

**How does ecological risk  
relate to commercial risk?**

**Welcome**  
*Sir Partha Dasgupta FRS*

THE  
ROYAL  
SOCIETY







**Emily McKenzie**



**Professor Yadvinder  
Malhi CBE FRS**



**Professor Braulio  
Ferreira de Souza Dias**



**Claudine Blamey**



**Daniella Vega**



**Professor Sebsebe  
Demissew ForMemRS**



**Professor Dame  
Theresa Marteau**



**Professor Jane  
Lubchenco ForMemRS**



# Ecosystem services and physical risk

*Chair:* Professor Jane Lubchenco ForMemRS

Dr Tony Juniper CBE

Professor Louise Heathwaite CBE FRS

Professor Carl Folke

Paul Polman KBE

THE  
ROYAL  
SOCIETY

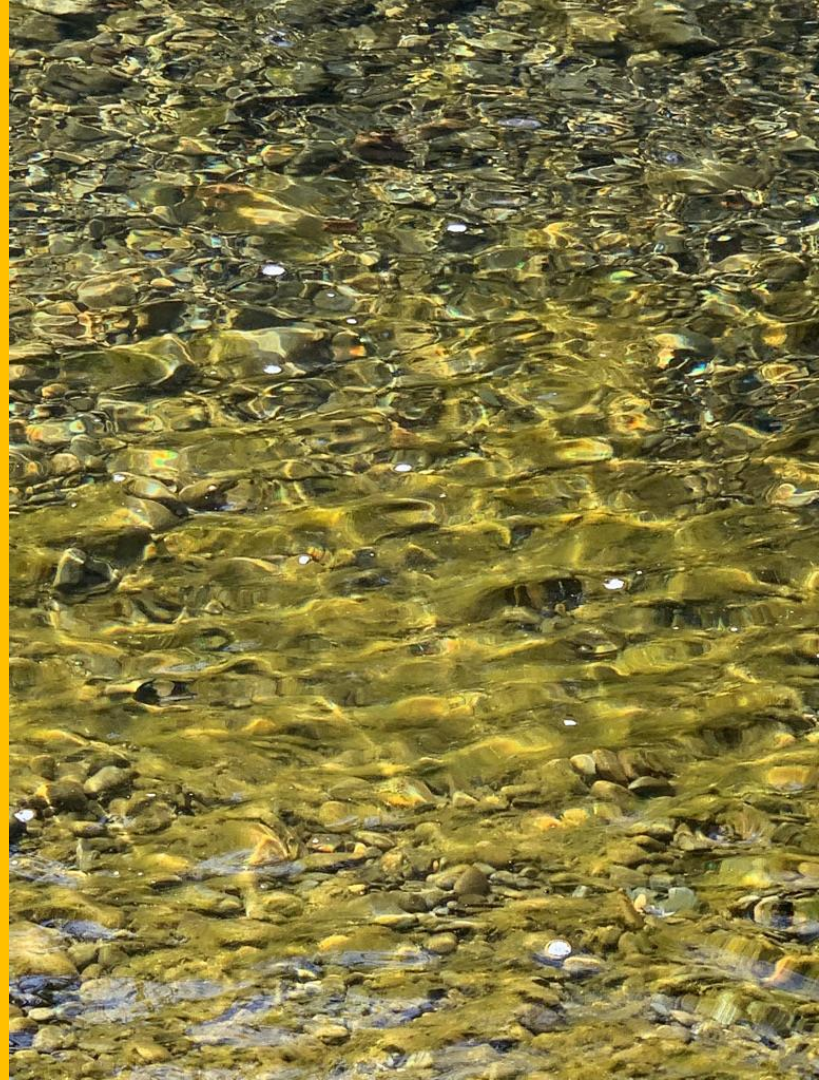




# How does ecological risk relate to commercial risk?

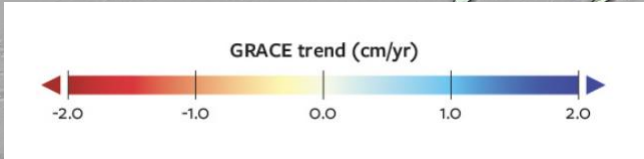
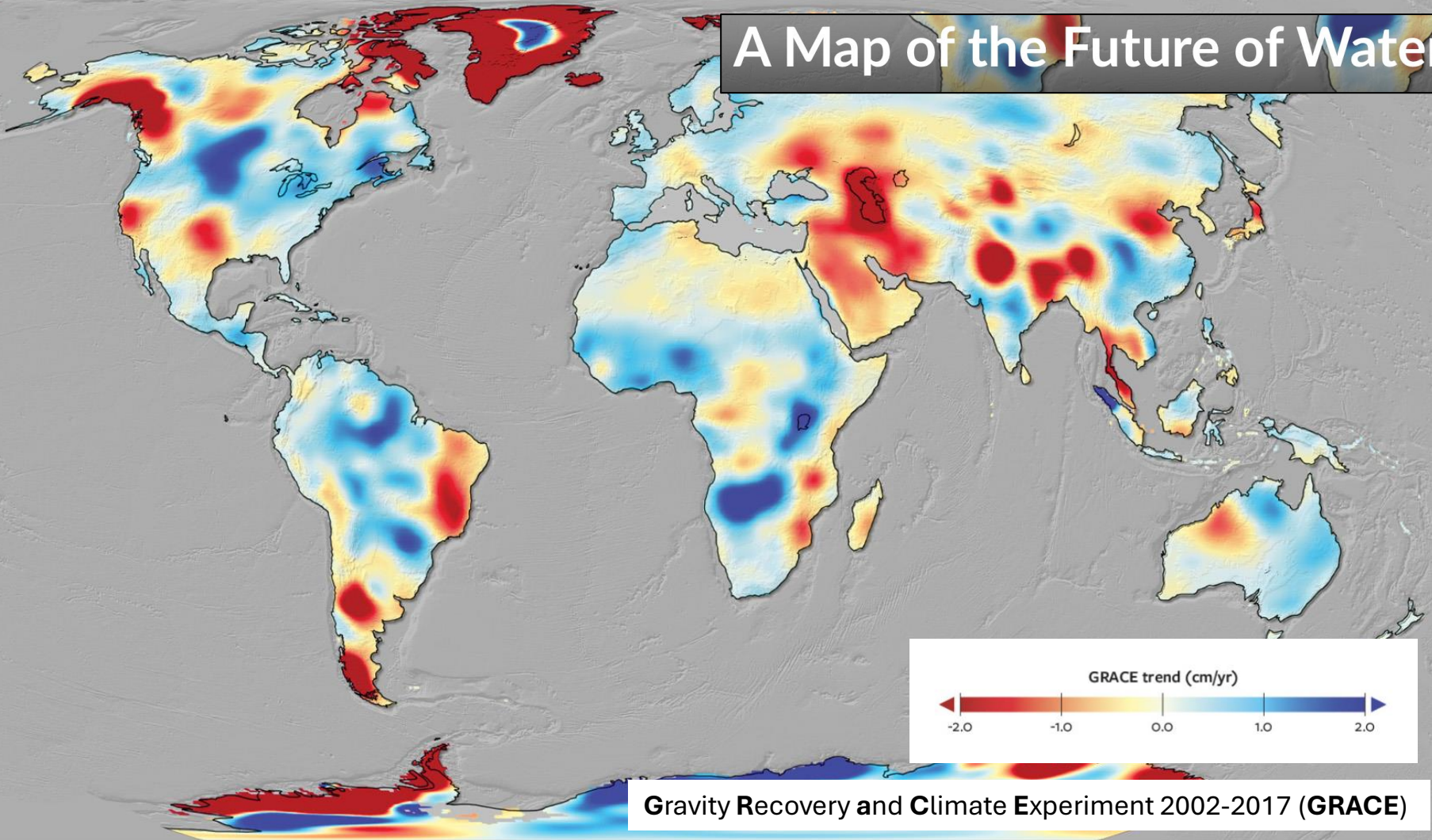
*Ecosystem services and physical risks: freshwater availability*

Professor Louise Heathwaite CBE FRS



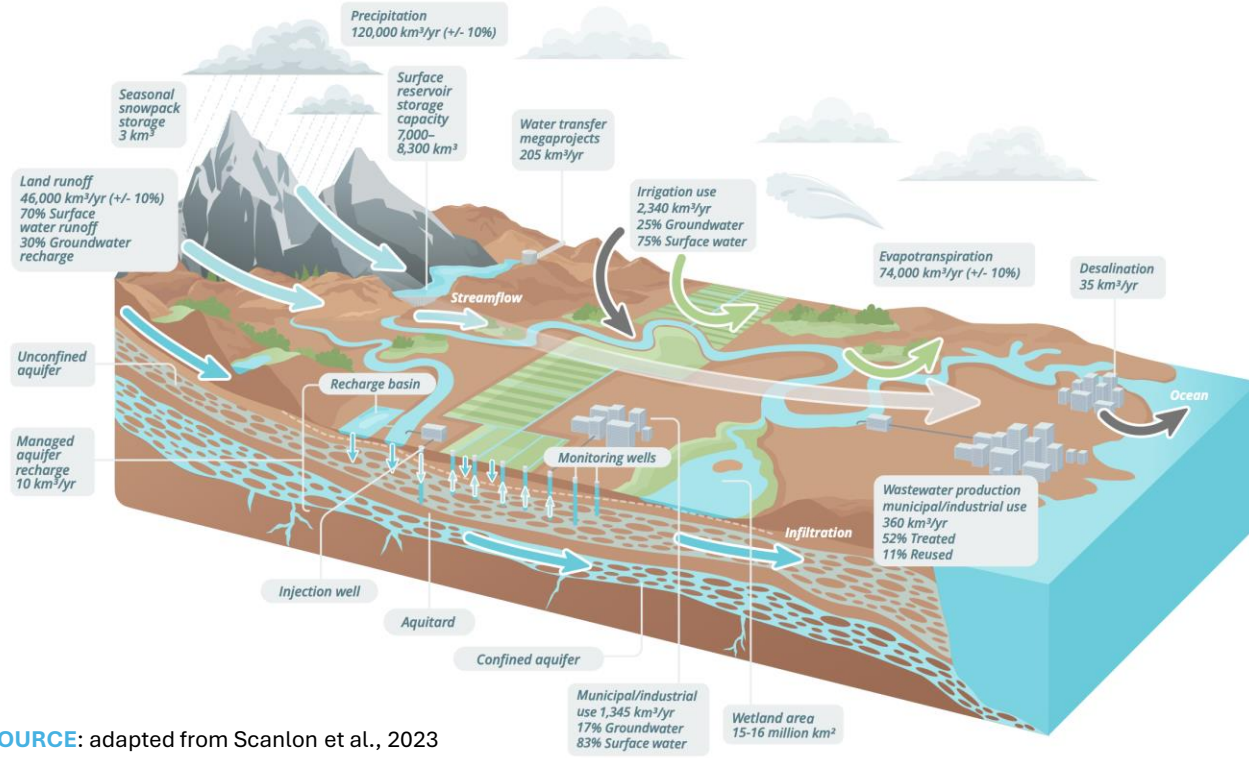


# A Map of the Future of Water



Gravity Recovery and Climate Experiment 2002-2017 (GRACE)

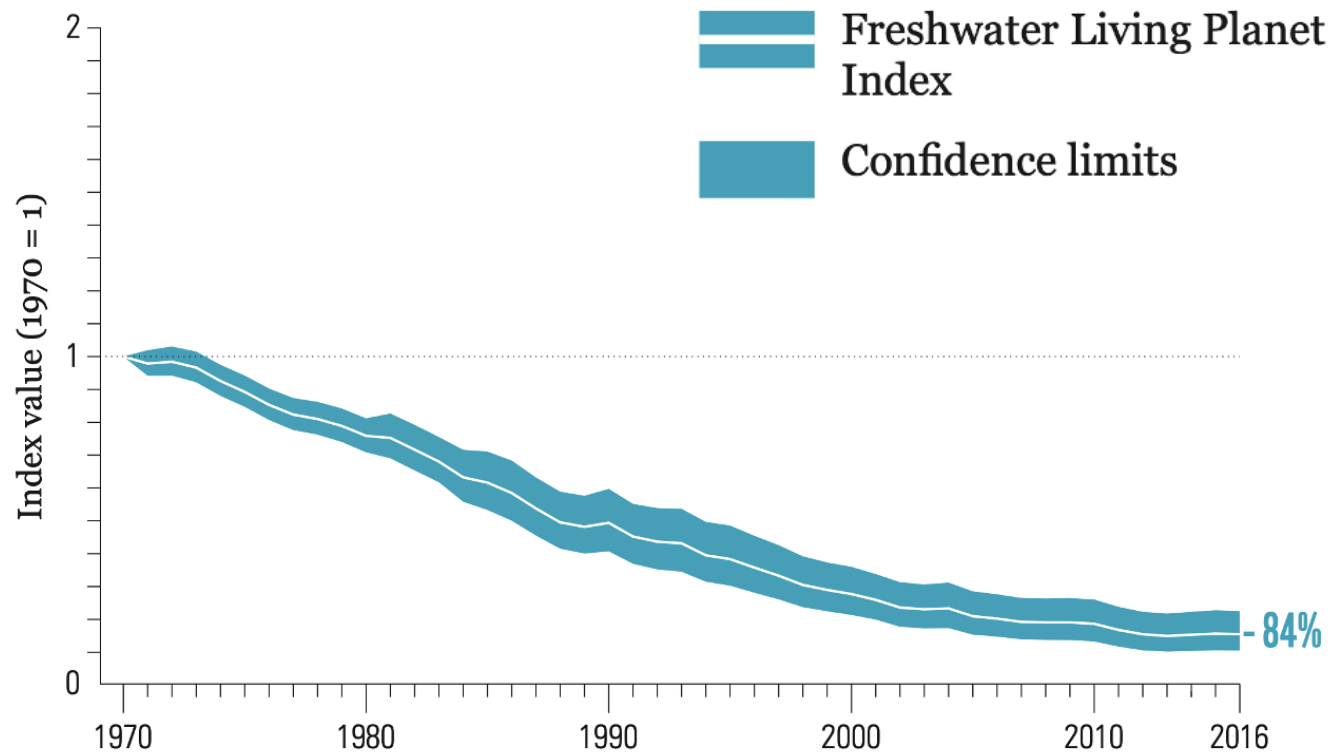




**SOURCE:** adapted from Scanlon et al., 2023

- Green Water**  
Water stored in soil available for evapotranspiration by plants
- Blue Water**  
Rivers, lakes, wetlands, groundwater & water storages
- White Water**  
Glaciers, snow & ice
- Grey Water**  
Wastewater with contaminants but no human defecation waste
- Black Water**  
Wastewater with human defecation and other contaminants

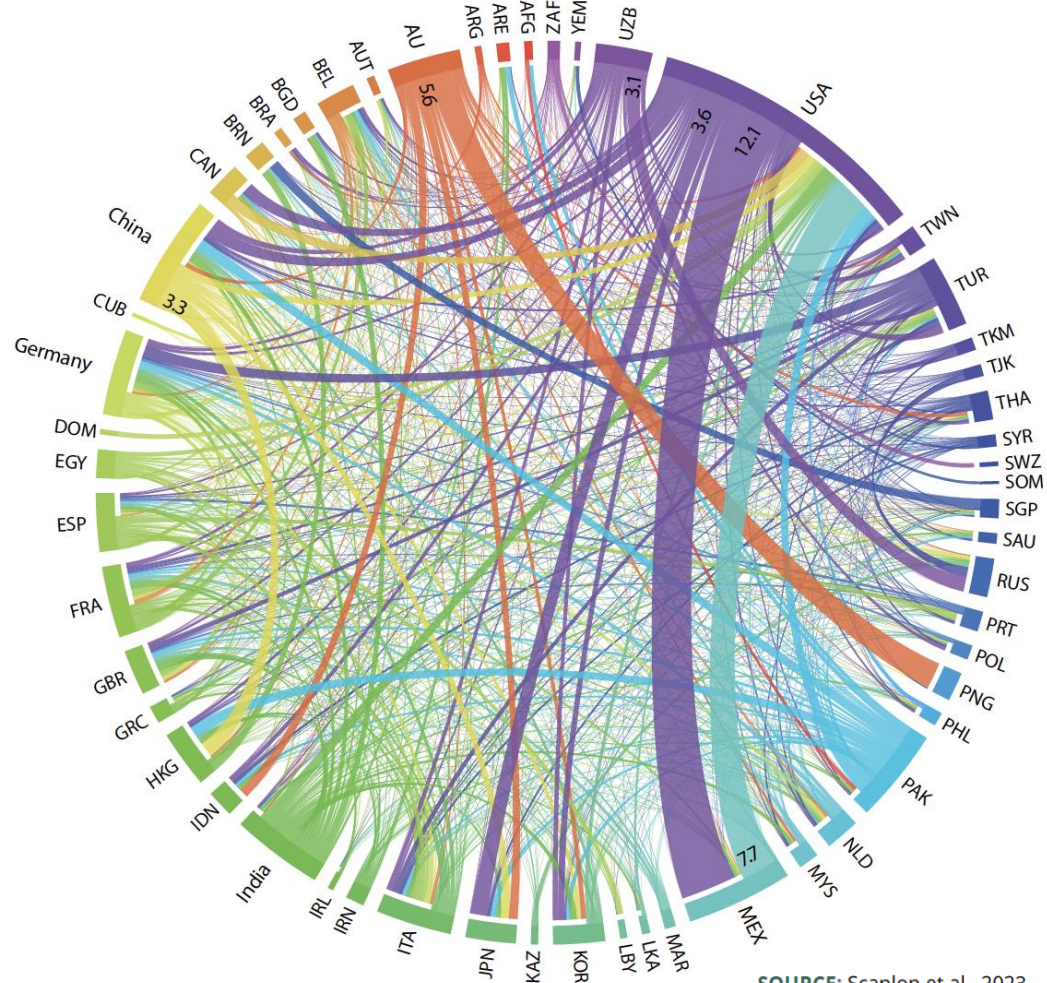






# SUPPLY CHAINS & FUTURE SHOCKS

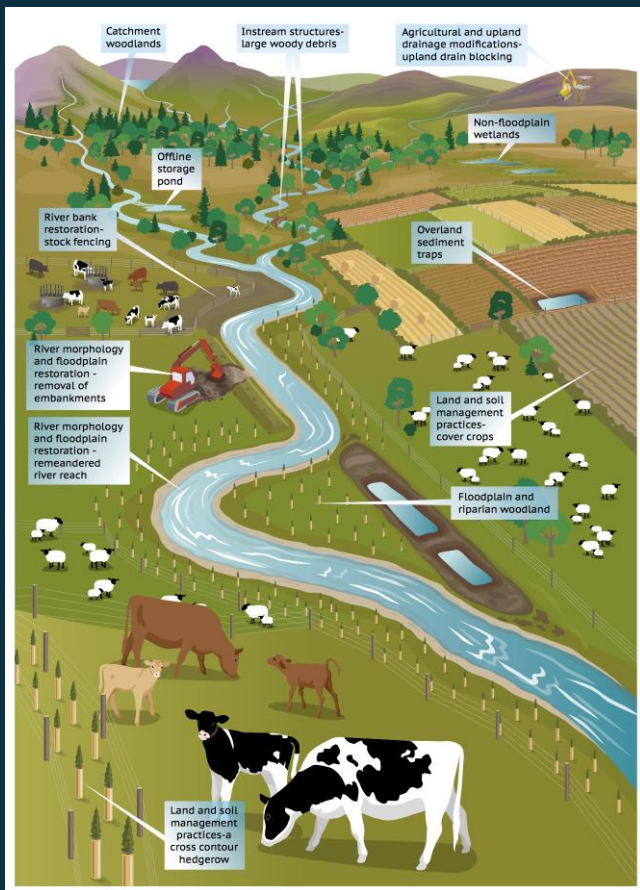
Virtual water flows between countries  
1996-2005  
( $\text{km}^3 \text{ yr}^{-1}$ )



