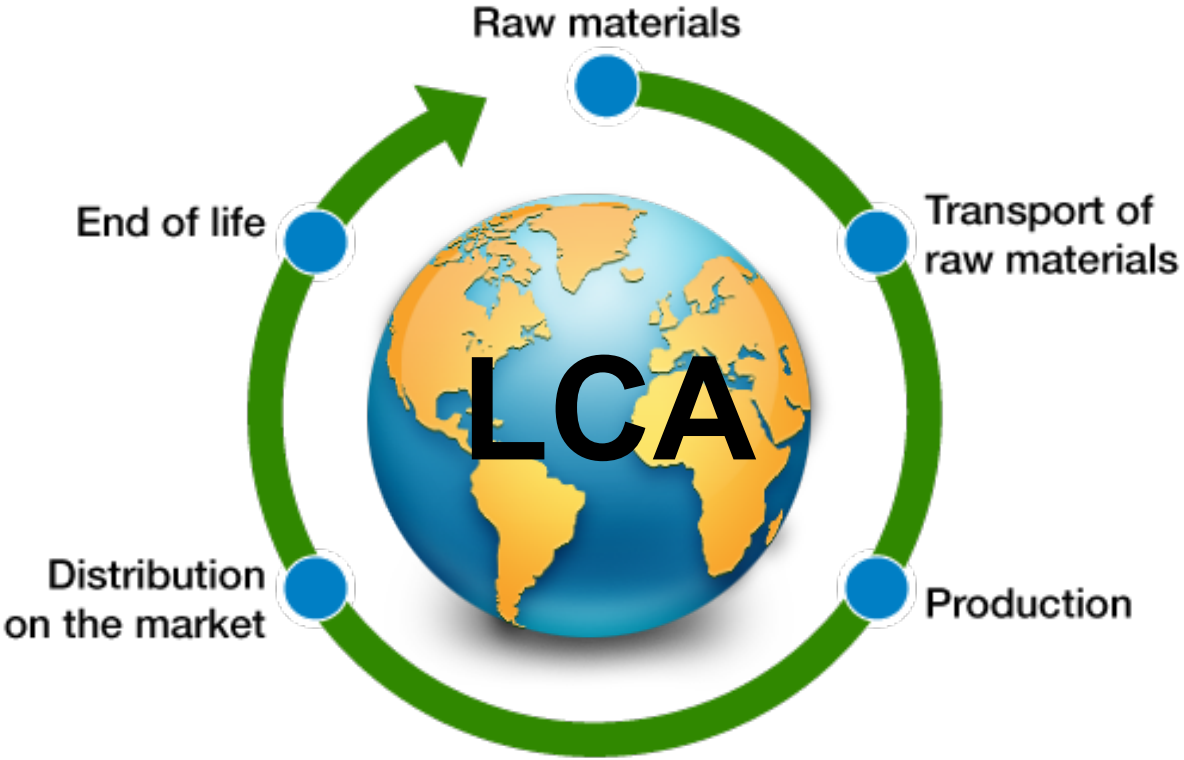
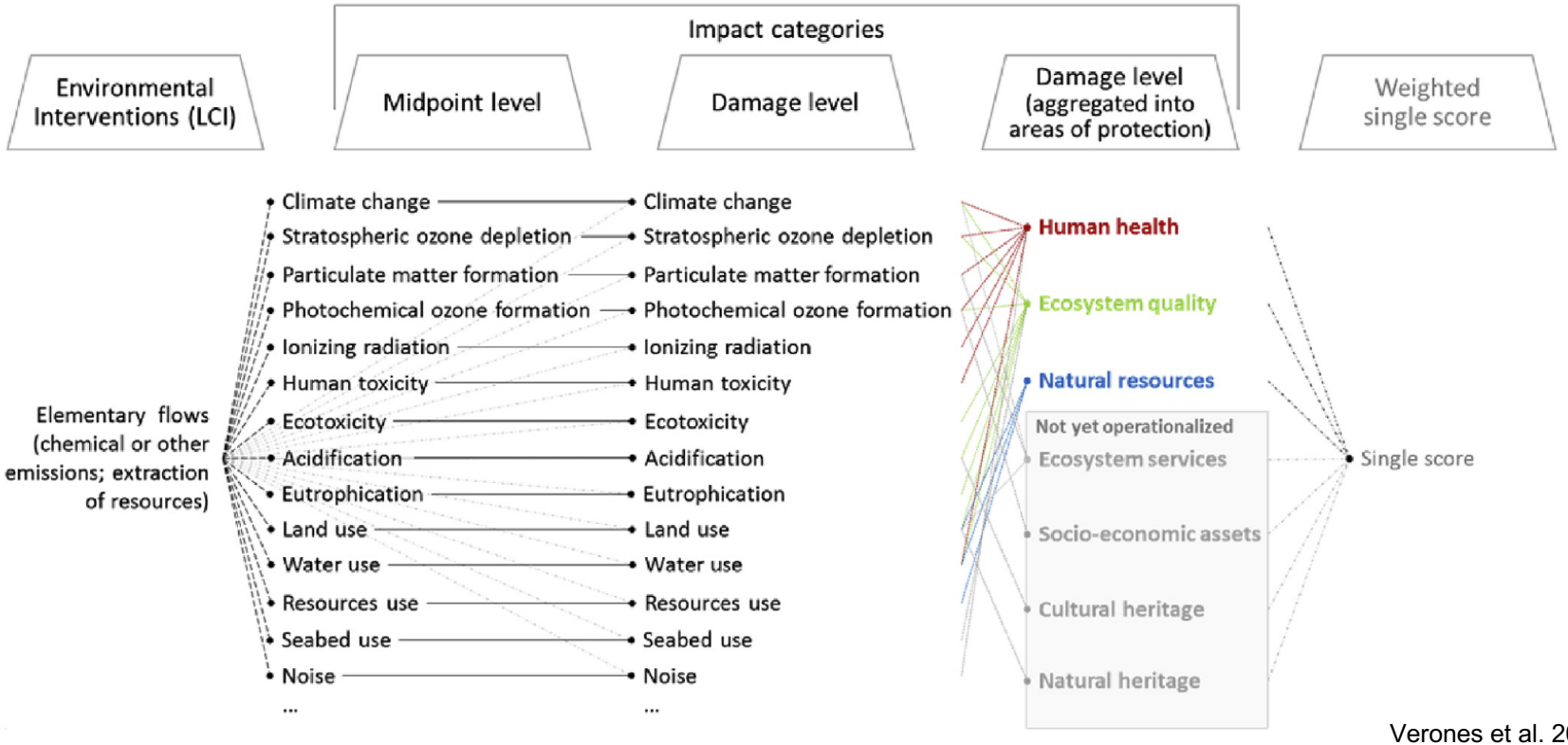
Life Cycle Assessment and biodiversity impacts

