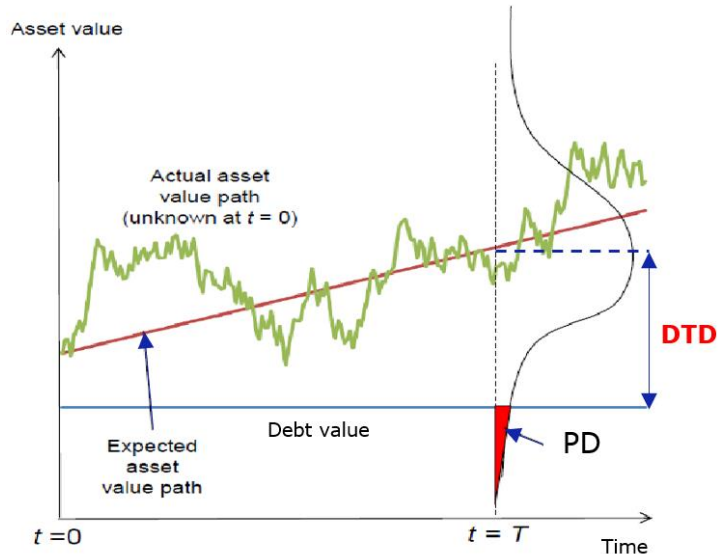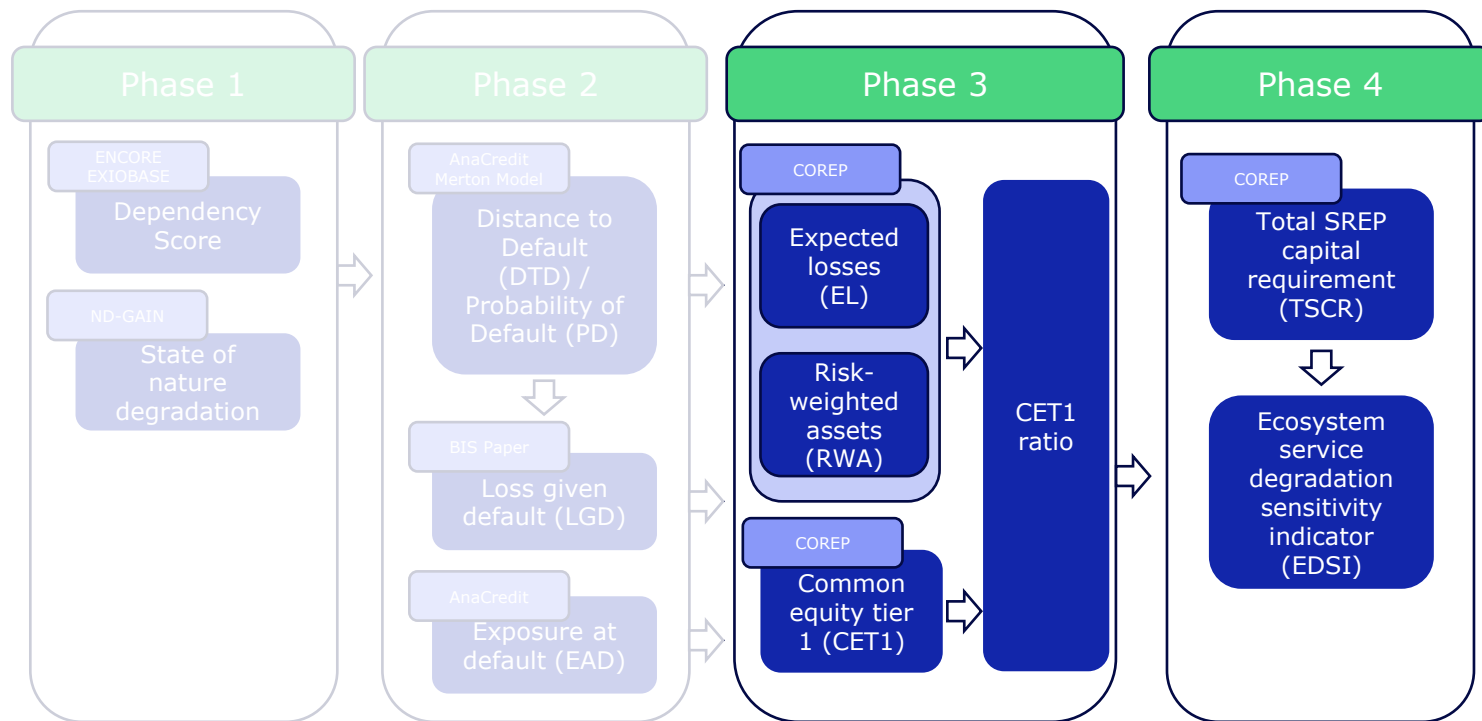

2. Novelty: Mathematically consistent modelling of nature degradation and its impact on a firm's balance sheet.
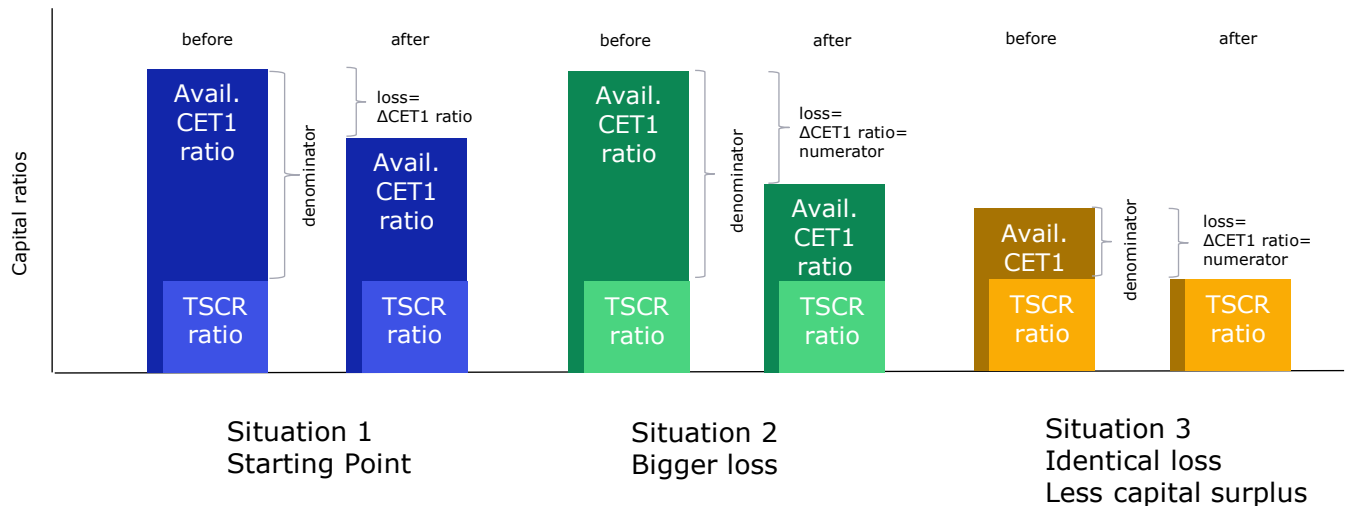
$$DTD_i^{dep} = DTD_i - \frac{\alpha_{ES}\, Vuln_{ES,i}}{\sigma_i}$$

- α_{ES}, sets the overall level of the aggregated shock
- $Vuln_{ES,i}$, mix of dependency and nature degradation
- σ_i, volatility of the asset value