SOURCE: Scanlon et al., 2023



# Co-benefits: NFM

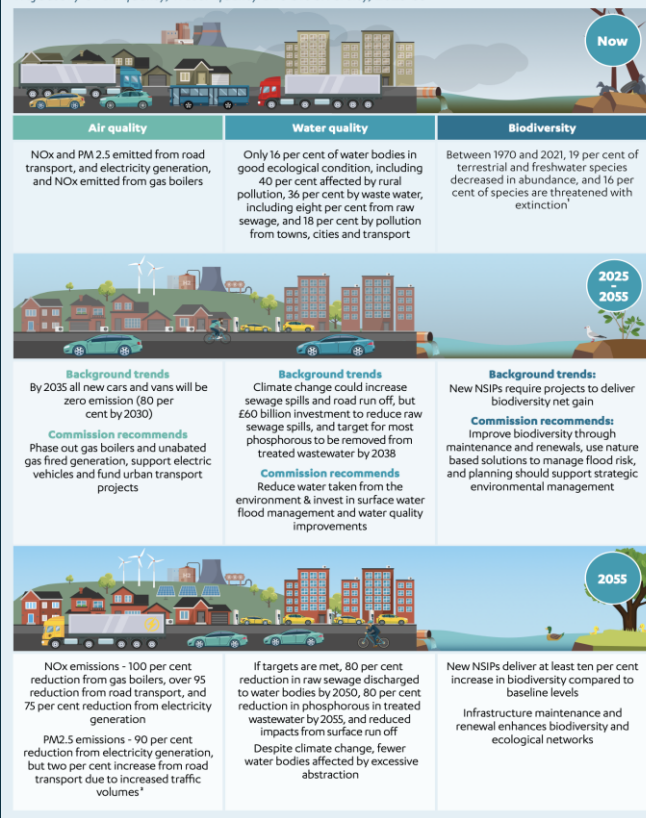


Source: SEPA Natural Flood Management Handbook 2015

# Co-benefits: Infrastructure

Figure 4.4: Environmental outcomes will improve through Commission recommendations and government action

Trajectory of air quality, water quality and biodiversity, 2025-55



Source: The second National Infrastructure Assessment, October 2023


# THE SAFE SLUDGE MATRIX



*Guidelines for the  
Application of Sewage  
Sludge to Agricultural Land*

**BRC**  
BRITISH RETAIL CONSORTIUM  
The Voice of British Retailing

  
**WATER UK**

  
**ADAS**  
Issue Date:  
April 2001  
3rd Edition

CROP GROUP	UNTREATED SLUDGES	CONVENTIONALLY TREATED SLUDGES	ENHANCED TREATED SLUDGES
FRUIT	X	X	✓
SALADS	X	X (30 month harvest interval applies)	✓
VEGETABLES	X	X (12 month harvest interval applies)	✓
HORTICULTURE	X	X	✓
COMBINABLE & ANIMAL FEED CROPS	X	✓	✓
- GRAZED GRASS & FORAGE	X	X (Deep injected or ploughed down only)	✓
- HARVESTED	X	✓ (No grazing in season of application)	✓

10 month harvest interval applies

3 week no grazing and harvest interval applies



# Tipping points and Biosphere stewardship

Carl Folke

**Beijer  
Institute**  
OF ECOLOGICAL ECONOMICS



KUNGL.  
VETENSKAPS-  
AKADEMIEN  
THE ROYAL SWEDISH ACADEMY OF SCIENCES

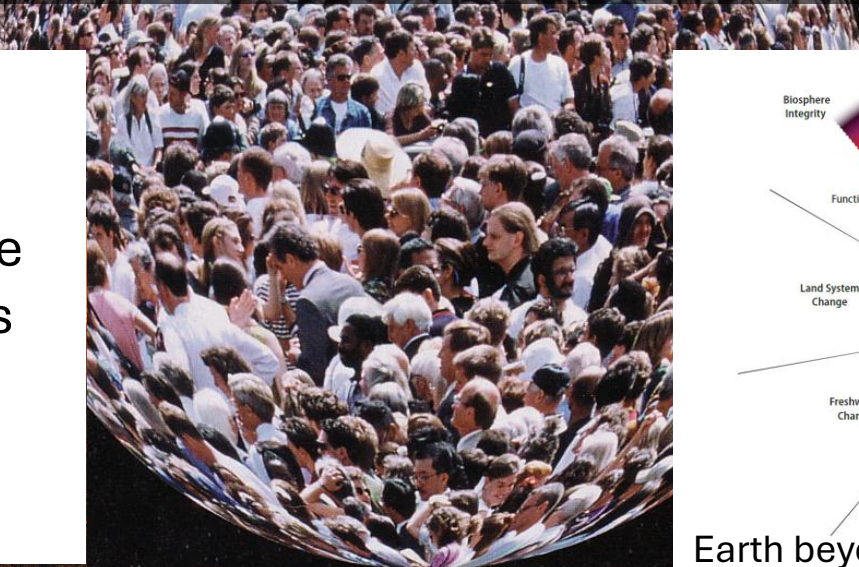
**Stockholm Resilience Centre**  
Sustainability Science for Biosphere Stewardship



**Stockholm  
University**

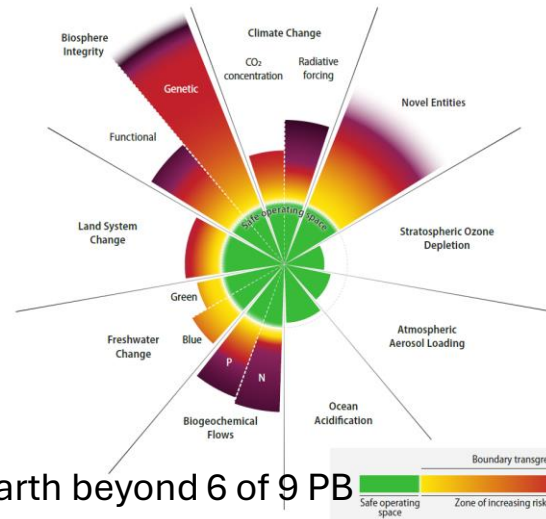


# New Biosphere Terrain Feeding back on humanity

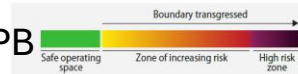


## Polycrises

Climate change  
Simplified biosphere  
Intertwined systems  
Interacting shocks  
Tipping and thresholds

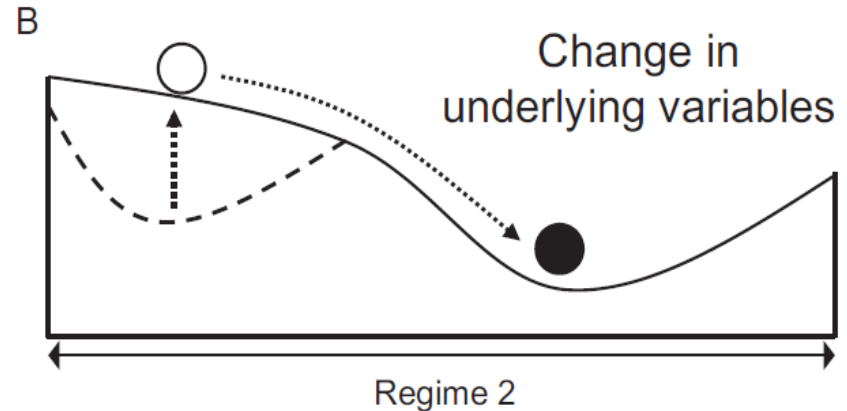
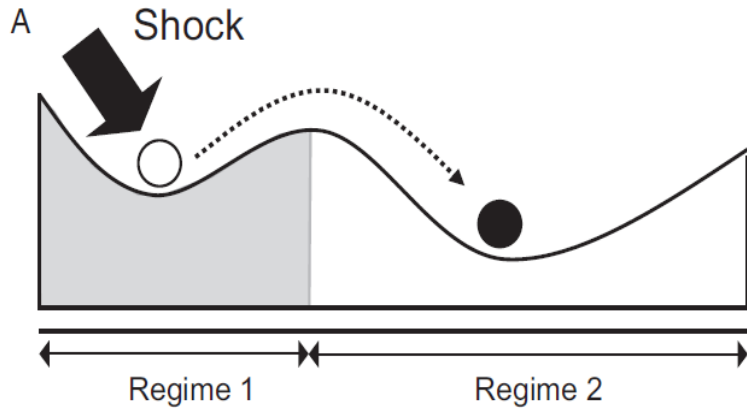


Earth beyond 6 of 9 PB

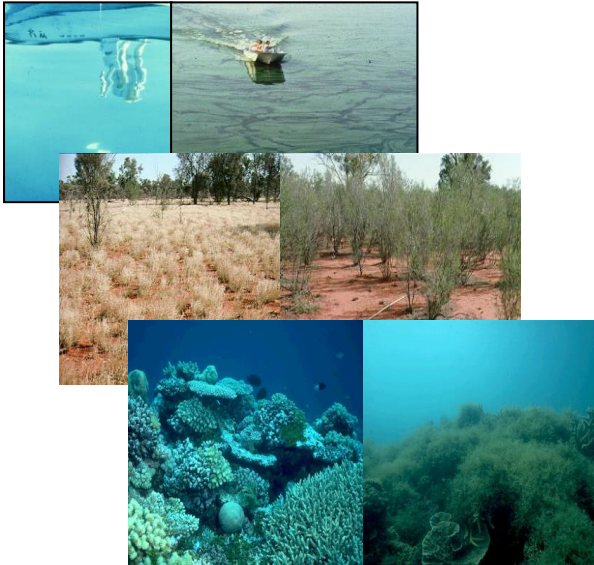




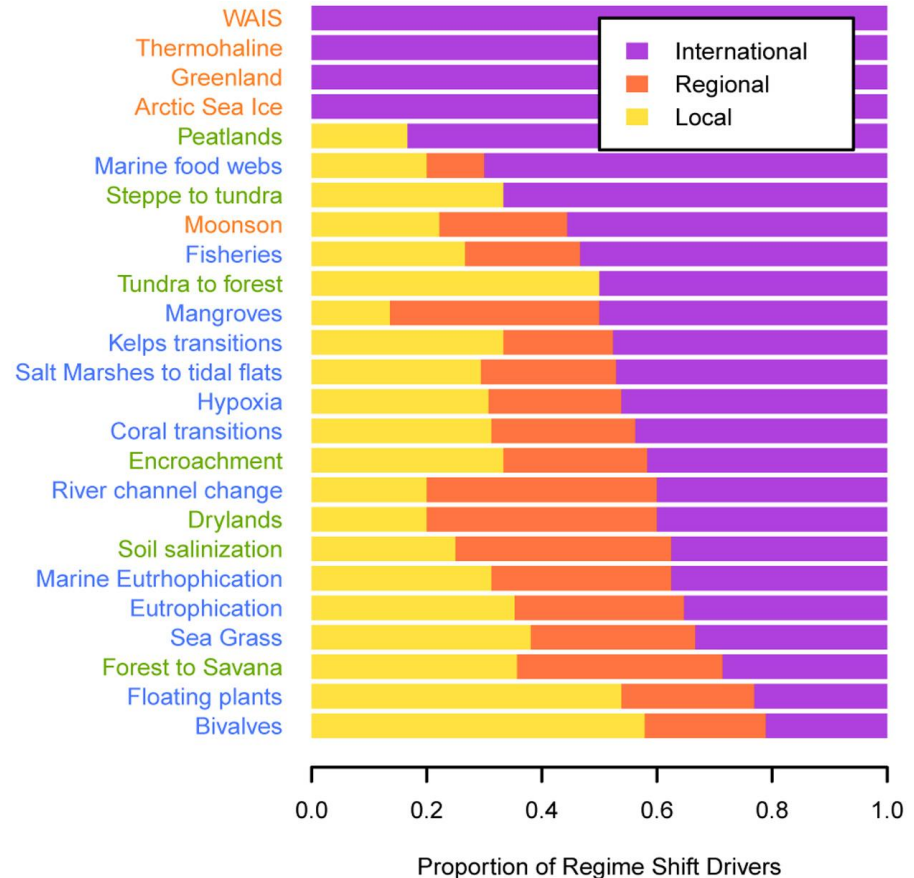
# Regime shifts and tipping points – fast and slow combine to produce surprise



# Ecosystem tipping points and regime shifts



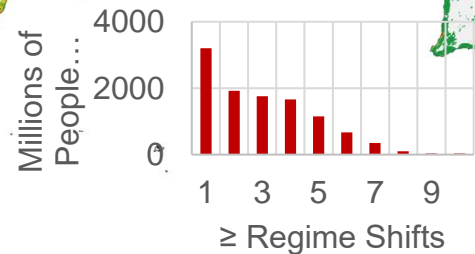
Scheffer et al 2001 Nature  
Folke et al. 2004 Annual Rev Ecol Evol Syst



Regime shifts names are coloured according to ecosystem type: blue = marine regime shifts, green = terrestrial and orange = subcontinental regime shifts.



