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Engineering, ecological or social-ecological – the use of resilience in forest literature

Managing forests in the 21st century, 03.-05.3.2020, Potsdam

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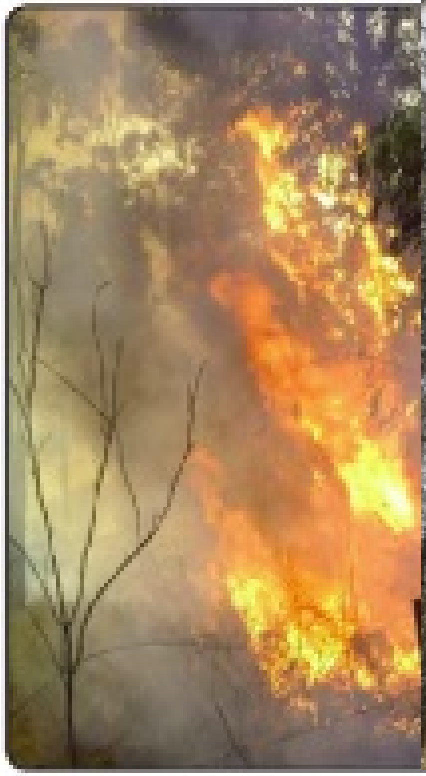
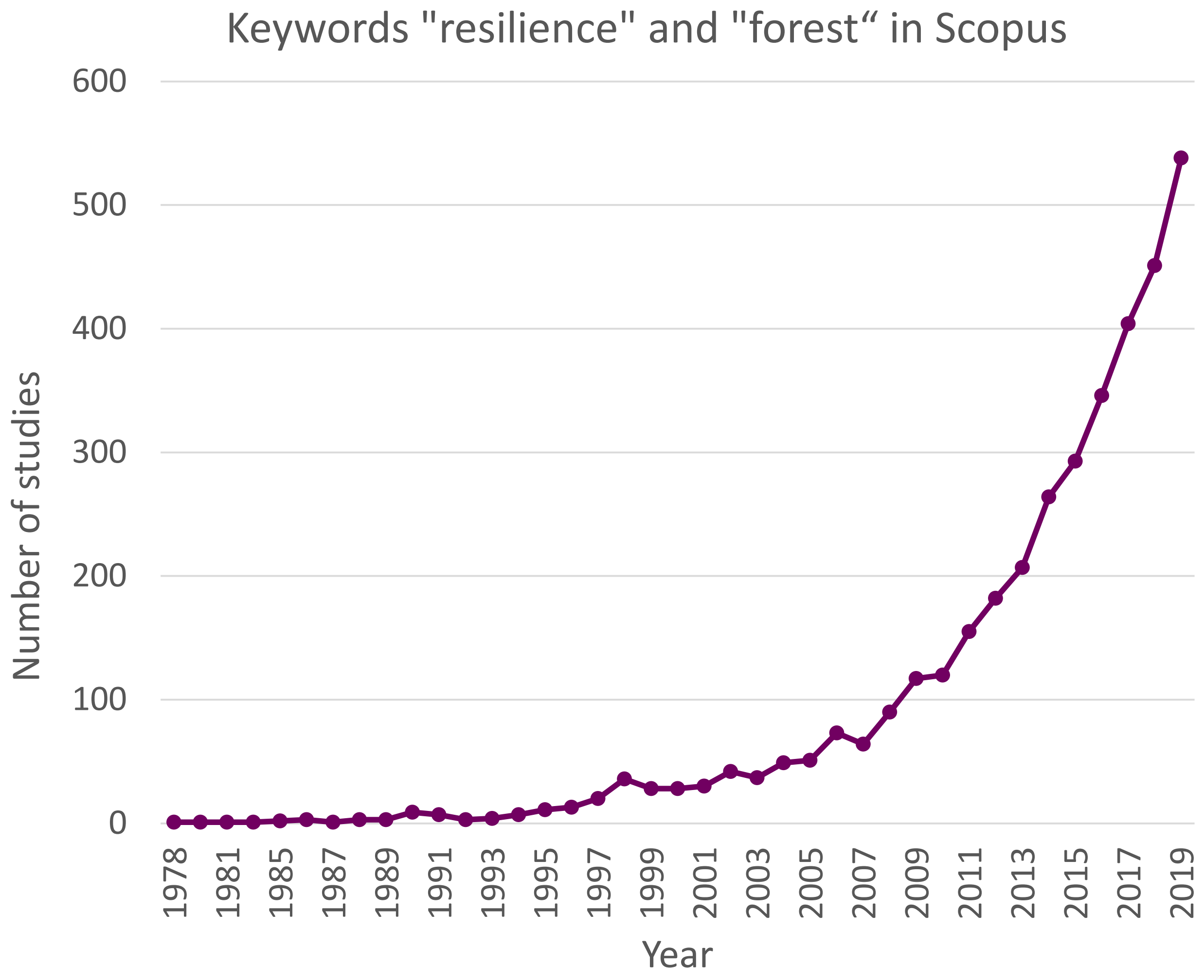
Forests are under multiple pressures