Francesca Verones

Life Cycle Assessment



Areas of Protection



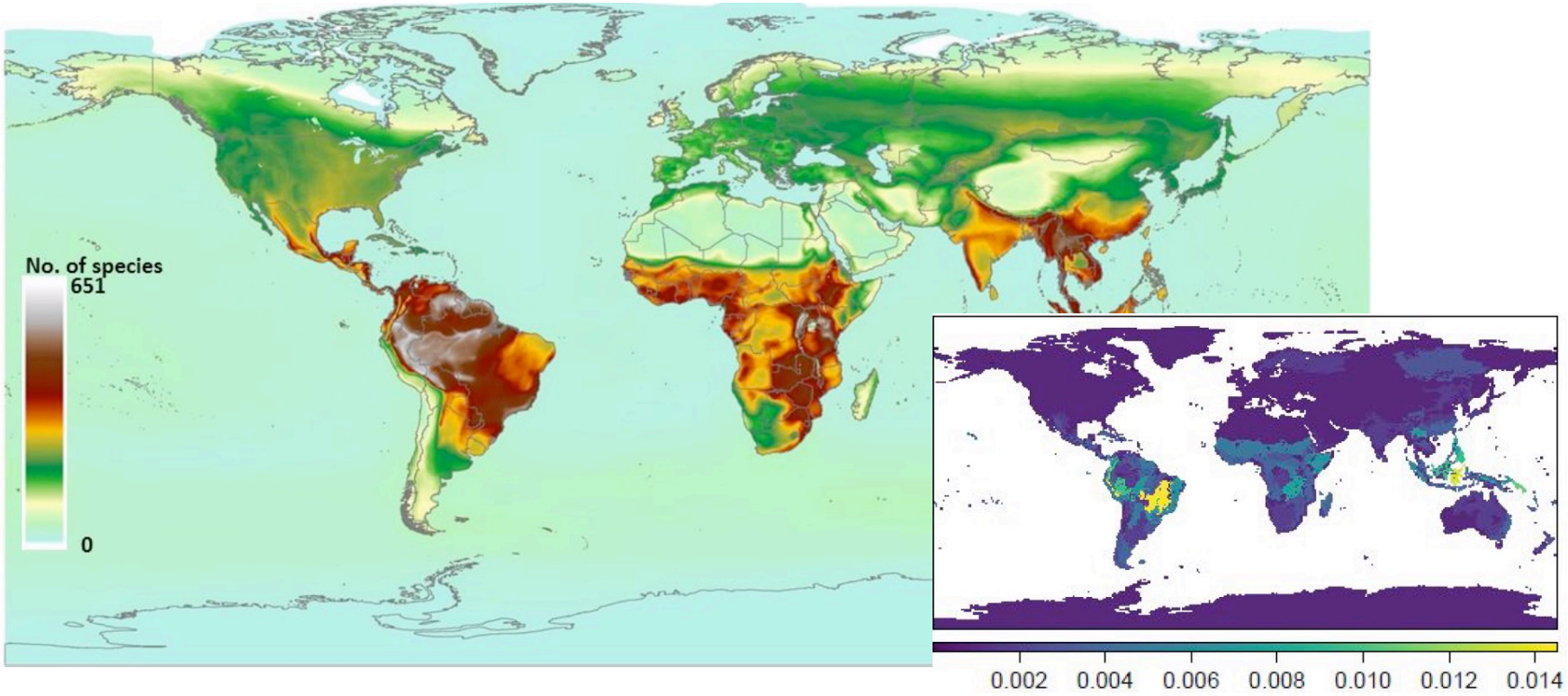
Verones et al. 2017

NTNU

What is biodiversity?

- Genetic diversity
- Species diversity
- Ecosystem diversity

Where is the biodiversity?