# Density of people exposed to 21 ecological regime shifts

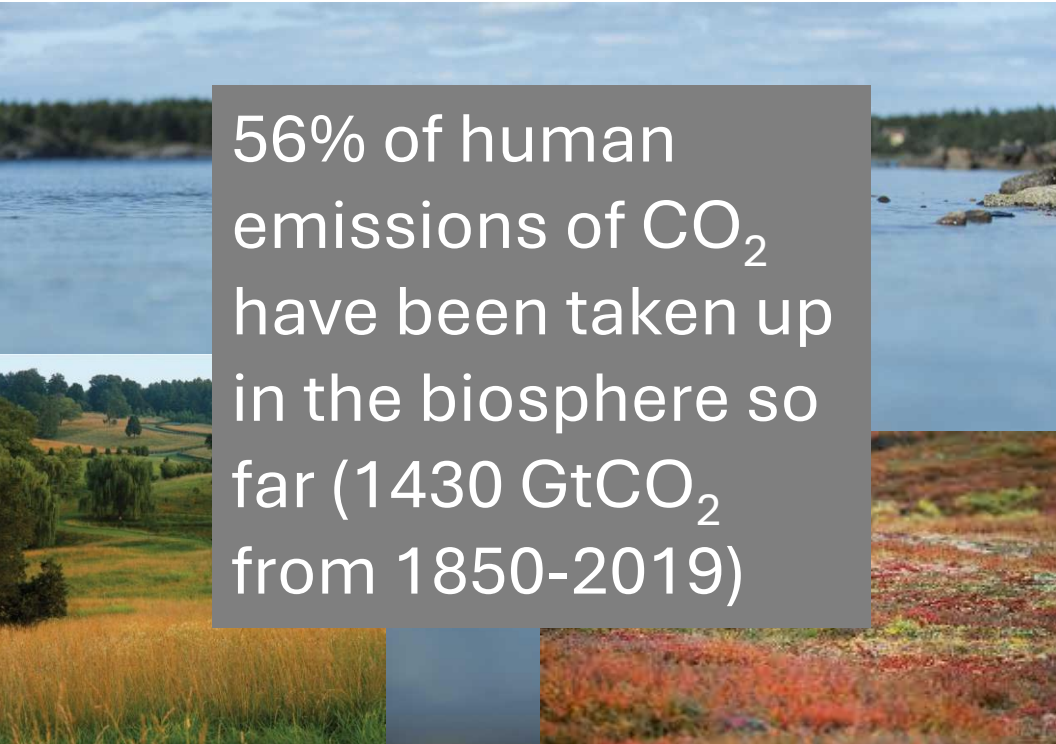


## We need biosphere stewardship that protects carbon sinks and builds resilience

Johan Rockström<sup>a,b,1</sup>, Tim Beringer<sup>a</sup>, David Hole<sup>c</sup>, Bronson Griscom<sup>c</sup>, Michael B. Mascia<sup>c</sup>, Carl Folke<sup>b,d</sup>, and Felix Creutzig<sup>e,f</sup>

56% of human emissions of CO<sub>2</sub> have been taken up in the biosphere so far (1430 GtCO<sub>2</sub> from 1850-2019)

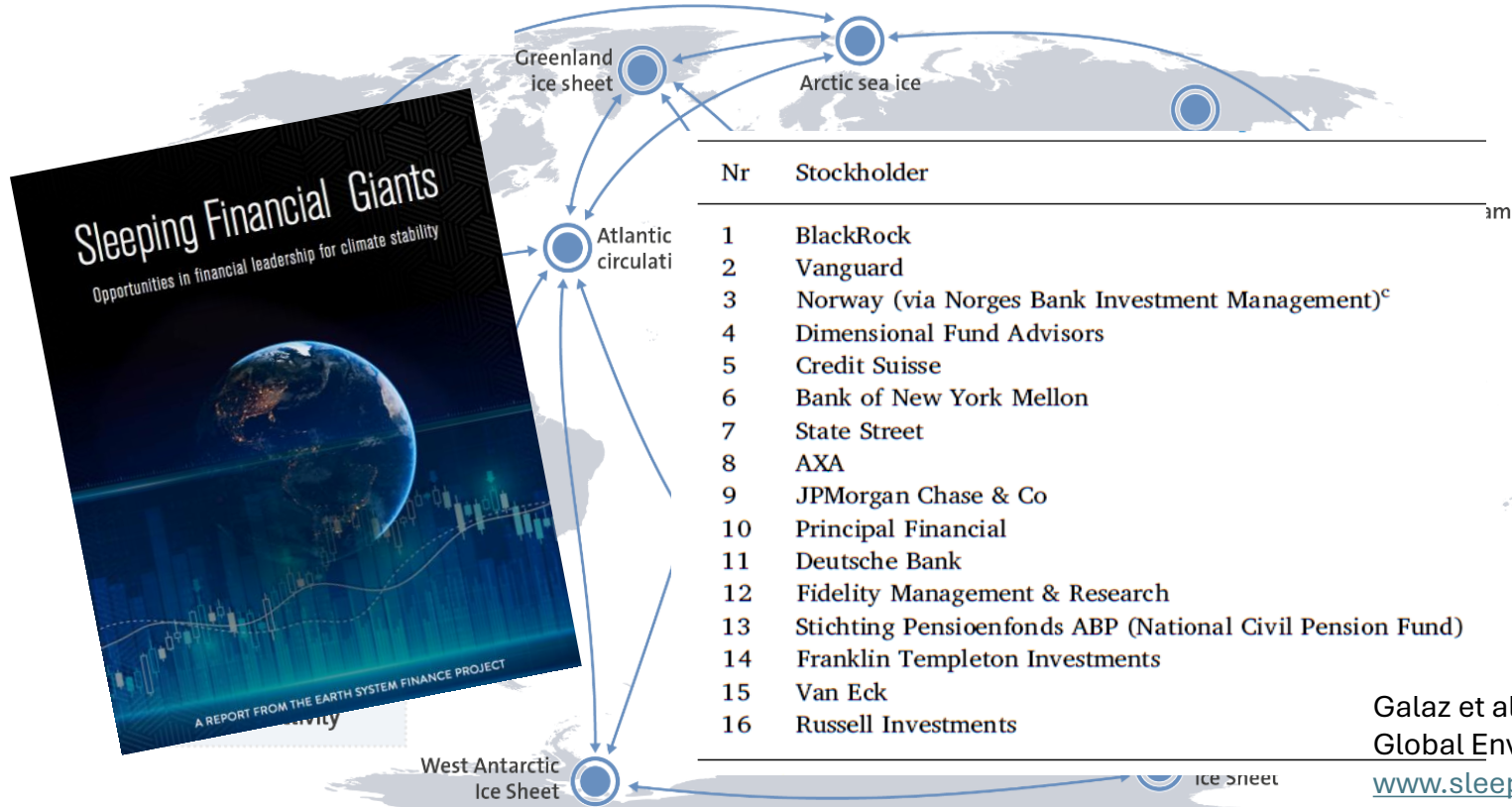
Without Nature we would have exceeded 1.5°C already today





# Climate tipping points – too risky to bet against

# Exceeding 1.5°C global warming could trigger multiple climate tipping points



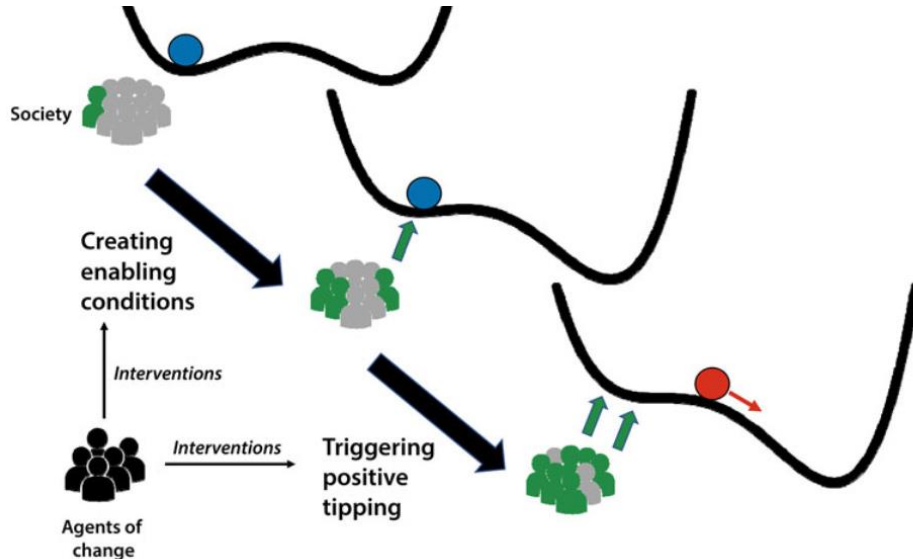
Galaz et al. 2018.  
Global Environmental Change  
[www.sleepinggiantsearth](http://www.sleepinggiantsearth)

Lenton et al. 2009. PNAS, 2019. Nature, Steffen et al. 2018. PNAS, Armstrong McCay et al. 2022 Science

Timothy M. Lenton<sup>1</sup>, Scarlett Benson<sup>2</sup>, Talia Smith<sup>2</sup>, Theodora Ewer<sup>2</sup>, Victor Lanel<sup>2</sup>, Elizabeth Petykowski<sup>2</sup>, Thomas W. R. Powell<sup>1</sup>, Jesse F. Abrams<sup>1,2</sup>, Fenna Blomsma<sup>4</sup> and Simon Sharpe<sup>5,6</sup>



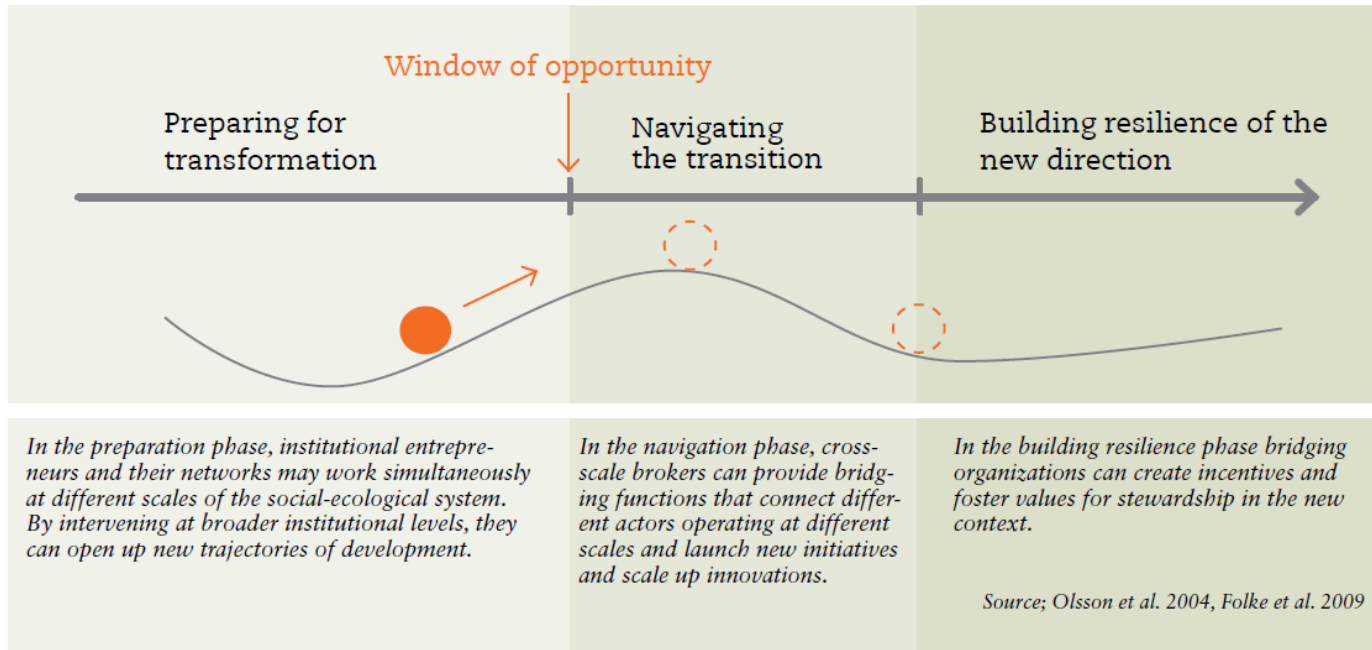
## Earth stewardship: Shaping a sustainable future through interacting policy and norm shifts - Chapin et al. 2022. Ambio



GLOBAL TIPPING POINTS REPORT 2023
Social norms
Policies may influence
Nyborg et al. 2016. S



# Social-ecological transformations to Biosphere stewardship



Olsson et al. 2004. Social-ecological transformation for ecosystem management. *Ecology and Society*

Gelcich et al. 2010. Navigating transformations in governance of Chilean marine coastal resources. *PNAS*

Westley et al. 2011. Tipping toward sustainability: emerging pathways of transformations. *Ambio*.

# Corporate Biosphere Stewardship

a new business logic with the purpose of shepherding and safeguarding the resilience of the biosphere for human well-being and fostering the sustainability of a rapidly changing planet

compliance	→	conviction
adaptation	→	innovation
incremental	→	transformational
follower	→	forerunner



# Charting a sustainable course: The SeaBOS initiative

Our Impact 2022-2023

## scientific reports

 Check for updates

### OPEN Scientific mobilization of keystone actors for biosphere stewardship

Henrik Österblom<sup>1,2,3,✉</sup>, Carl Folke<sup>1,4,5</sup>, Juan Rocha<sup>1,2,6</sup>, Jan Bebbington<sup>7</sup>, Robert Blasiak<sup>1,3</sup>, Jean-Baptiste Jouffray<sup>1,5</sup>, Elizabeth R. Selig<sup>8</sup>, Colette C. C. Wabnitz<sup>8,9</sup>, Frida Bengtsson<sup>1</sup>, Beatrice Crona<sup>1,5</sup>, Radhika Gupta<sup>1</sup>, Patrik J. G. Henriksson<sup>1,4,10</sup>, Karolin A. Johansson<sup>1</sup>, Andrew Merrie<sup>1</sup>, Shinnosuke Nakayama<sup>8</sup>, Guillermo Ortuño Crespo<sup>1</sup>, Johan Rockström<sup>1,11</sup>, Lisen Schultz<sup>1</sup>, Madlen Sobkowiak<sup>12</sup>, Peter Søgaard Jørgensen<sup>5</sup>, Jessica Spijkers<sup>1</sup>, Max Troell<sup>1,4</sup>, Patricia Villarrubia-Gómez<sup>1</sup> & Jane Lubchenco<sup>13</sup>

Joint Statement by the  
Multilateral Development Banks:

## NATURE, PEOPLE AND PLANET



PRESS RELEASE | 15 August 2024 | Directorate-General for Environment | 6 min read

## Degraded ecosystems to be restored across Europe as Nature Restoration Law enters into force

The regulation sets binding targets to restore degraded ecosystems, particularly those with the most potential to capture and store carbon and to prevent and reduce the impact of natural disasters.

## Exclusive: White House finalizes ecosystem services guidance

By Jean Chemnick | 02/28/2024 06:08 AM EST



## Nature Action 100



ecosperity  
week 2024

15-17 APR 2024 | SINGAPORE

TEMASEK

Welcome to the Taskforce on Nature-related Financial Disclosures

## Developing and delivering a risk management and disclosure framework for organisations to report and act on evolving nature-related risks



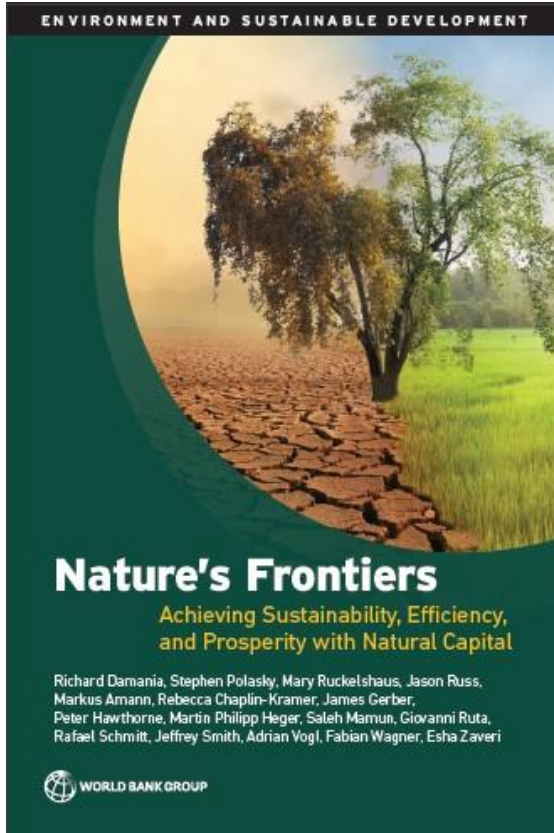
"Biodiversity loss could have significant macroeconomic implications. Failure to account for, mitigate, and adapt to these implications is a source of risks relevant for financial stability."

## G7 Alliance on Nature Positive Economies

NEWS ARTICLE | 31 July 2023 | Directorate-General for Financial Stability, Financial Services and Capital Markets Union | 1

## The Commission adopts the European Sustainability Reporting Standards





NGFS Occasional Paper

## The Green Scorpion: the Macro-Criticality of Nature for Finance

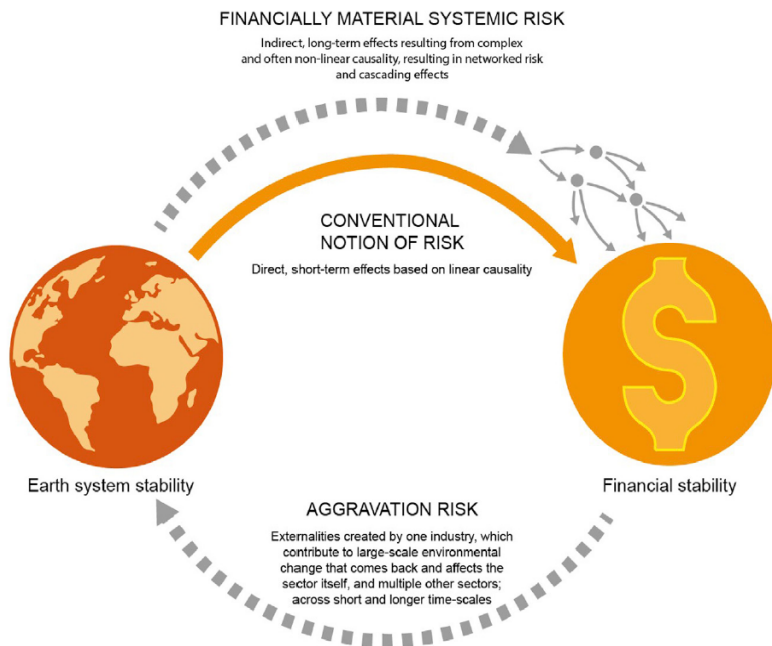
Foundations for scenario-based analysis of complex and cascading physical nature-related financial risks

Nicola Ranger, Jimena Alvarez, Anna Freeman, Thomas Harwood, Michael Obersteiner, Estelle Paulus and Juan Sabuco

13 December 2023



# The Anthropocene reality of financial risk



Globally, financial services will be critical for supporting corporate activities that regenerate and promote biosphere resilience as a key strategy to confront the new risk landscape of the Anthropocene.

Failure to account for investment externalities will aggravate climate and other environmental change and set current sustainable finance initiatives off course.

Developing impact accounting systems of the Anthropocene reality that cut across financial investments and become a core part of capital allocation decisions.