Picture: Agata Konczal



- No agreement on the meaning of the term
- No mainstream approach to implement resilience into practice

Resilience concepts

- Engineering resilience (Pimm, 1984)
  - *The time that it takes for variables to return towards their equilibrium following a disturbance.*
- Ecological resilience (Holling, 1973)
  - *The system's capacity to absorb external disturbance without changing as well as the ability to self-organize and build adaptive capacity.*
- Social-ecological resilience (Resilience Alliance)
  - *The capacity of a social-ecological system to absorb or withstand perturbations and other stressors such that the system remains within the same regime, essentially maintaining its structure and functions. It describes the degree to which the system is capable of self-organization, learning, and adaptation*.

Aim and Objectives

1. Evaluate the adoption of the three concepts
2. Analyse similarities and differences
3. Develop guidance for selecting appropriate concept

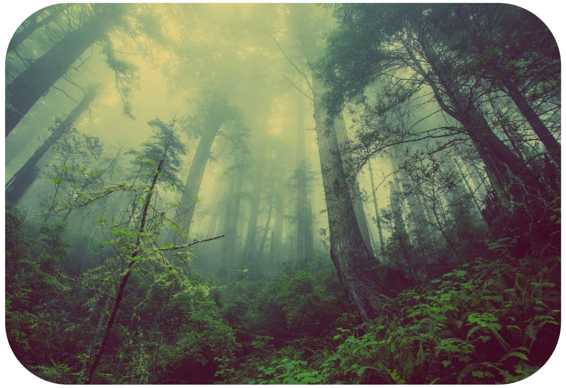
Our hypotheses

- In the context of facing global change, the use of more holistic resilience concepts, such as social-ecological resilience, is increasing.

- Forest resilience is a widely adopted concept in forest science, but its large variety of approaches prevents its mainstreaming into forestry practice.

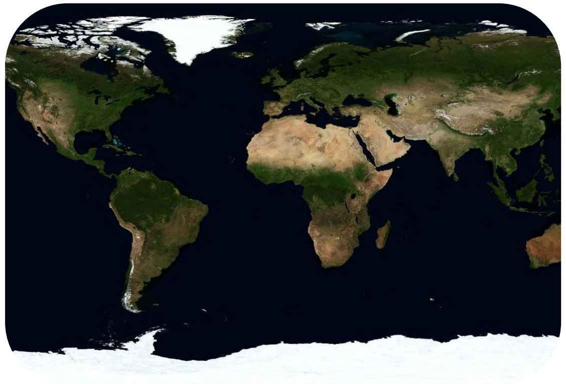
Methods

- Systematic literature review in (Scopus)
- Classification of studies
- Identification of relevant data
- Classification of indicators (cf. OECD’s environmental indicators) + NMDS analysis on indicators