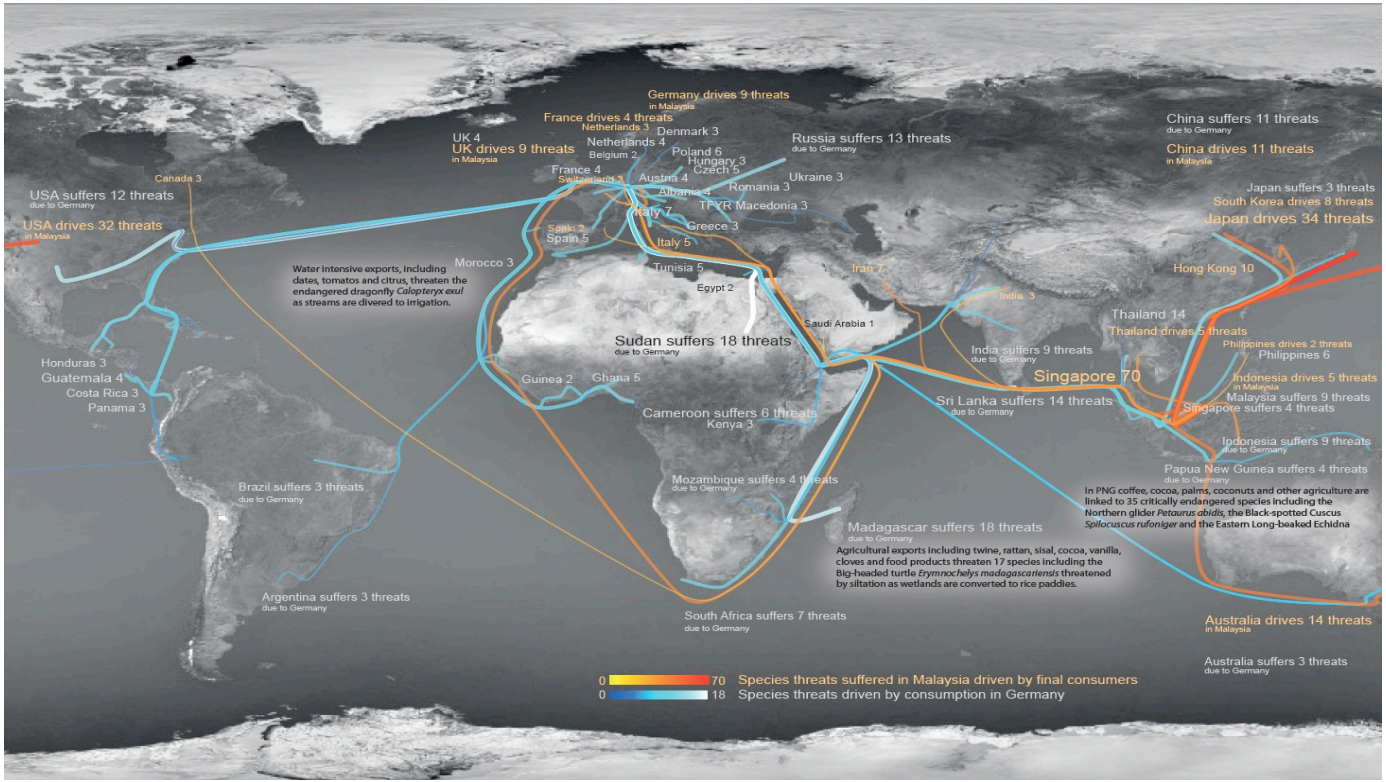


Verones et al. (2017), Kuipers et al. (2019)

NTNU

What affects biodiversity?

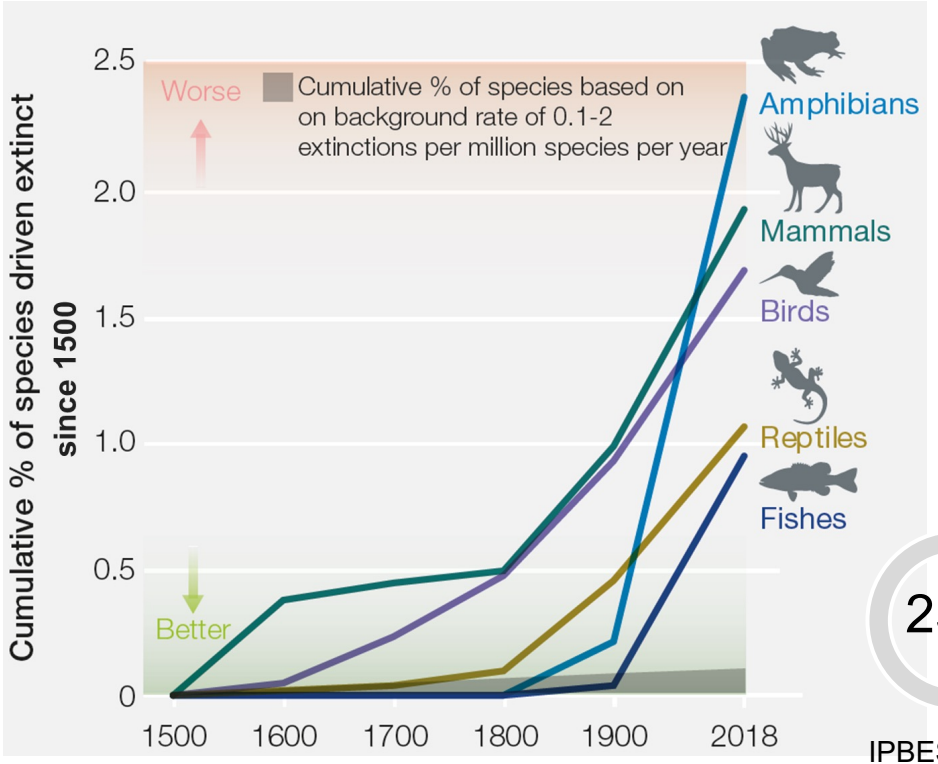
What affects biodiversity?



Lenzen et al. (2012)

NTNU

How bad are these impacts?



IPBES (2019)