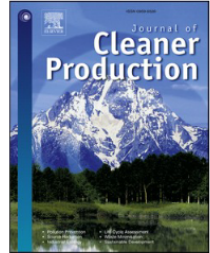




Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

## Journal of Cleaner Production

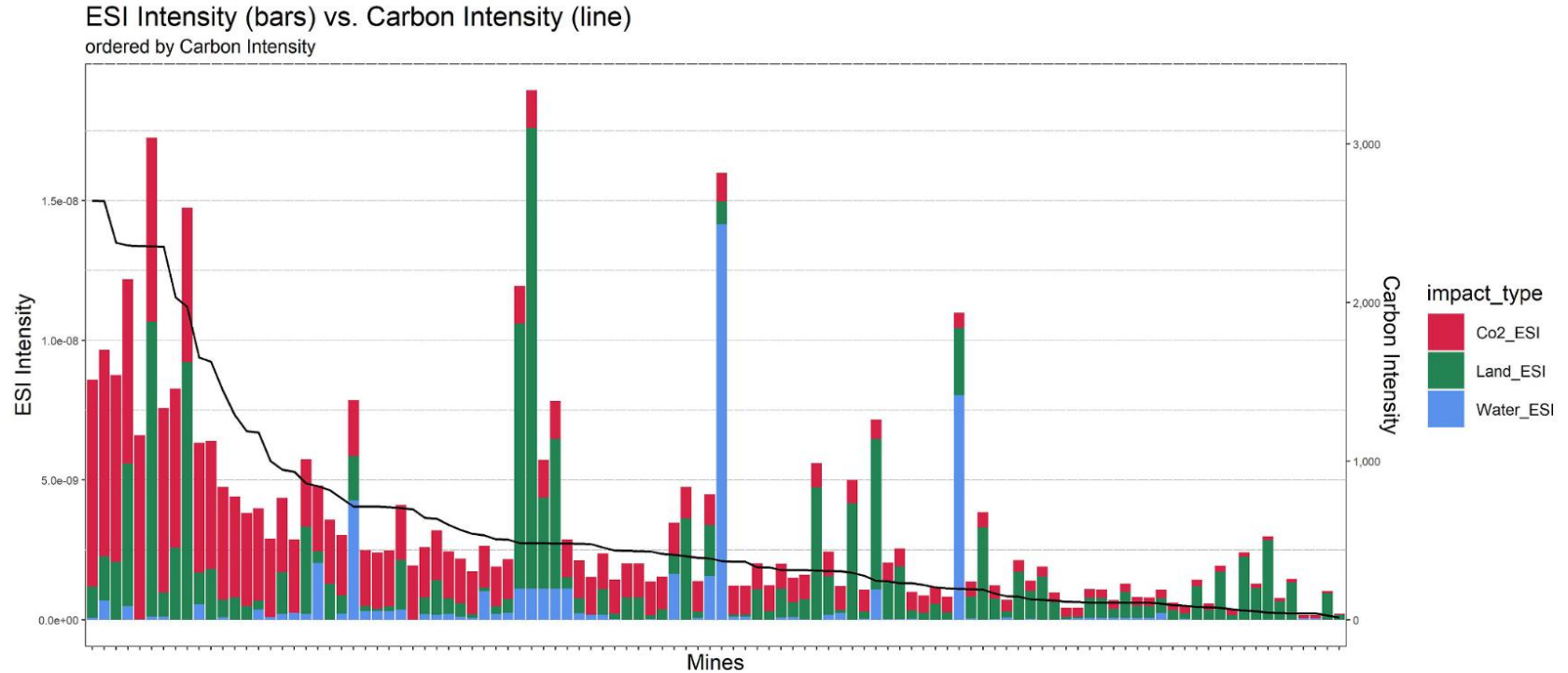
journal homepage: [www.elsevier.com/locate/jclepro](http://www.elsevier.com/locate/jclepro)



# Going beyond carbon: An "Earth system impact" score to better capture corporate and investment impacts on the earth system

Beatrice Crona<sup>a,b,\*</sup>, Giorgio Parlato<sup>a,\*\*</sup>, Steven Lade<sup>b,c</sup>, Ingo Fetzer<sup>b</sup>, Victor Maus<sup>d,e</sup>





**Fig. 4. Earth System Impact intensity compared to CO<sub>2</sub> intensity for mining assets with revenues above \$100M in our sample (n = 106).** For each mine, the ESI score is also broken down to indicate the individual contribution of CO<sub>2</sub> emissions, landuse and water consumption to the total ESI score. Superimposed on the ESI intensity plot is the CO<sub>2</sub> intensity measure for each mine (black line), and mines are plotted (from left to right) according to their carbon intensity score.





# Ecosystem services and physical risk

---

**The Royal Society**  
October 3rd, 2024

# Nothing can function in the world without nature. It is our home and our life support system





# Human activity is destroying our most valuable asset



2005



2023



# Our planet is at a tipping point

Just this past week:

## Oxfordshire flooding enters day three as warnings issued

25th September

## Hurricane Helene live: At least six dead as 10ft storm surge hits Florida and flash flood emergency in Georgia

Death toll continues to rise after Helene slammed into Florida's coast as a Category 4 hurricane, marking one of the most powerful storms to strike US in recent memory

James Liddell, Stuti Mishra, Michelle Del Rey, Julia Musto • 2 minutes ago •  Comments

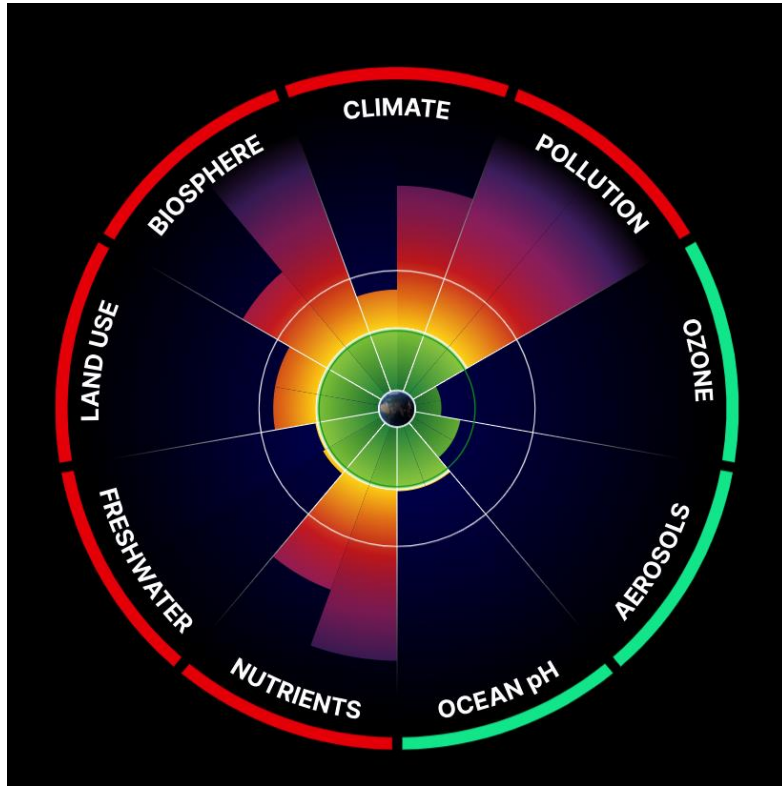


## People heading to Spain told to 'bring wellies' after extreme weather

Brits currently in Salou, Spain, shared footage of the resort town's streets, which have been hit with severe flooding - and people are being urged to pack wellies.

By **ALAN JOHNSON**, Social News Reporter  
11:52, Tue, Sep 24, 2024 | UPDATED: 11:55, Tue, Sep 24, 2024

# We are breaching our planetary boundaries



## 10 years

- 1<sup>st</sup> Extreme weather events
- 2<sup>nd</sup> Critical change to Earth systems
- 3<sup>rd</sup> Biodiversity loss and ecosystem collapse
- 4<sup>th</sup> Natural resource shortages
- 5<sup>th</sup> Misinformation and disinformation
- 6<sup>th</sup> Adverse outcomes of AI technologies
- 7<sup>th</sup> Involuntary migration
- 8<sup>th</sup> Cyber insecurity
- 9<sup>th</sup> Societal polarization
- 10<sup>th</sup> Pollution



# Businesses that invest in nature can unlock huge opportunities



**Innovation**



**Cost savings**



**Enhanced  
performance**

## Key priorities

- ❑ **Repair & restore nature:** engage in efforts to maintain pressure to deliver on ambitious targets
- ❑ **Account for nature:** set science-based targets & disclose nature-related dependencies, impacts & risks
- ❑ **Form transformative partnerships & engage in positive advocacy,** eg, Business for Nature, One Planet Business for Biodiversity, Planetary Guardians and others
- ❑ **Align financial flows** with Global Biodiversity Framework & Paris

**“There comes a time when humanity is called upon to shift to a new level of consciousness, to reach a higher moral ground. That time is now”**

**Wangari Maathai**





An aerial photograph of a dirt road winding through a forest. The road is light brown and shows tire tracks. The surrounding vegetation is a mix of green and brown, suggesting some trees are dead or dormant. The left side of the image is overlaid with a solid red rectangle containing white text.

# **Legal risk to companies and directors**

***Chair: Dame Julie Maxton  
Sharif A. Shivji KC  
Rebecca Stubbs KC  
Lord Robert Carnwath CVO***

THE  
ROYAL  
SOCIETY

# Legal risk to companies and directors

- Chair: Dame Julie Maxton
- Lord Robert Carnwath CVO
- Rebecca Stubbs KC
- Sharif A. Shivji KC

# What are nature related risks?

- TNFD definition: risks that arise from loss of biodiversity, the degradation of ecosystems and the decline in the services that nature provides to businesses and the economy
- Include a company's dependencies and impacts on nature
- Three main types:
  - Physical risks
  - Transition risks
  - Systemic risks



# How the legal landscape for companies is evolving

- Regulation of direct impacts on nature
- Regulation of indirect impacts through supply chains
- Control of access to markets and investment
- Reporting requirements for the largest companies
- Claims for misstating climate and nature credentials
- Prospect of novel climate and nature related claims
- Shareholder activism

# How are directors affected?

- Duties codified in Companies Act 2006. Relevantly include:
  - Fiduciary duty of loyalty (s. 172)
    - Subjective
    - No definition of success, but a list of factors, including “*the impact of the company’s operations on the community and the environment*”
    - If director fails to consider a material risk, held to a higher, objective, standard
  - Duty of care to exercise reasonable skill, care and diligence (s. 174)
    - Wide latitude given to directors in the exercise of their business judgment

# Disclosure

- Regime highly complex and fact specific
- Pressure to make voluntary disclosure
- Direction of travel: voluntary → mandatory → informing the content of the duties of directors



# Litigation round-up

- Nature of cases (Grantham Institute):
  - Polluter pays cases
  - Corporate framework cases
  - Failure to adapt cases
  - Climate-washing cases
  - Transition risk cases
- Pool of claimants widening, e.g.
  - Ecuador (2008)
  - New Zealand: Te Urewera Forest (2014); Whanganui River (2017)
  - Indian courts: Ganges, Yamuna

# Ecocide

- Countries with ecocide legislation:
  - Vietnam (1990)
  - Georgia (1999)
  - Post-Soviet states: Armenia, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Ukraine
  - France (2021)
- Campaign to amend the Rome Statute of the ICC to recognise ecocide as the fifth international crime
  - June 2021 definition: “unlawful or wanton acts committed with knowledge that there is a substantial likelihood of severe and either widespread or long-term damage to the environment being caused by those acts”

# How do ecological risks compare with other supply chain risks?

*Chair: Daniella Vega  
Dr Nicola Ranger  
Jo Paisley  
Charmain Love*

THE  
ROYAL  
SOCIETY







# How do ecological risks compare with other supply chain risks?

**Dr Nicola Ranger**  
Director, Global Finance and Economy Group  
Environmental Change Institute  
University of Oxford



## Key Messages:

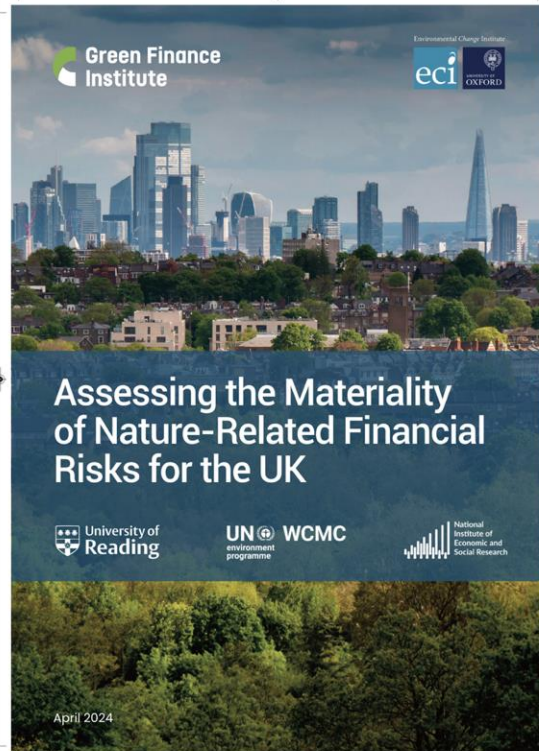
**Half** of nature-related risks are related to supply chains

Climate and nature risks have different characteristics: overlapping footprints between risk and impact means businesses and banks can be **“shooting themselves in the foot”**

The impacts of nature degradation via supply chains are **‘macro-critical’**

Many historical shocks have a **‘nature signature’**

**Material** compounding of nature-related risks with other supply chain risks



Findings come from a series of research papers in collaboration with fantastic partners as part of the **NERC Integrating Finance and Biodiversity Programme** and the **Oxford Martin Systemic Resilience Initiative**

Two upcoming papers:

**‘Banks at Risk’** with Emma O’Donnell and Nathalie Seddon

**”Toward UK systemic resilience to international cascading climate and nature risks”** (FCDO funded)







## Contents

**Introduction:** characteristics of nature-related risks and historical experience

**Macro-criticality of nature-related risks:** findings from NGFS and UK studies

**Compounding of nature, climate and wider risks to supply chains**

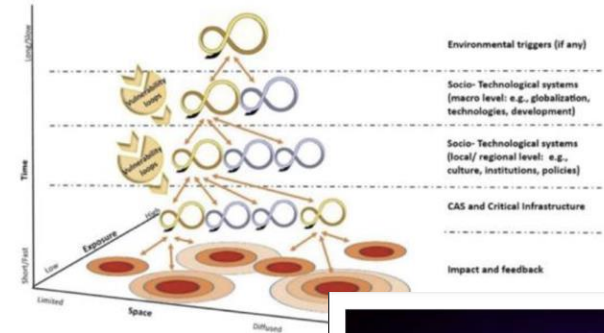
**Risk versus impact:** a false dichotomy?

**Conclusions**

## Evidence of materiality?

1. Conceptual understanding of risk transmission and characteristics
2. Historical performance of companies and economies
3. Case study-based evidence
4. Simulation – modelling future scenarios

Characteristics	Climate-related physical financial risks	Nature-related physical financial risks
Driver	Global, Increasing GHG emissions and changes in natural sinks directly attributable to human activities	Local (albeit could occur as a global trend). Wide range of drivers directly attributable to human activities
Acute and chronic	Both acute (shocks) and chronic (gradual) impacts	Both acute (shocks) and chronic (gradual) impacts
Diversity of impacts	Wide range of potential impacts on natural and human systems	Range of potential impacts on natural and human systems is arguably even wider and more direct than for climate change, including changes in genetic materials for medicines etc.
Timescales	Immediate but time delay before the physical impacts of GHG emissions fully manifest	Impacts of nature degradation can be immediate or can build up over time
Spatial scales and localisation	The impacts of rising GHG concentrations are global, albeit are spatially heterogeneous and determined by a combination of local nature and socioeconomic factors (including nature loss)	Impacts of nature degradation are local, and determined by local natural and socioeconomic factors, however can also have a global impact, due to connections across natural and social systems
Linearity, uncertainty and predictability	The relationship between climate change and local and global physical climate risks can be strongly non-linear, with potential for compounding and cascading risks that can amplify local effects, making prediction difficult	The relationship between nature and related local and global physical nature risks can be strongly non-linear, with potential for compounding and cascading risks that can amplify local effects, making prediction difficult
Thresholds and tipping points	Climate change can drive tipping points in nature and socioeconomic systems with extreme impacts	Nature degradation can drive tipping points in natural and socioeconomic systems with extreme impacts
Climate-Nature Risk amplifiers	Nature degradation and associated socioeconomic vulnerabilities are risk amplifiers of climate risks	Climate change, natural climate variability and socioeconomic vulnerabilities are risk amplifiers of nature risks