Studied system

Disturbance



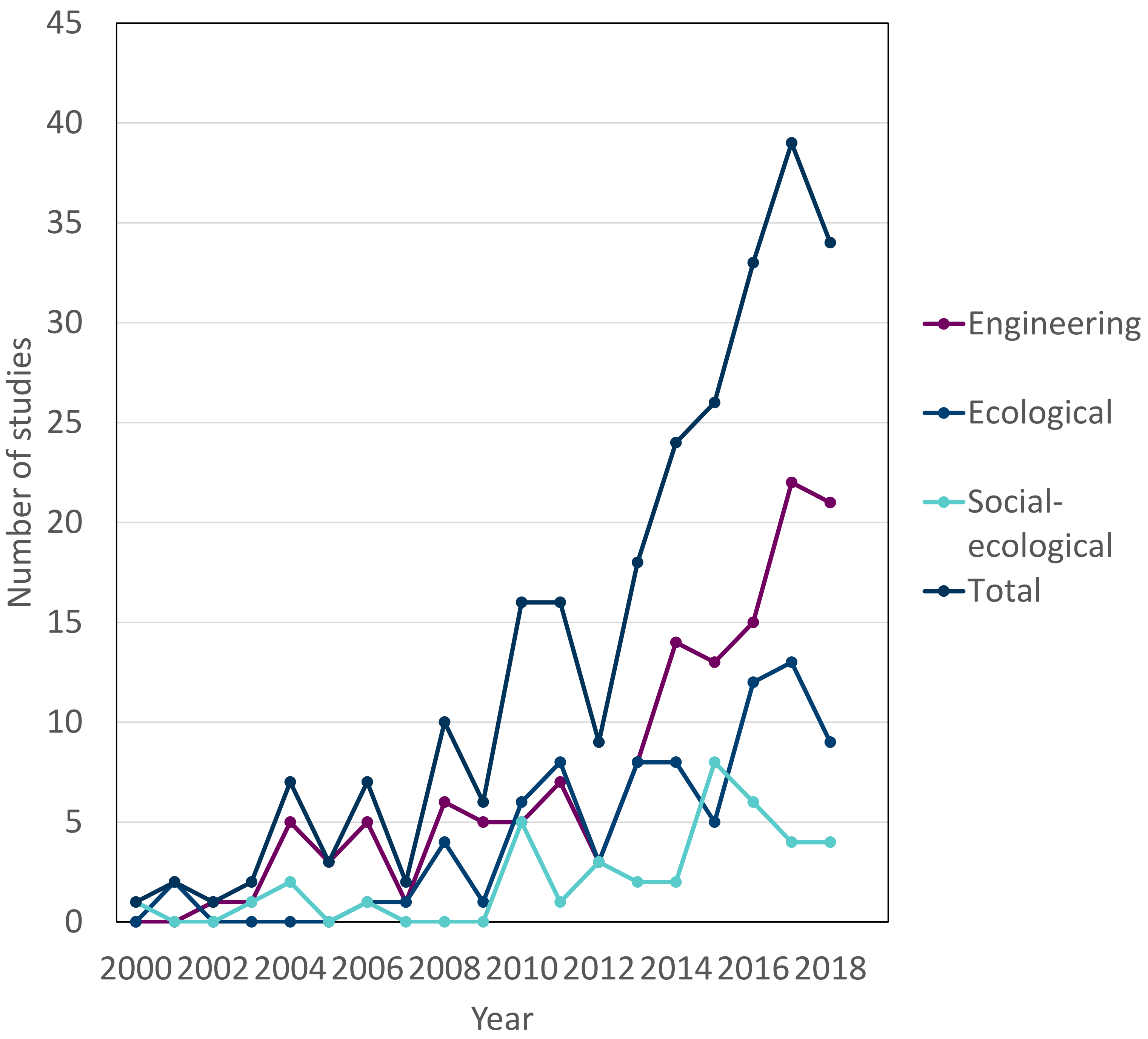
Biome

Indicators

Pictures: Pixabay

Results

- Engineering resilience: **54%**
- Ecological resilience: **31%**
- Social-ecological resilience: **15%**