Stylized phases of the Framework - Methodology

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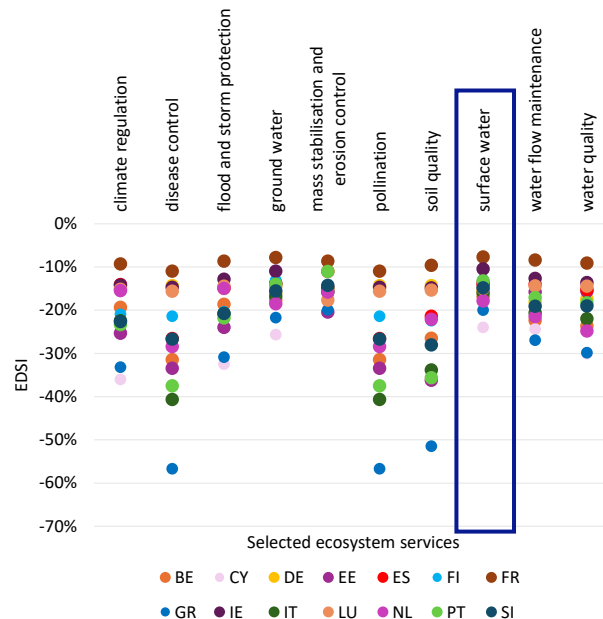EUROSYSTEEM

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Understanding the added value of the EDSI across examples

Results with fixed depreciation rate of 1% per ES at the aggregated SSM level
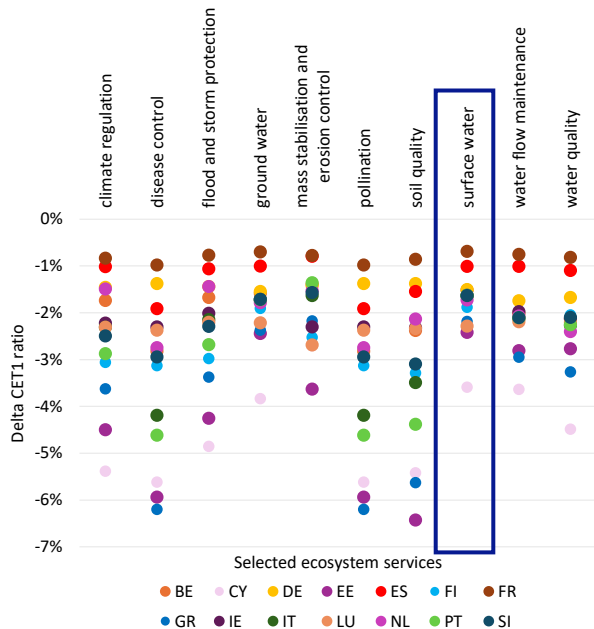
Research Highlights

Credit Risk Estimation ①

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- Integration of ecosystem service dependence and degradation into credit risk estimations

Financial Risk Approach ②

————————————

- Introduction of a capital-based sensitivity indicator, "exposure" → "financial risk"

Comparability ③

————————————

- Cross-bank and cross-country comparisons of potential financial losses

Flexibility ④

————————————

- Integration of PR and TR
- New tool for stress tests
- Possible extension to market risk

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Thank you very much for your attention!

QR code to working paper

Literature

- van Toor, J., Piljic, D., Schellekens, G., van Oorschot, M., & Kok, M. (2020). *Indebted to Nature*. De Nederlandsche Bank

- Svartzman, R. et al., (2021). *A "Silent Spring" for the Financial System? Exploring Biodiversity-Related Financial Risks in France*. Banque de France

- Boldrini, S., Ceglar, A., Lelli, C., Parisi, L., & Heemskerk, I. (2023). *Living in a world of disappearing nature: physical risk and the implications for financial stability*. ECB.

- Prodani, J., Gallet, S., Jansen, D.-J., Kearney, I., Schotten, G., Brower, G., . . . Marques, A. (2023). *The economic and financial stability repercussions of nature degradation for the Netherlands: Exploring scenarios with transition shocks.* De Nederlandsche Bank

- Ranger, N., & Oliver, T. (2024). *Assessing the Materiality of Nature-Related Financial Risks for the UK*

- Reinders, H., Schoenmaker, D., & van Dijk, M. (2023). *A finance approach to climate stress testing*. Journal of International Money and Finance 131.

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