# Learning from Historical Analogues



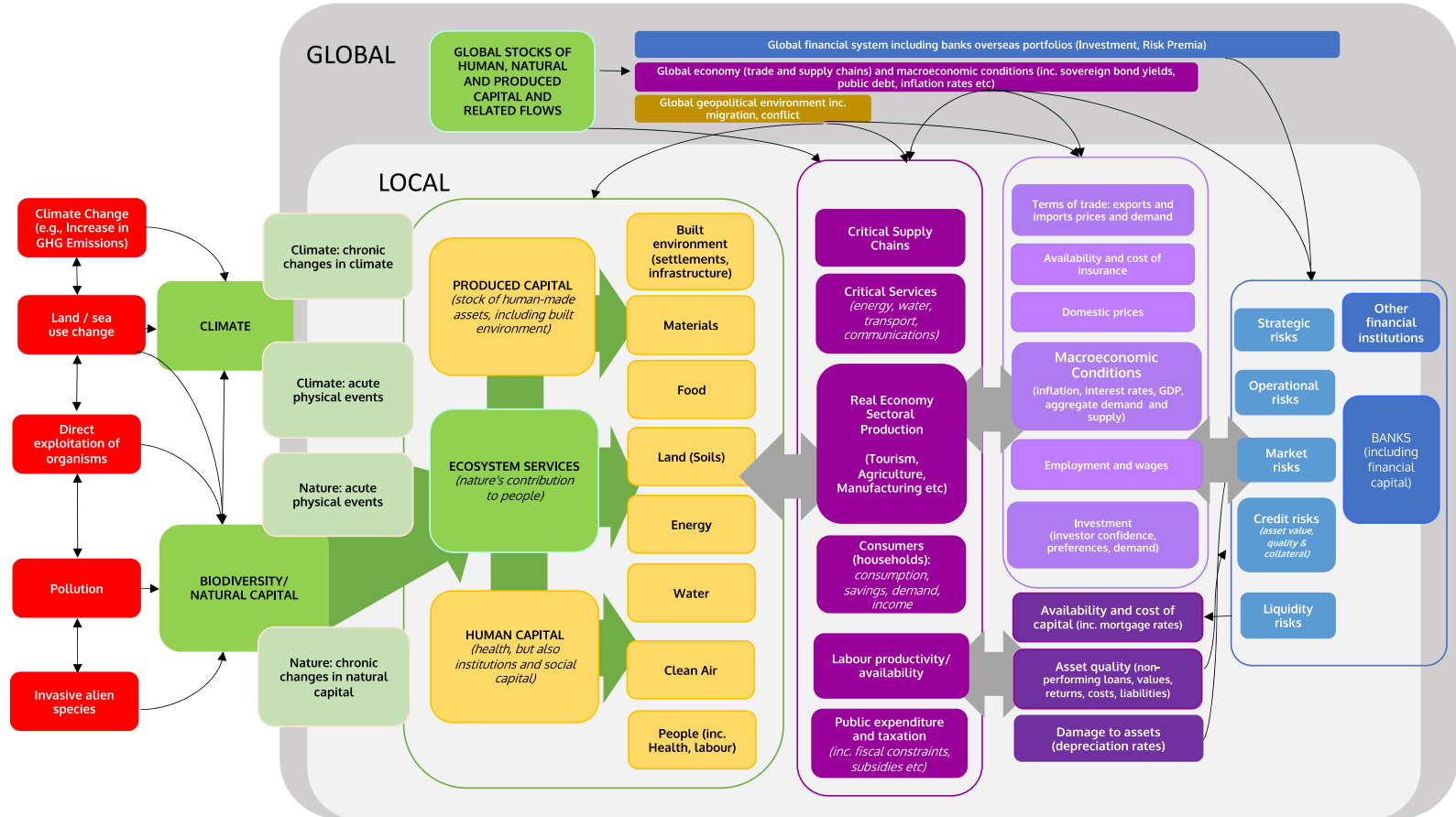
Historical example	Date	Geography	Details	Shock and key economic receptors summary
Aral Sea Crisis	Ongoing from 1960s	Central Asia	Significant decline in water levels starting in the 1960s. Diversion of water for agriculture led to the shrinking of the Aral Sea and increased salinity, devastating local ecosystems. (Micklin, 2007; 2016)	FISHERIES COLLAPSE
Swine Fever	Ongoing from 2018	Asia-Pacific	Viral disease that affects pigs and boars. A 2019 outbreak in China affected 100 million people and increased food prices. As of 2021, the economic impact in China is estimated at 1.4 to 2% of GDP. (Lloyds of London and CCRS, 2023)	AGRICULTURE (MEAT); DISEASE OUTBREAK
'Bivalves' fisheries collapse (several examples)	Ongoing	Several regions worldwide	Overfishing coupled with disease, habitat loss and an increase in algal blooms from nutrient increase due to agricultural and urban runoff has resulted in bivalves collapse across the world. Negative impacts on ecosystem services include: provisioning (freshwater, fisheries), regulating (water purification) and cultural services which, in turn result in negative economic impacts. In addition, negative health impacts from contamination of seafood and fish. (Hammond et al. 2012 (and references therein); Gobler et al., 2022)	FISHERIES COLLAPSE
Dust Storms and Desertification	Ongoing	Several (notably Australia, North America and Asia)	Drought and overgrazing contributed to severe dust storms and desertification, impacting agriculture, air quality and -in some cases- visibility. [Several examples, e.g. Ghosh and Pal, 2014.]	DUST STORMS, health impacts, property damage, aviation industry.
Forest to Savannas	Ongoing	Several regions worldwide	420 Mill. have been deforested between 1990-2020 and recent studies have identified a potential forest to savanna tipping point for the Amazon beyond 40% deforestation. With over 1.6 billion people directly dependent on forests, the extent of this regime shift can have large negative impacts on ecosystem services including: provisioning, regulating and cultural ecosystem services. (Rocha et al., 2017 and references therein; UN-DESA, 2021; Franklin and Pindyck, 2018)	FOREST REGIME SHIFT
Gulf of Mexico Dead Zone	Ongoing	Gulf of Mexico	Agricultural runoff containing nutrients has led to the formation of a large hypoxic zone, affecting marine life. (Rabalais et al., 2002)	WATER QUALITY, EUTROPHICATION
Indus River Pollution and Water Scarcity	Ongoing (increasing)	Pakistan	Significant decline in water availability driven by increases in food production to cope with growing population and rise in commodities prices. Negative impacts including crop losses, migration to urban areas and social security. Heavy metal and microplastics pollution negatively impact fish and human health. (Zhang et al., 2020; Janjua et al., 2021; Tsering et al., 2021; Al-Ghanim et al., 2016)	WATER SUPPLY SHOCK; HUMAN HEALTH/RECREATION IMPACT OF WATER
Lake Chad Shrinking	Ongoing	Sahel	Over-extraction of water for irrigation and climate variability have led to a significant reduction in the size of Lake Chad, impacting water availability and ecosystems. (Gao et al., 2011; Jedwab et al., 2023)	WATER SUPPLY SHOCK; FISHERIES COLLAPSE; migration
Madagascar chronic loss of arable land	Ongoing	Madagascar	Deforestation and unsustainable agricultural practices have led to extensive soil erosion and loss of arable land. (Scales, 2014; Harvey et al., 2014)	SOIL QUALITY DETERIORATION AFFECTS FOOD PRODUCTION

Identification of more than sixty relevant historical shocks, and focus on analysis of thirty-two shocks selected as a sample for relevance, magnitude and quality of the evidence base

## Conclusions:

- Frequency and widespread nature of shocks
- Not just the 'poorest' countries
- Linkages between climate and nature
- Complex interplay of social and political factors
- Response to crises can aggravate impacts
- Potential for cascading risks (supply chains)

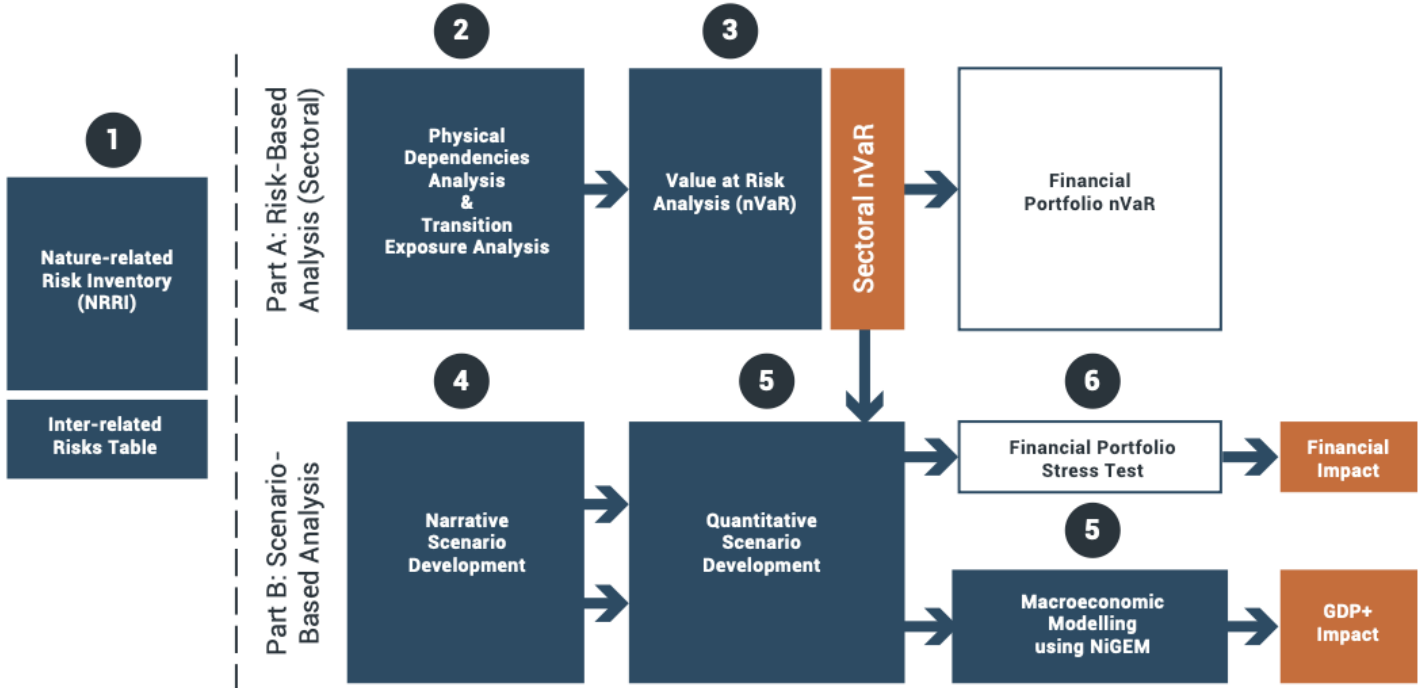
# Cascading risks: supply chains versus wider macroeconomic amplification



# UK Nature Risks - Methodology



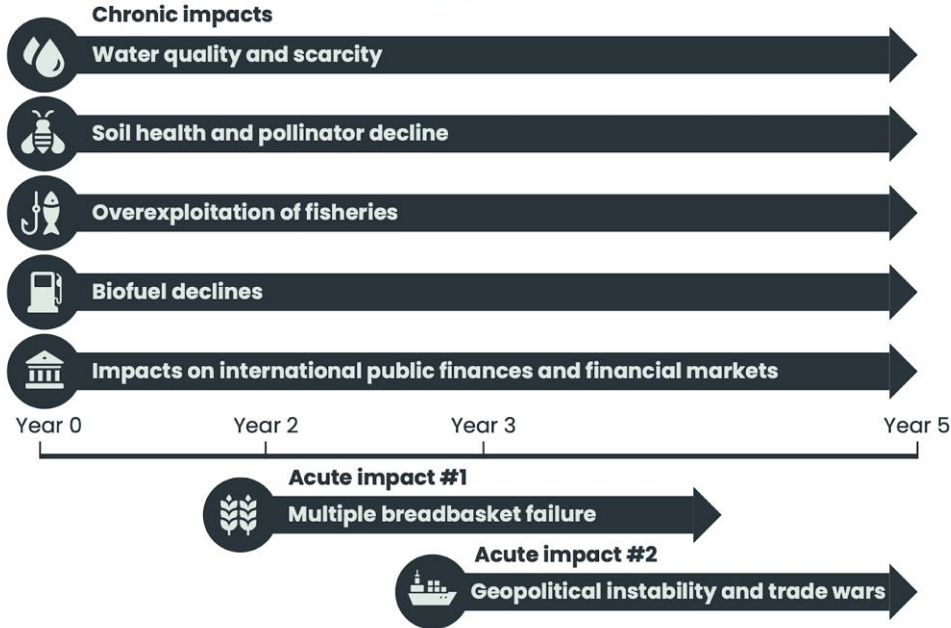
## Overview of the Building Blocks within the Overall Analysis



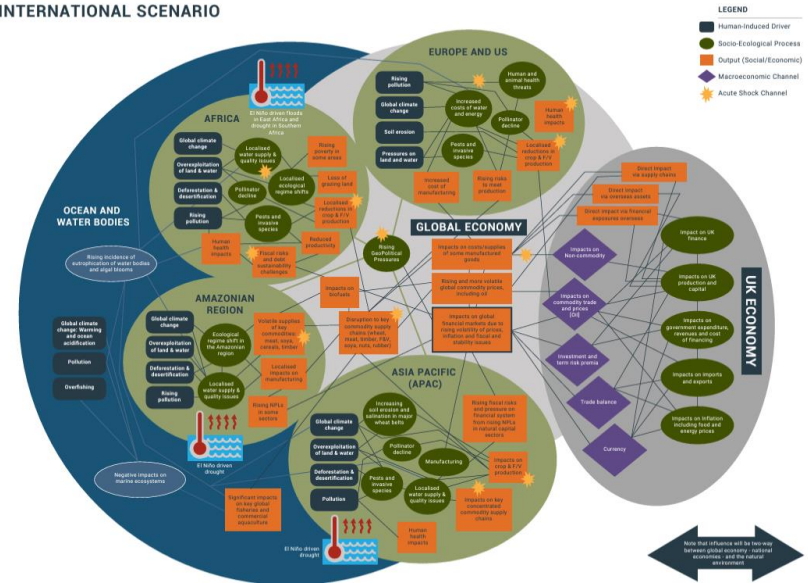




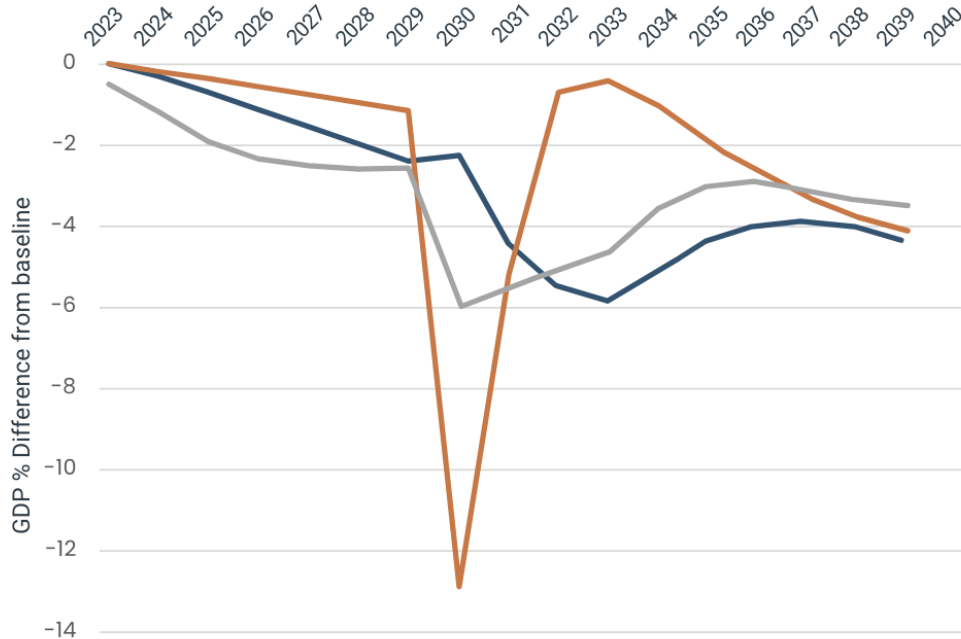
## INTERNATIONAL (SUPPLY CHAIN) SCENARIO



## INTERNATIONAL SCENARIO



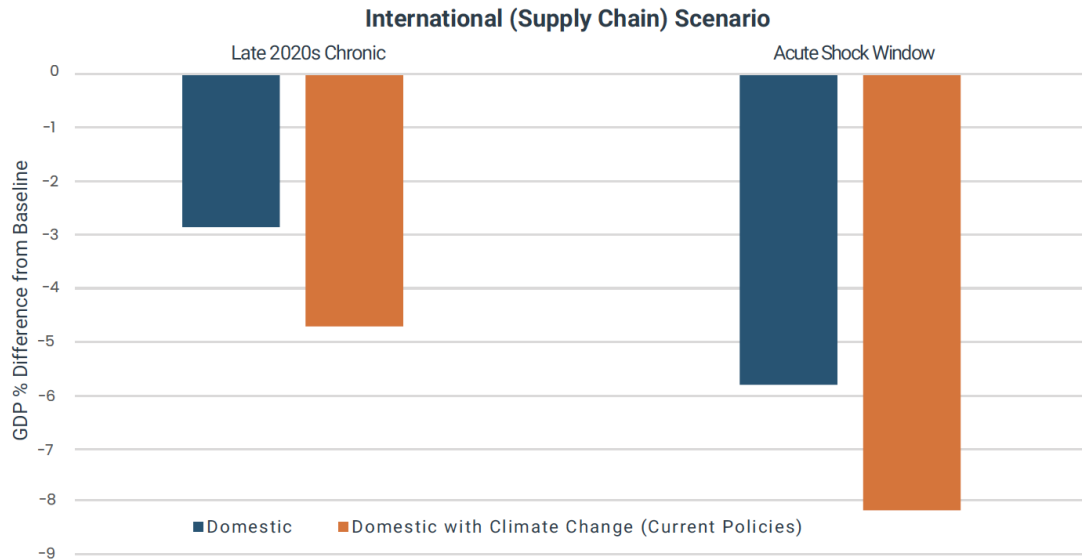
# Nature-related risks are macro-critical



The deterioration of the natural environment in the UK and around the world could slow economic growth and lead to major shocks that could result in GDP being 6% lower than it would have been otherwise by the 2030s under two scenarios and 12% lower under an AMR-pandemic scenario

Gradual (chronic) year-to-year environmental degradation is as detrimental or more so than climate change; **nature doubles climate losses**

Environmental degradation increases the chance and impacts of an acute climate or health shock, and the combined effect would have a very material impact on the economy



## Nature-related risks amplify climate risks

**Environmental degradation increases the severity and likelihood of acute shocks related to climate change**

**The compounding impacts of climate and nature are macro-critical**

### Implications for Adaptation:

- Adaptation and nature are aligned
- Consider nature-climate feedbacks in risk assessment and disclosure
- Don't forget indirect risks!
- Integrate adaptation and nature within transition plans
- Engage with clients and investees
- Seek co-benefits from investments

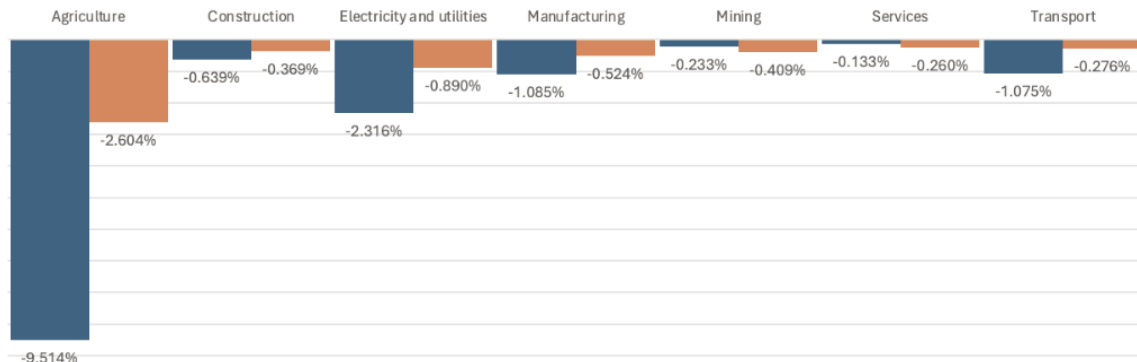


# First nature financial ‘stress test’

Warning –these results are conservative!