IPBES (2019), slide from K.Kuipers

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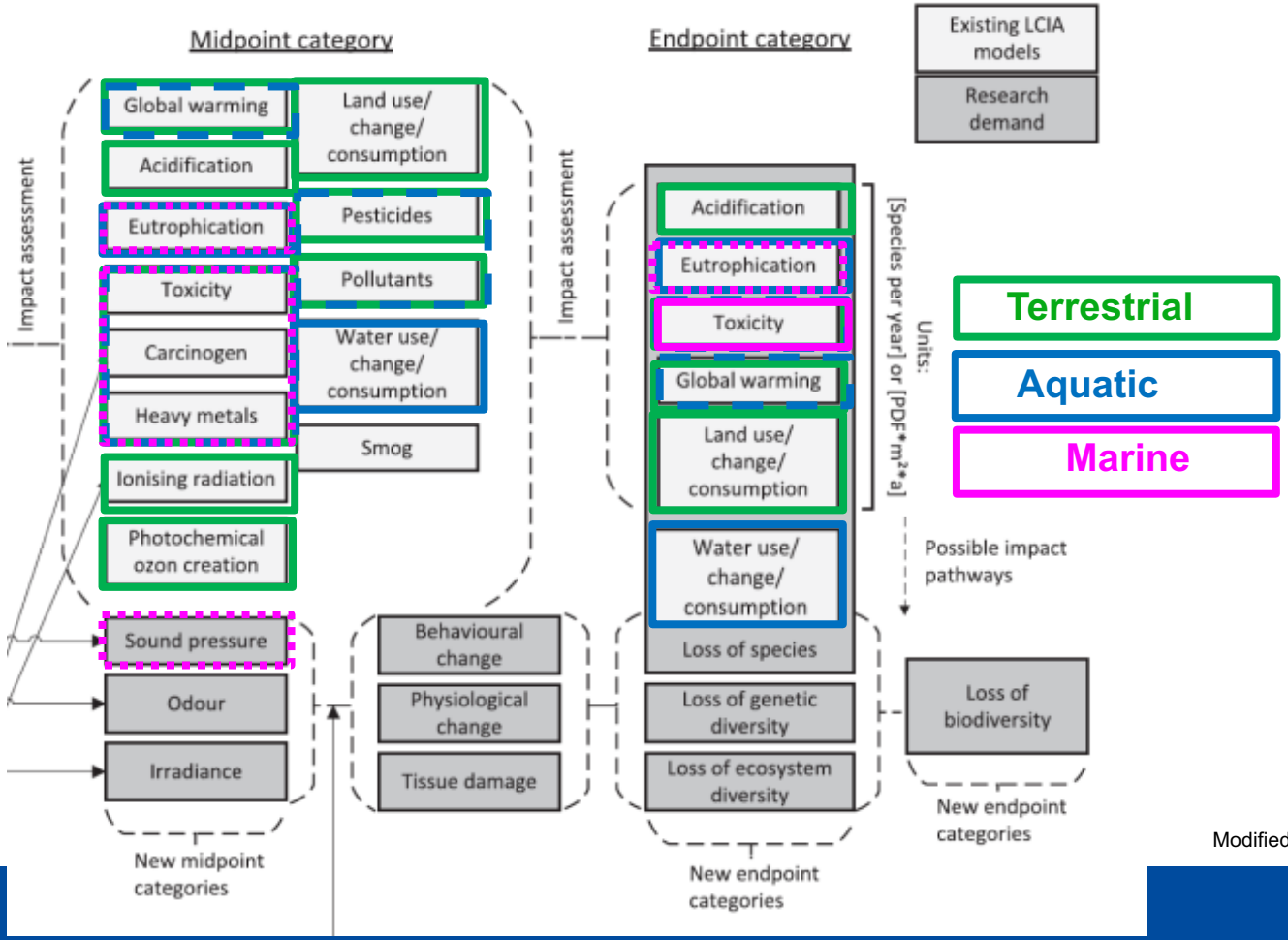
How can we assess biodiversty impacts?