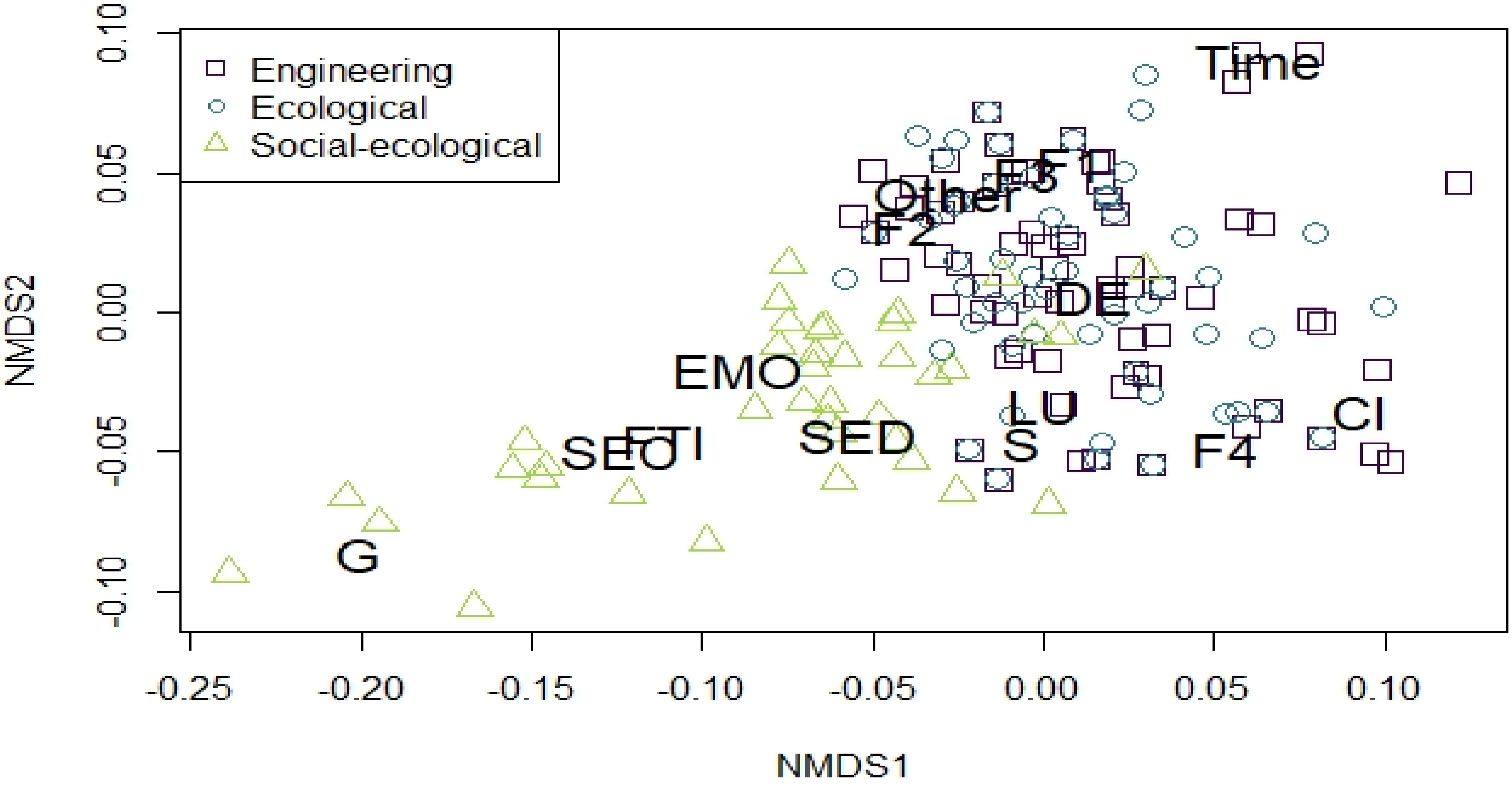


- Resilience of what?
  - EngR: mainly in tree populations
  - EcoR: mainly in forest ecosystems
  - SER: mainly in forest-dependent communities