Adjustment in Loan Value in 2028



	Bank 1	Bank 2	Bank 3	Bank 4	Bank 5	Bank 6
Domestic Scenario	1.29%	1.48%	3.95%	0.64%	2.26%	1.45%
Domestic + International Scenario	1.85%	2.08%	5.16%	1.01%	3.04%	2.04%

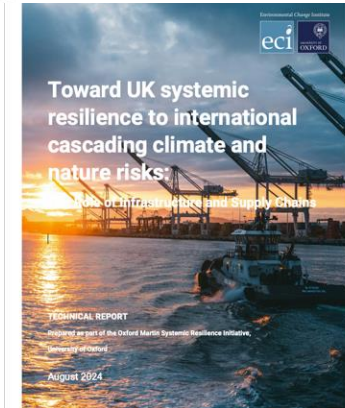
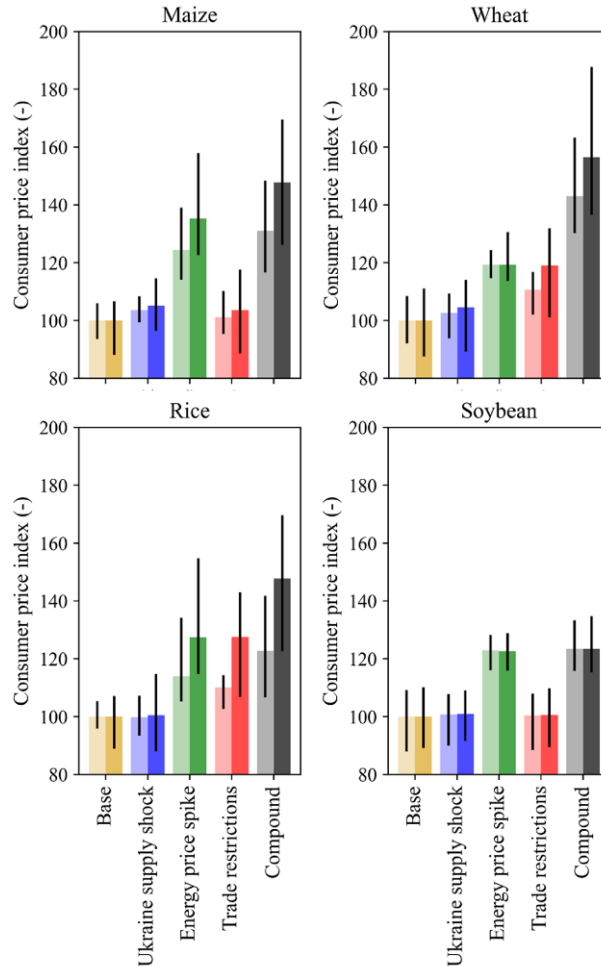
**Even in the next decade, material impacts on the values of loans portfolios are expected.**

Looking across the portfolios of the seven largest UK banks, the analysis indicates possible near-term adjustments in the values of domestic holdings of up to 4-5% for particular sectors and banks from nature-related risks alone. This is very conservative – does not include second-order effects or possible tipping points.

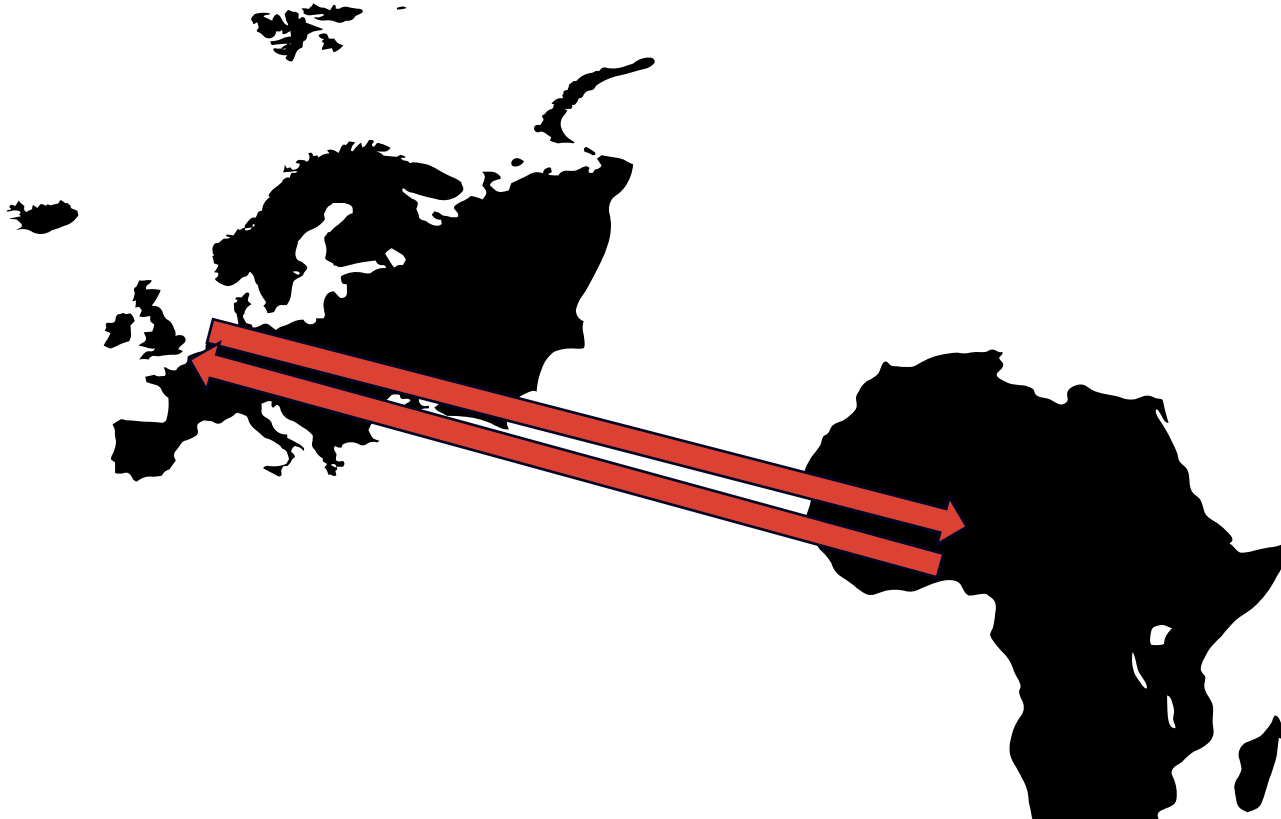
Climate change would amplify these risks further.

# Nature versus wider Supply Chain Risks

Analysis suggests that for food supply chains, the impacts of environmental shocks on prices are on a par with other types of shocks, but the **compounding effect can be very material.**



# IMPLICATIONS: SINGLE OR DOUBLE MATERIALITY? RISK VERSUS IMPACT



# Supply Chain Opportunities



GLOBAL CENTER ON ADAPTATION

## Financing Nature-Based Solutions for Adaptation at Scale: Learning from Specialised Investment Managers and Nature Funds

Resilient Planet Finance Lab

eci UNIVERSITY OF OXFORD

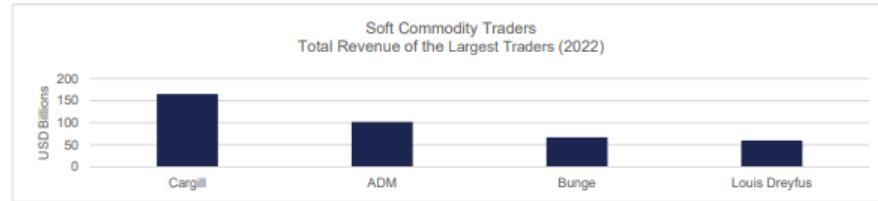


Figure 4: Revenue of largest agri-traders. Source: S&P (2023).

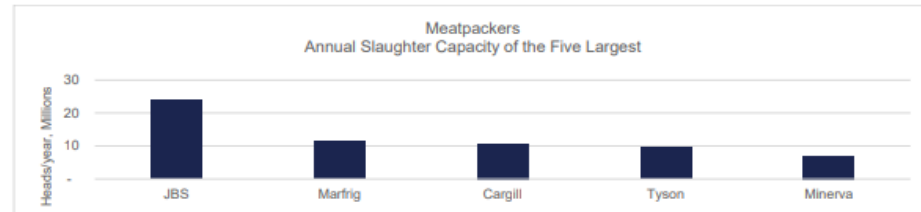


Figure 5: Production capacity of largest global meatpackers. Source: The Spatial Finance Initiative (Sabuco et al, 2022).





## Key Messages:

**Half** of nature-related risks are related to supply chains

Climate and nature risks have different characteristics: overlapping footprints between risk and impact means businesses and banks can be **“shooting themselves in the foot”**

The impacts of nature degradation via supply chains are **‘macro-critical’**

Many historical shocks have a **‘nature signature’**

**Material** compounding of nature-related risks with other supply chain risks

Beyond tragedy  
of the horizon...  
**rationale for  
regulatory  
intervention**

Scale and  
transmission

Sequential and  
compounding  
threats

Tragedy of the  
horizons

Tragedy of  
scale

Risk  
accumulation

Information  
asymmetries





GLOBAL FINANCE &  
ECONOMY GROUP



# Thank you

For more information, please contact

Dr Nicola Ranger

[Nicola.ranger@ouce.ox.ac.uk](mailto:Nicola.ranger@ouce.ox.ac.uk)

<https://www.eci.ox.ac.uk/research/global-finance-and-economy>

**IFB** Integrating  
Finance &  
Biodiversity



# Supply Chain Risks: Nature & Others

Jo Paisley, President, GARP Risk Institute

3 October 2024



# Supply Chains Risks



## Vulnerability

Characteristics of the supply chain that make it vulnerable to disruption



## Unexpected event

Occurrence of events that could result in a negative impact on the supply chain



## Supply chain risk

Supply chain disruption that results in operational or financial impact

## Examples of Factors Affecting Vulnerability

1. Visibility of suppliers
2. Strategic/ operational planning
3. Risk management
4. Redundancy/agility
5. Labour relations
6. Regional conflicts
7. Physical vulnerabilities & dependencies

## Examples of shocks that might impact

1. Labour dispute
2. Financial risks in a supplier - e.g. liquidity issues
3. Data/Cyber security incidents
4. Trade tensions
5. (Geo) Political risk
6. Social unrest
7. Nature and climate impacts

# Nature-related Risk: Physical and Transition



## Financial regulators' focus on nature

*Increased focus of ECB, DNB and BoE on nature risk materiality assessment*



## UK Environment Act

*Rainforest products due diligence, Binding targets, inc. for air quality, water, biodiversity, and waste*



## Biodiversity Net Gain Law (Delay Nov23->Jan24)

*Most new developments to deliver min. 10% biodiversity net gain*



## Deforestation Regulation

*Companies to ensure products not linked to deforestation*



## CSRD (EU Taxonomy) and CS3D

*Defining environmentally positive and transition*



## IFRS 1&2, U.K. TPT and EU CSDDD

*Frameworks include nature components/considerations*



## FCA, anti-greenwashing reg & SDR, inc investment labelling (upcoming)

*Covers sustainability claims including the environment*



## EBA Pillar 3 requirements & Dutch env and human rights due diligence bill.



## Taskforce on Nature-related Financial Disclosures



Plus market, reputational and technological transition risks

# Climate and Nature Risk Management in Financial Firms

Governance

Are the board and senior management engaged?

Strategy

Has the firm assessed risks and opportunities?

Risk Management

Is climate/nature risk integrated in day-to-day risk management?

Metrics, Targets  
and Limits

Does the firm use metrics, targets and limits?

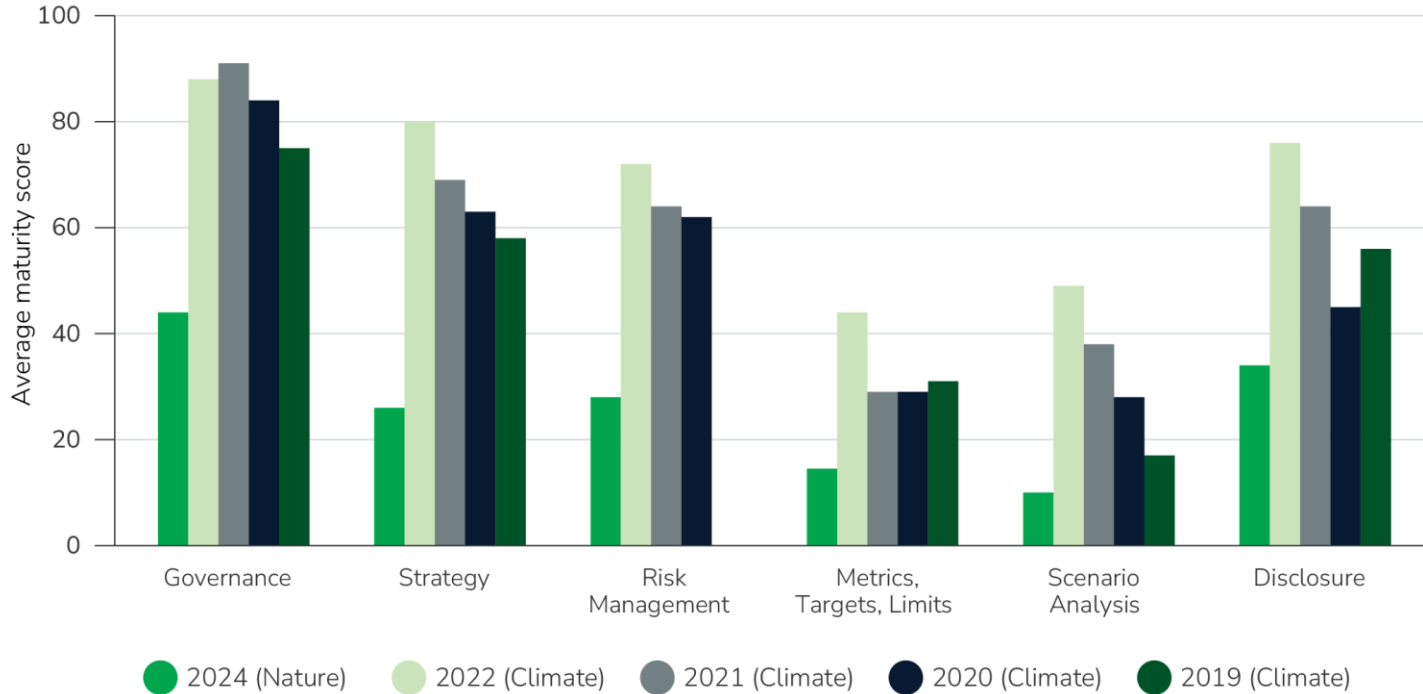
Scenario Analysis

Does the firm use scenario analysis?

Disclosure

What is disclosed? How advanced are they?

# Climate and Nature Risk Management Maturity Levels





# Supply Chain Risks Are Often Opaque



Two useful episodes:

[Supply Chains: Why Sustainability is the Best Form of Risk Management](#)

[EU Deforestation Directive: Overcoming Challenges in Supply Chain Transparency](#)

Research and thought-leadership at [garp.org/sustainability-climate](https://garp.org/sustainability-climate)



**About GARP** | The Global Association of Risk Professionals is a non-partisan, not-for-profit membership organization focused on elevating the practice of risk management. GARP offers the leading global certification for risk managers in the Financial Risk Manager (FRM®), as well as the Sustainability and Climate Risk (SCR®) Certificate and ongoing educational opportunities through Continuing Professional Development. Through the GARP Benchmarking Initiative and GARP Risk Institute, GARP sponsors research in risk management and promotes collaboration among practitioners, academics, and regulators.

Founded in 1996 and governed by a Board of Trustees, GARP is headquartered in Jersey City, N.J., with offices in London and Hong Kong.

For more information, visit [garp.org](http://garp.org) or follow GARP on LinkedIn, Facebook, and X (formerly Twitter).

---

#### HEADQUARTERS

111 Town Square Place  
14th Floor  
Jersey City, New Jersey  
07310 USA  
+1 (201) 719.7210

#### LONDON

17 Devonshire Square  
4th Floor  
London, EC2M 4SQ UK  
+44 (0) 20 7397.9630

#### HONG KONG

The Center  
99 Queen's Road Central  
Office No. 5510, 55th Floor  
Central, Hong Kong SAR, China  
+852 3168.1532

[garp.org](http://garp.org)



# What can my business do?

***Chair:*** Diane Holdorf  
Alison Bewick  
Professor Robert Blasiak  
Catherine David

THE  
ROYAL  
SOCIETY



# Ecological risk: what can my business do?

Collective action as an approach for tackling ecological risk

3<sup>rd</sup> October | Catherine David

This document is the property of WRAP and may not be reproduced or reused without permission.





The world produces **142.6 million tonnes** of plastic packaging every year.<sup>1</sup>

Enough plastic is thrown away every year to **circle the earth four times**.<sup>2</sup>



## Sources

<sup>1</sup> OECD (2022) Global Plastics Outlook – Economic Drivers, Environmental Impacts and Policy Options  
<sup>2</sup> National Geographic Education, "Reality of Plastics", accessed October 2, 2024,  
<https://education.nationalgeographic.org/resource/reality-plastics/>





**+900**  
**Members**  
from NGO, business  
and public sector  
organisations



**NATIONAL PLASTICS PACTS**

- Canada
- Chile
- Colombia
- France
- India
- Kenya
- Poland
- Portugal
- South Africa
- United Kingdom
- United States of America
- - Pact in development: Mexico\*

**12**  
**Plastics Pacts**  
The Plastics Pact  
Network spans every  
continent.

**REGIONAL PLASTICS PACT**

- Australia, New Zealand and the Pacific Island Nations (ANZPAC)

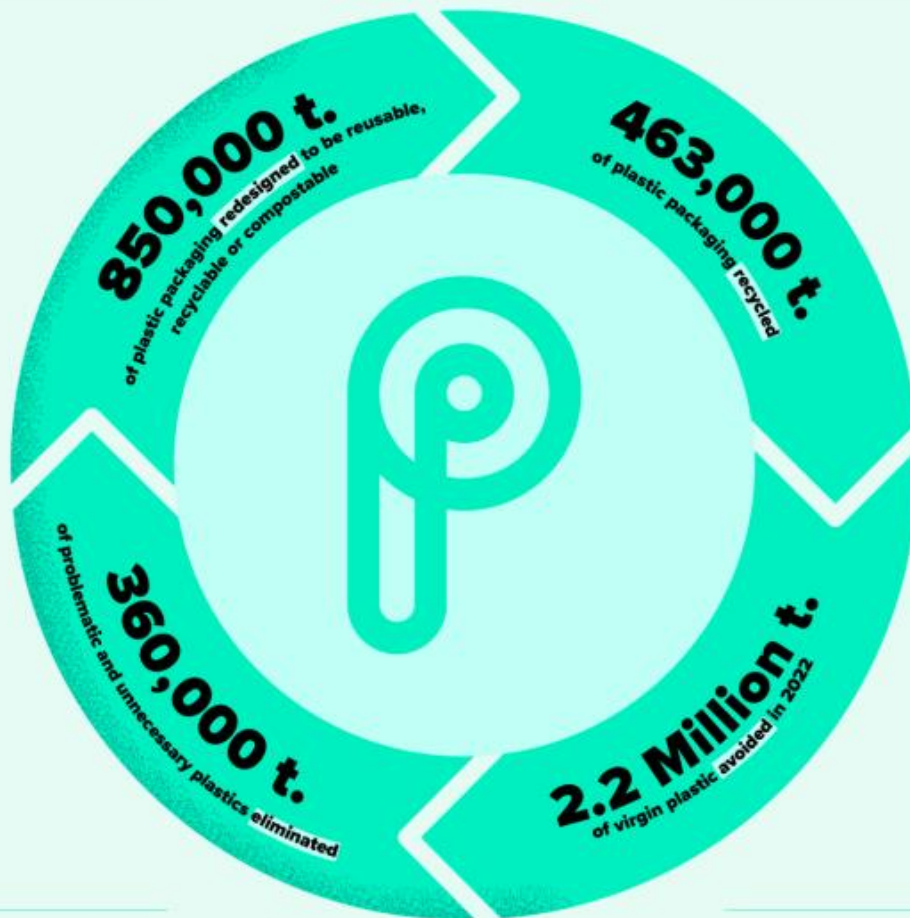


**23%**

increase  
in amount of  
plastic packaging  
that is recyclable,  
reusable or  
compostable

**360,000**

tonnes of  
problematic and  
unnecessary  
plastics eliminated  
as a result of the  
Pacts' activity

**+9%**

increase in  
the amount of  
plastic packaging  
recycled

**+44%**

increase in  
recycled content  
incorporated back  
into packaging





# 70%

of the world's accessible freshwater  
is used for agriculture

Source: WWF

This document is the property of WRAP and may not be reproduced or reused without permission.



# England's Rivers in Crisis

**theguardian**

## River Wye health status downgraded by Natural England after wildlife review

River's condition said to be declining as Wildlife Trusts calls for action from government on farming pollution



📍 The River Wye near Hampton Bishop, Herefordshire. Photograph: Simon Whaley Landscapes/Alamy

**BBC NEWS**

## River Wye: Judicial review granted over agricultural pollution

© 29 October 2022



| The River Wye was in a 'very poor condition', the court heard

**The Standard**

## Natural England downgrades River Wye after wildlife decline

The river's previous status of 'unfavourable-recovering' has been updated to 'unfavourable-declining'



THE RIVER WYE IS DESIGNATED A SITE OF SPECIAL SCIENTIFIC INTEREST FOR ITS IMPORTANCE TO A WIDE RANGE OF PLANT AND ANIMALS (DARRY BATCHELOR/PA)

**YH**  
Your Herefordshire

## NEWS | Concerns that 'algal bloom' has been spotted on the River Wye earlier than ever before

by Stefan Davies | Apr 11, 2022 | News



**LEIGH DAY**

## Multi-million-pound legal claim launched to compensate people living near River Wye for pollution allegedly caused by chicken producers

A legal claim potentially worth hundreds of millions of pounds has been launched by law firm Leigh Day in a bid to compensate thousands of people living in the Wye catchment likely to have been affected by a major degradation of the River Wye and its tributaries in



# A roadmap towards water security for food & drink supply



Protecting critical water resources for food supply, for nature and for local communities.

The Wye & Usk Foundation

M&S EST. 1884

88op Foundation

WWF

avara foods

The Rivers Trust

NATURAL ENGLAND


LIDL

Environment Agency



Photo: River Nar (Norfolk)





**If food waste were a country, it would be the world's third largest emitter...**

Globally, 25-30% of total food produced is lost or wasted, and waste is estimated by the Intergovernmental Panel on Climate Change to contribute 8-10% of total man-made greenhouse gas (GHG) emissions.



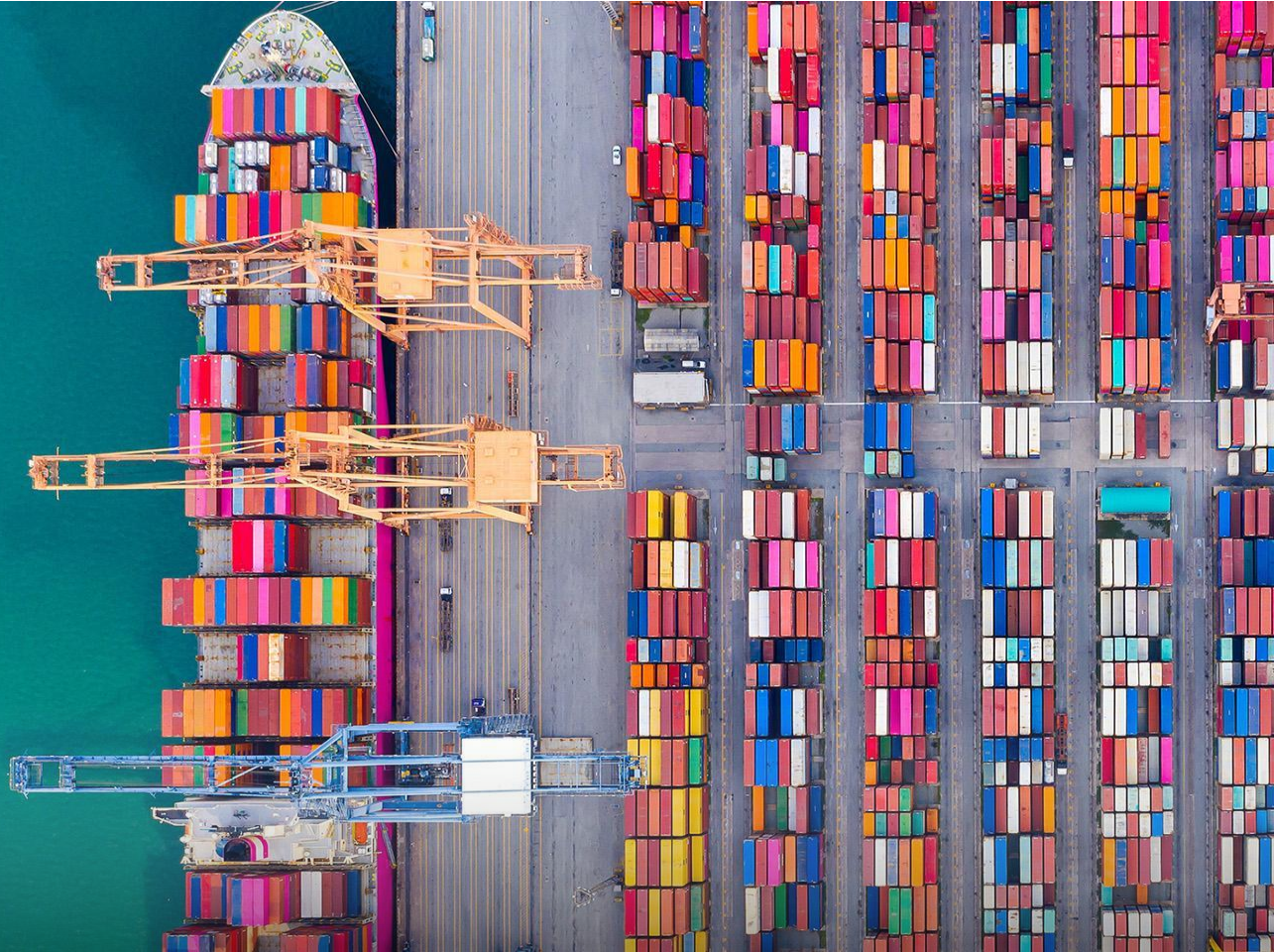


# 45%

Of CEO's don't believe their companies can survive the next decade

Source: PWC (2024)

This document is the property of WRAP and may not be reproduced or reused without permission.





# Thank you.

**Catherine David**

**Director of Behaviour Change & Business Programmes**





# Mobilizing keystone actors for transformation

3 October 2024  
Robert Blasiak

Stockholm Resilience Centre  
Sustainability Science for Biosphere Stewardship



Stockholm  
University

But what is a 'keystone actor' anyway?



RESEARCH ARTICLE

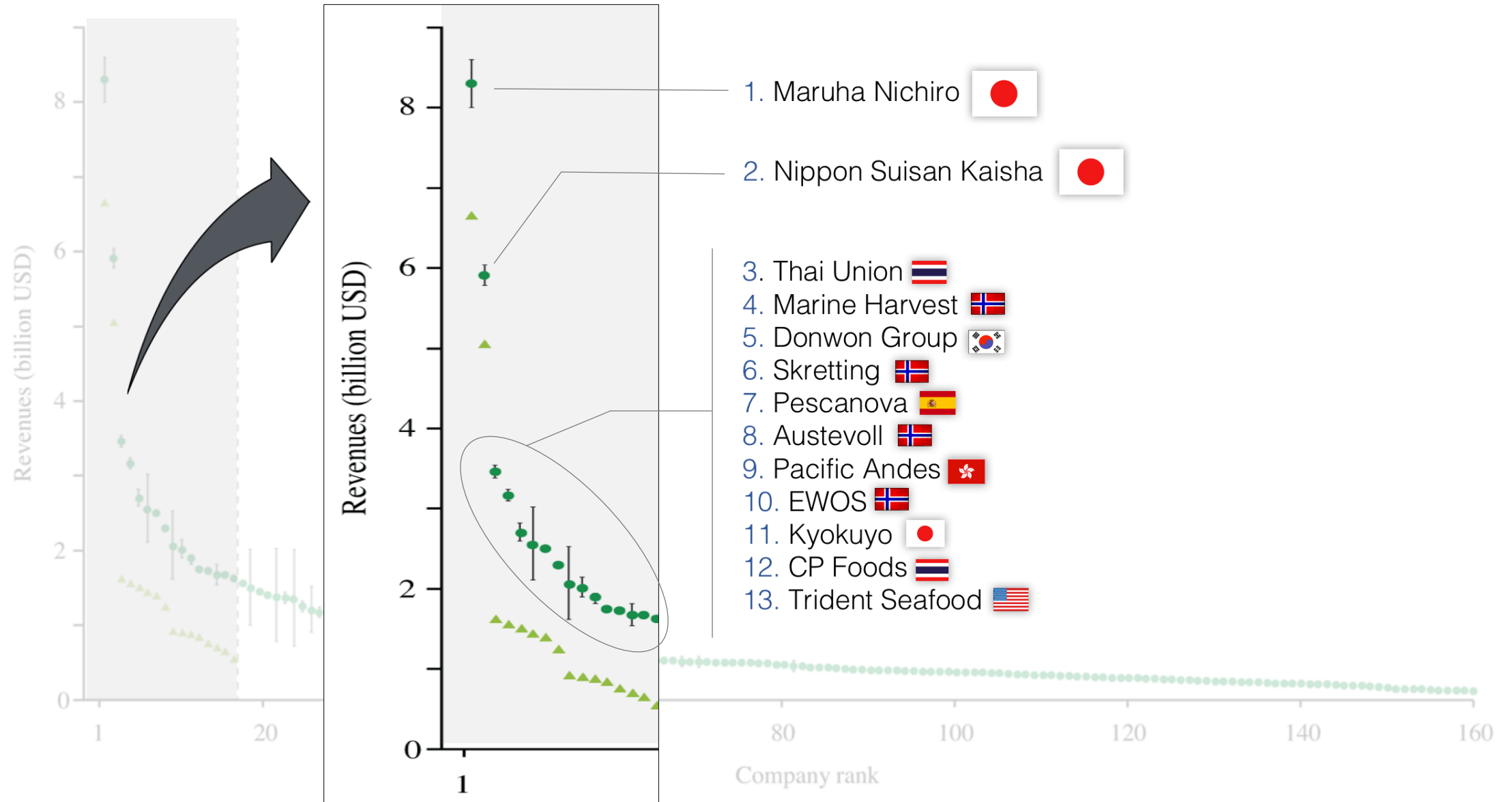
# Transnational Corporations as ‘Keystone Actors’ in Marine Ecosystems

**Henrik Österblom<sup>1\*</sup>, Jean-Baptiste Jouffray<sup>1,2</sup>, Carl Folke<sup>1,2,3</sup>, Beatrice Crona<sup>1,2</sup>, Max Troell<sup>2,3</sup>, Andrew Merrie<sup>1</sup>, Johan Rockström<sup>1</sup>**

**1** Stockholm Resilience Centre, Stockholm University, 106 91, Stockholm, Sweden, **2** Global Economic Dynamics and the Biosphere Academy Programme, Royal Swedish Academy of Sciences, PO Box 50005, 104 05, Stockholm, Sweden, **3** Beijer Institute of Ecological Economics, Royal Swedish Academy of Sciences, PO Box 50005, 104 05, Stockholm, Sweden

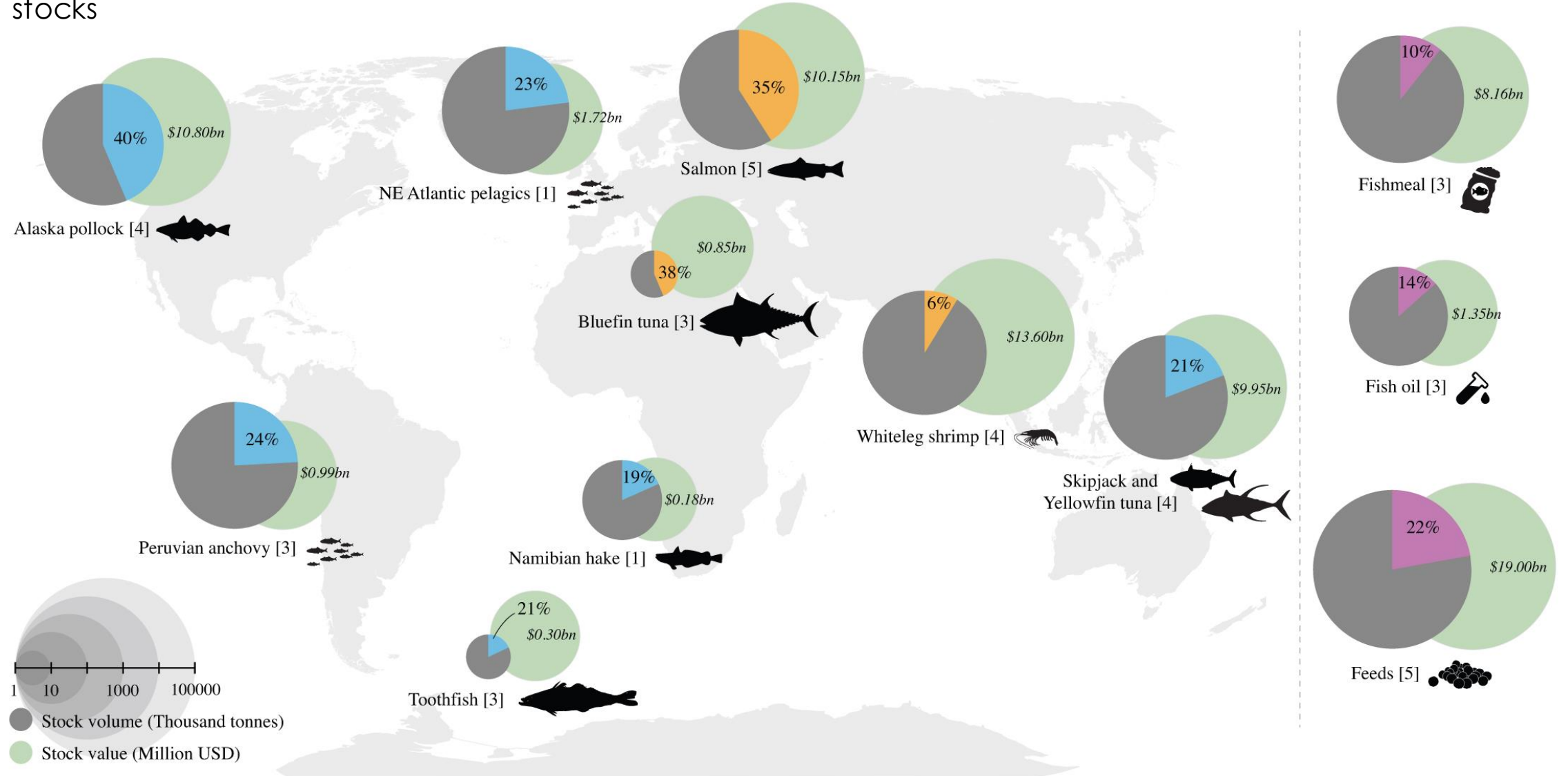
\* [henrik.osterblom@su.se](mailto:henrik.osterblom@su.se)