- Resilience to what?
  1. Drought (22 %)
  2. Fire (13 %)
  3. Climate change (11 %)

Picture: Pixabay

Indicator rank of occurrence	***Engineering resilience***	***Ecological resilience***	***Social-ecological resilience***	***All reviewed studies***
1	Basal area increment (27.5 %)	Vegetation cover (13.9 %)	Socio-economic diversity (30.0 %)	Basal area increment (17.6 %)
2	Vegetation cover (15.4 %)	Density or number of trees (13.9 %)	Biodiversity (22.5 %)	Vegetation cover (12.5 %)
3	Species richness (10.3 %)	Basal area increment (11.4 %)	Stock of natural resources (20.0 %)	Species composition (9.0 %)
4	Species composition (10.3 %)	Biomass (11.4 %)	Networks (20.0 %)	Species richness (8.2 %)
5	Precipitation (10.3 %)	Species composition (11.4 %)	Knowledge (17.5 %)	Biomass (7.5 %)
6	Standardised Precipitation Evapotranspiration Index (9.6 %)	Species diversity (10.1 %)	Income (17.5 %)	Regeneration (7.1 %)



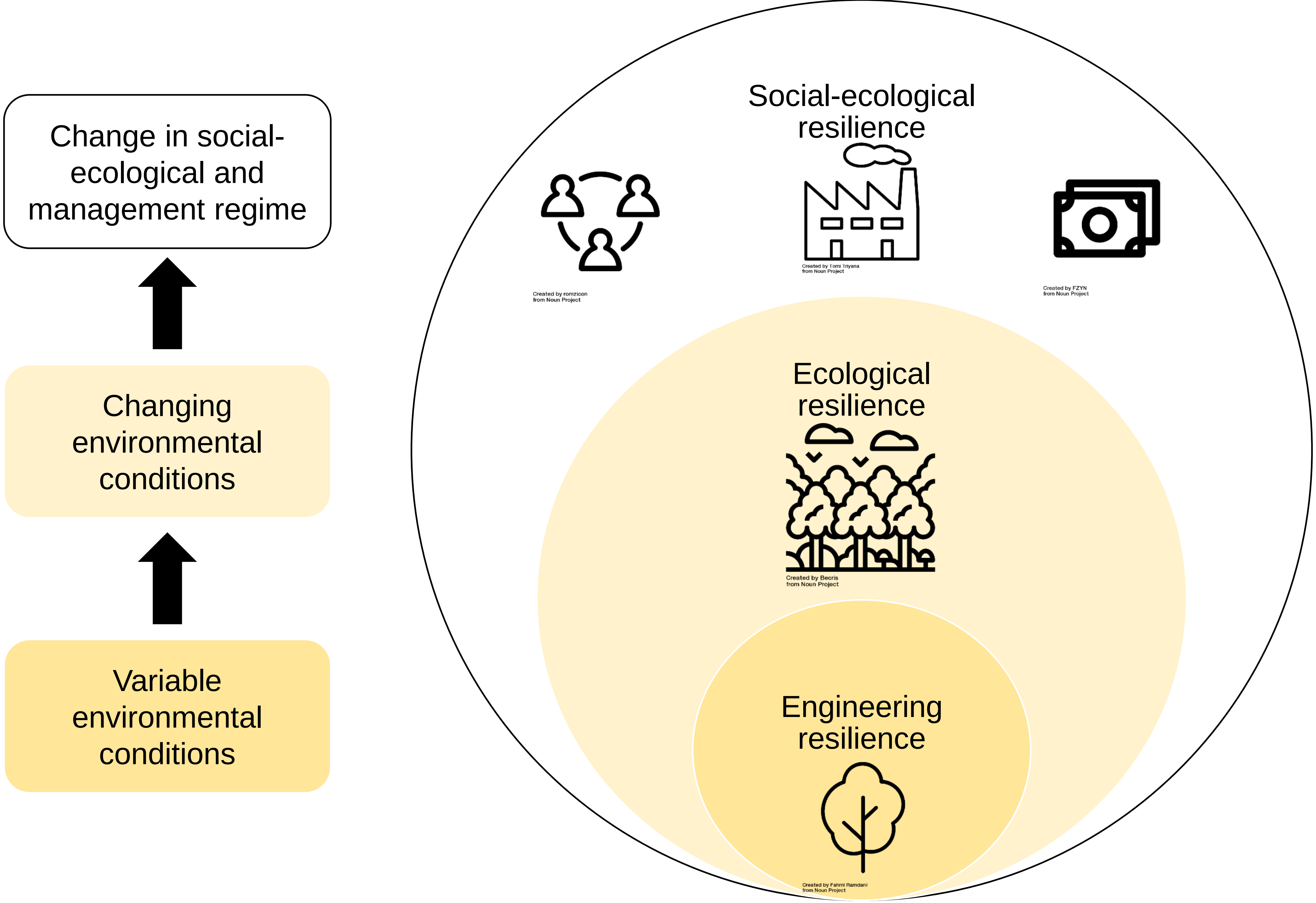
Engineering
Ecological
Social-ecological
Time
F1
F3
Other
F2
DE
EMO
LU
CI
SED
S
F4
SEO
FTI
G
NMDS1
NMDS2
-0.25
-0.20
-0.15
-0.10
-0.05
0.00
0.05
0.10