# Who are they?



# How much do they produce?

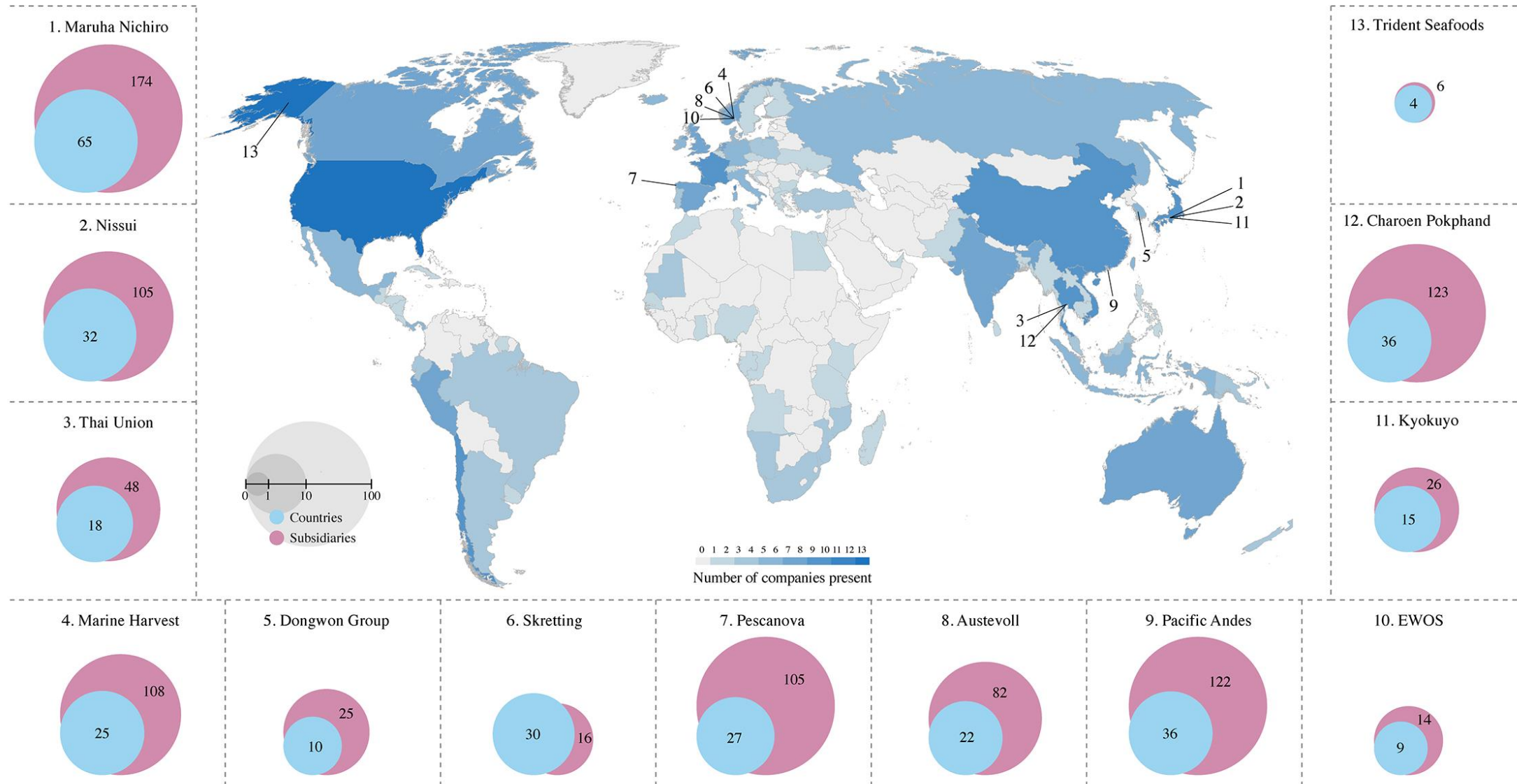
11-16% of global catch and up to 40% of several of the world's largest or most valuable stocks





# Where do they operate?

Handling >400 species from >900 subsidiaries operating in >100 countries







## KEYSTONE ACTORS

... **dominate** global production revenues and volumes

... **control** globally relevant segments of seafood production

... **connect** ecosystems globally through subsidiaries

... **influence** global governance processes and institutions

What is the **research question**?



## Transnational Corporations as 'Keystone Actors' in Marine Ecosystems

Markus Oelmann<sup>1\*</sup>, Jean-Benoit Jouffroy<sup>2</sup>, Carl-Friedrich Schmidt<sup>3,4</sup>, Benjamin David<sup>1</sup>, Max Trösel<sup>5</sup>, Andrew Wilford<sup>6</sup>, Julian Paikow<sup>7</sup>

**1** Stockholm Resilience Centre, Stockholm University, 106 91 Stockholm, Sweden, **2** Global Business Center, Stockholm University, 106 91 Stockholm, Sweden, **3** Stockholm University, 106 91 Stockholm, Sweden, **4** Department of Applied Environmental Science, Stockholm University, 106 91 Stockholm, Sweden, **5** Department of Applied Environmental Science, Stockholm University, 106 91 Stockholm, Sweden, **6** Department of Applied Environmental Science, Stockholm University, 106 91 Stockholm, Sweden, **7** Department of Applied Environmental Science, Stockholm University, 106 91 Stockholm, Sweden

### Abstract

Keystone species have a disproportionate influence on the structure and function of natural systems. Here we analyze whether a keystone-like pattern can be observed in the relationship between transnational corporations and marine ecosystems globally. We show that transnational corporations control 71–92% of the global marine catch (20–73 million tons) and 76–92% of the largest and most valuable species, including species of highest production, species that are under threat, and species of high biodiversity and are particularly involved in fisheries and aquaculture production. They own most of the world's fishing vessels, control most of the world's fish processing capacity, and own most of the world's fish stocks. The proliferation of keystone actors represents an emerging pattern in the human-dominated world. Sustainable leadership by keystone actors could lead to cascading effects throughout the entire seafood industry and enable a critical transition towards improved management of marine living resources and ecosystems.

### Introduction

Globalization is increasing the economic power of transnational corporations as evident in the world's largest governments, but the effects of the global shift are largely unknown [1]. The world's largest transnational corporations are highly concentrated in a small number of companies that have led a major part of global demand. The core of highly concentrated companies has been identified as a "super-core" of the global economy [2]. Consequently, these companies may be able to influence the world's economic and environmental systems. Super-core companies are likely to have a disproportionate effect on the world's economic and environmental systems and may be able to influence the world's economic and environmental systems. The fact that transnational corporations have a disproportionate impact on the economy is well documented [3–5] and has recently been investigated in relation to greenhouse gas emissions [6].

**“... Sustainable leadership by keystone actors could result in cascading effects throughout the entire seafood industry and enable a critical transition towards improved management of marine living resources and ecosystems ...”**



What does our **experiment** look like?

# 1<sup>st</sup> KEYSTONE DIALOGUE – November 2016, Maldives





# CEO statement from the 1<sup>st</sup> Keystone Dialogue

- Improve **transparency** and **traceability** in our own operations
- Engage in concerted efforts to help reduce **IUU fishing** and ensure **endangered species** are not present in supply chains
- Engage in **science-based efforts** to improve fisheries and aquaculture management and productivity
- Engage in concerted efforts to eliminate any form of **modern slavery**
- Work towards reducing the use of **antibiotics** in aquaculture
- Reduce the use of **plastics** in seafood operations
- Reduce our own **greenhouse gas** emissions
- Secure new **growth** in aquaculture
- Collaborate and invest in emerging approaches and **technologies** for sustainable fisheries and aquaculture
- Support novel initiatives and **innovations** for ocean stewardship







Eight of the **world's largest seafood companies** working towards leadership in ocean sustainability

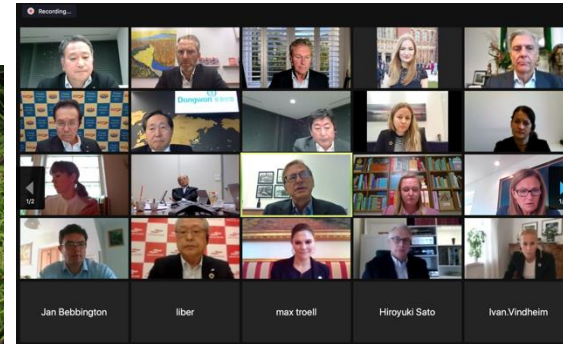


In collaboration with team of 19 **independently-funded scientists** from 9 institutions.



Is it **working**?

# Keystone dialogues / working meetings





# Milestones over the past year:

- Commitments **(2016)**
- To time-bound goals **(2020)**
- To general reporting **(2021)**
- To public monitoring and reporting framework **(2022)**
- To specific reporting based on M&R framework **(2023)**
- To eighth annual CEO dialogue **(NEXT WEEK!)**

# A growing repository of publications



Reports ▾ About ▾ Task Forces ▾ Keystone Projects ▾ Science ▾ News Member ▾

## Seafood Business for Ocean Stewardship (SeaBOS)

Leading a science-based global transformation towards sustainable seafood production and a healthy ocean

8

Committed companies

Representing over 10% of the world's seafood production

42

Scientific publications

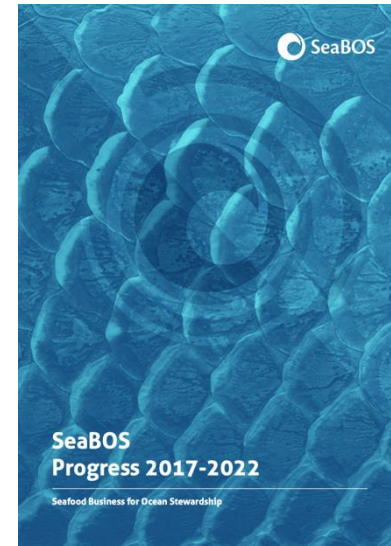
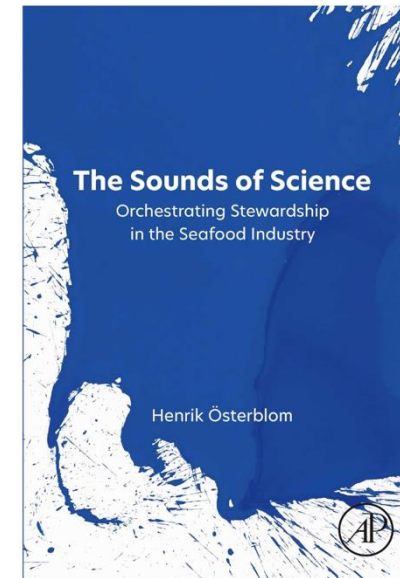
Powering wisdom and innovation

5

Task forces

Driving change across all aspects of seafood production

[www.seabos.org](http://www.seabos.org)

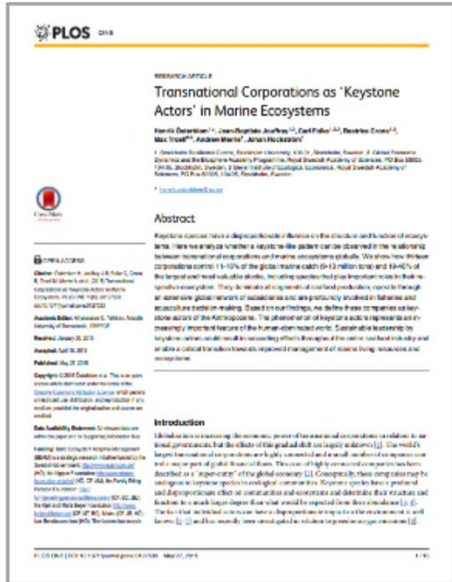


### scientific reports

**OPEN** Scientific mobilization of keystone actors for biosphere stewardship

Henrik Österblom<sup>1,2,3,5</sup>, Carl Folke<sup>4,5</sup>, Juan Rocha<sup>1,2,5</sup>, Jan Bebbington<sup>1</sup>, Robert Blasiak<sup>1,3</sup>, Jean-Baptiste Jouffray<sup>1,5</sup>, Elizabeth R. Selig<sup>1</sup>, Colette C. C. Wabnitz<sup>5,9</sup>, Frida Bengtsson<sup>1</sup>, Beatrice Crona<sup>1</sup>, Radhika Gupta<sup>1</sup>, Patrik J. G. Henriksson<sup>1,5,10</sup>, Karolin A. Johansson<sup>1</sup>, Andrew Merrie<sup>1</sup>, Shinnosuke Nakayama<sup>5</sup>, Guillermo Ortuño Crespo<sup>1</sup>, Johan Rockström<sup>1,11</sup>, Lisen Schultz<sup>1</sup>, Madlen Sobkowiak<sup>12</sup>, Peter Seggaard Jørgensen<sup>1</sup>, Jessica Spijkers<sup>1</sup>, Max Troell<sup>1,4</sup>, Patricia Villarrubia-Gómez<sup>2</sup> & Jane Lubchenco<sup>13</sup>

# Science of SeaBOS



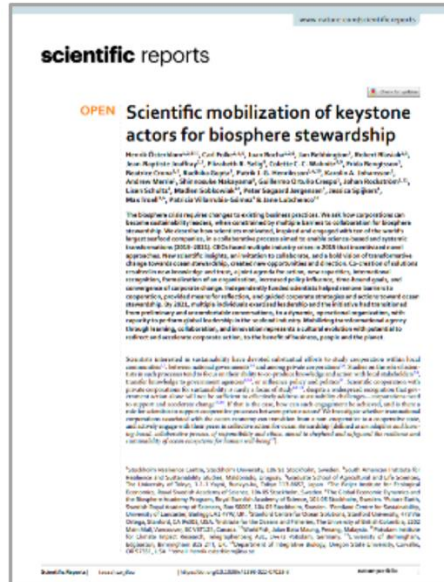
## Transnational Corporations as 'Keystone Actors' in Marine Ecosystems. (2015)

PLoS ONE, vol. 10, no. 5.  
<https://doi.org/10.1371/journal.pone.0127533>



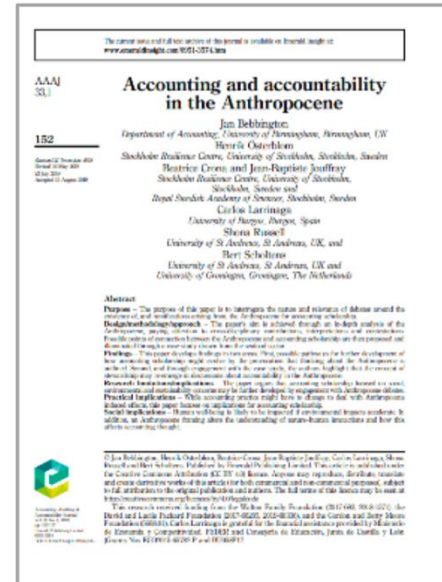
## Emergence of a global science-business initiative for ocean stewardship. (2017)

Proceedings of the National Academy of Science, vol. 114, no. 34.  
<https://doi.org/10.1073/pnas.1704453114>



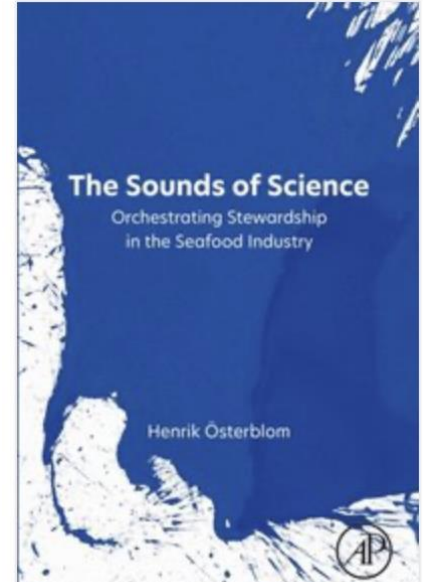
## Scientific mobilization of keystone actors for biosphere stewardship. (2021)

Nature Scientific Reports, vol. 12, no. 3802.  
<https://doi.org/10.1038/s41598-022-07023-8>



## Accounting and accountability in the Anthropocene. (2019)

Auditing and Accountability Journal, vol. 33, no. 1., pp. 152-177.  
<https://doi.org/10.1108/AAJ-11-2018-3745>



## The Sounds of Science: Orchestrating Stewardship in the Seafood Industry (2023)

Elsevier.  
<https://www.bokus.com/bok/9780443152689/sounds-of-science/>





**Thank you!**  
robert.blasiak@su.se