Discussion

- The popularity of the engineering resilience
  - Versatile concept
  - Clear definition
  - Limitations when applied in climate change setting

- Move from understanding to implementation

- Engineering ~ ecological resilience ⇔ social-ecological resilience
  - Resilience as a system property vs. a strategy for managing complexity and uncertainty
  - A difference in complexity


Change in social-ecological and management regime
Changing environmental conditions
Variable environmental conditions
Social-ecological resilience
Created by romzicon from Noun Project
Created by Tomi Triyana from Noun Project
Created by FZYN from Noun Project
Ecological resilience
Created by Becris from Noun Project
Engineering resilience
Created by Fahmi Ramdani from Noun Project

Guidelines for choosing the resilience concept

1. *Identify the managed system*
2. *Identify the stressors or disturbances affecting the system*
3. *Identify the temporal scale of interest*
4. *Consider the trade-off between accuracy and cost-efficiency in indicator selection*

Take home messages

- Engineering resilience, surprisingly, the most popular
- Large variety of approaches can be attributed to these concepts
    - ➢ Further step into implementing resilience into practice
- Always explicitly define what you mean with resilience

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Thank you for your interest!

More information from:

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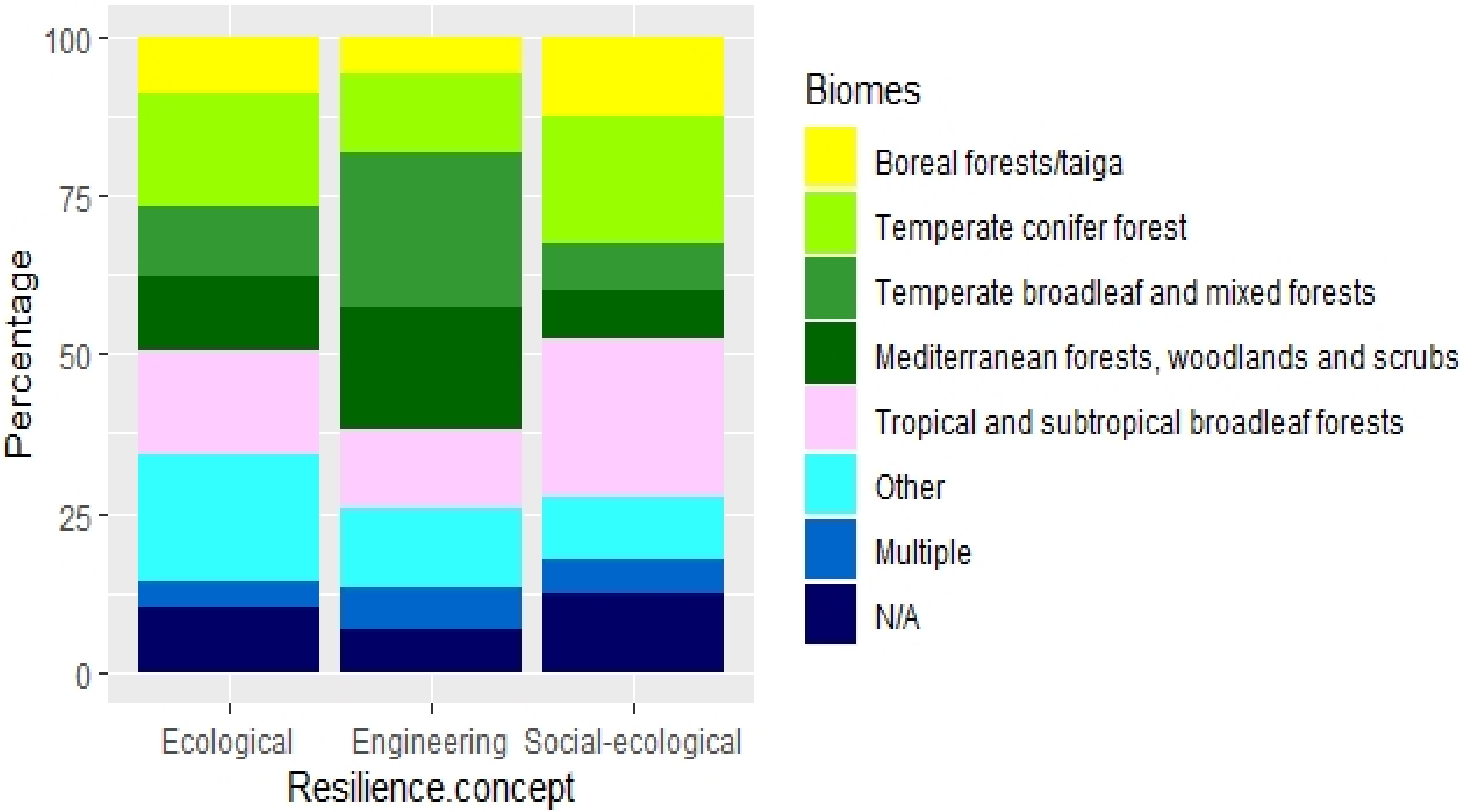
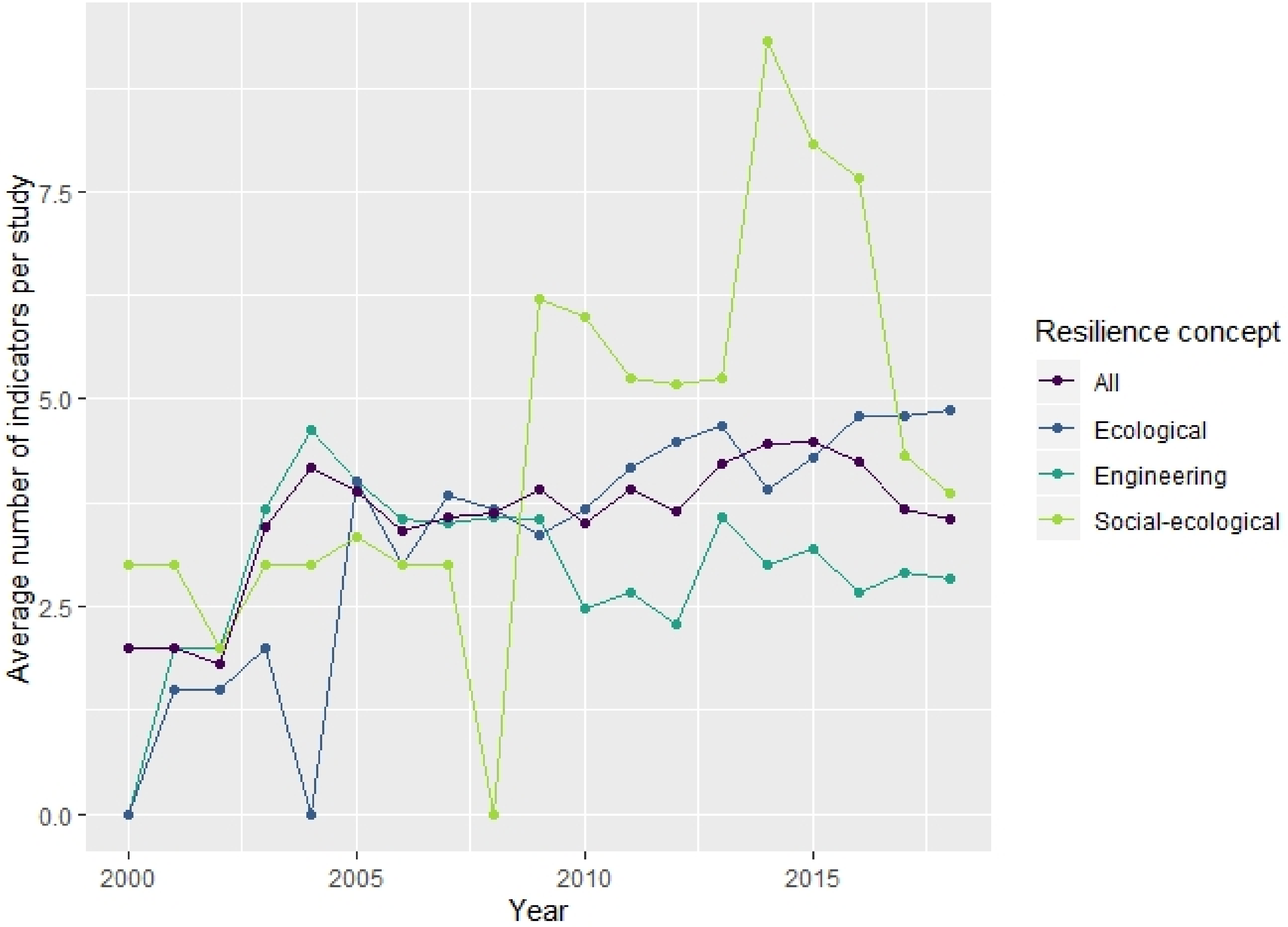
Full article:

Nikinmaa, L., Lindner, M., Cantarello, E. *et al.* Reviewing the Use of Resilience Concepts in Forest Sciences. *Curr Forestry Rep* (2020). https://doi-org. /10.1007/s40725-020-00110-x


Biomes
Boreal forests/taiga
Temperate conifer forest
Temperate broadleaf and mixed forests
Mediterranean forests, woodlands and scrubs
Tropical and subtropical broadleaf forests
Other
Multiple
N/A
Percentage
100
75
50
25
0
Ecological
Engineering
Social-ecological
Resilience.concept


Average number of indicators per study
0.0
2.5
5.0
7.5
2000
2005
2010
2015
Year
Resilience concept
All
Ecological
Engineering
Social-ecological