https://www.oneclicklca.com/life-cycle-assessment-explained/

NTNU

Current coverage of impact categories



Modified from Winter et al. 2017

Current coverage of impact categories

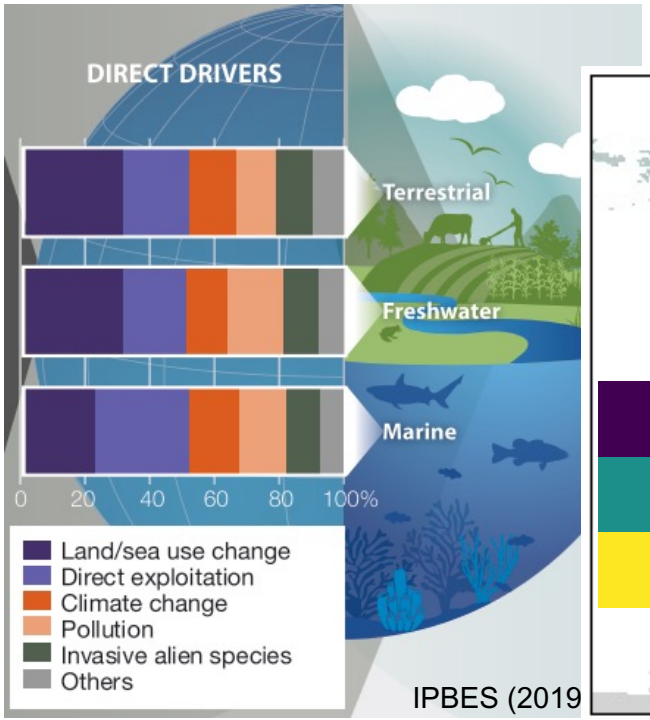
Terrestrial ecosystems

Aquatic ecosystems

Marine ecosystems

Where are the impacts of my cappuccino?

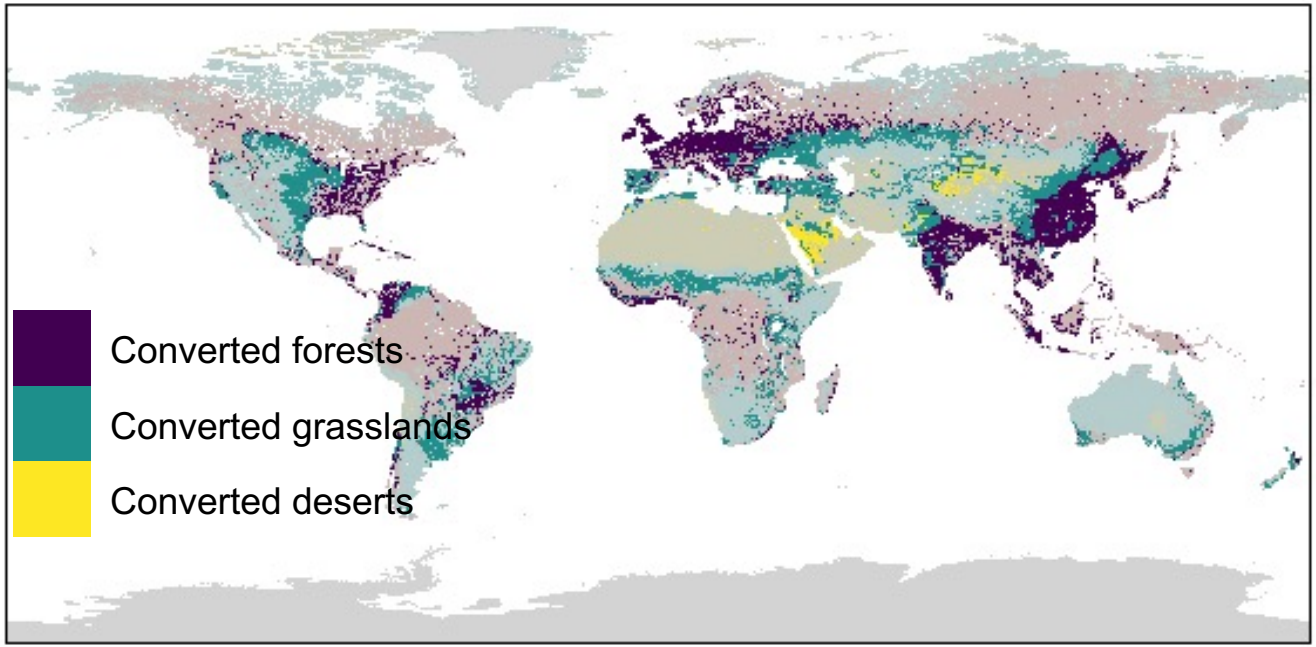
How to calculate biodiversity impacts from land use?



IPBES (2019

3,462 of the 5,620 endangered terrestrial vertebrate species are threatened with land use

IUCN (2019)



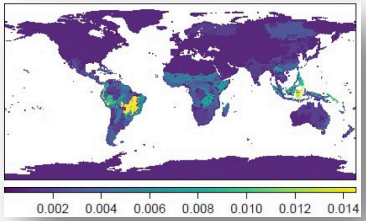
Slide by K.Kuipers

NTNU

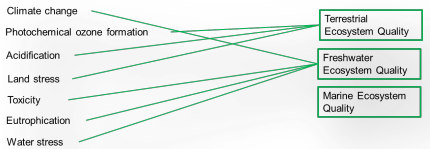
How to calculate biodiversity impacts from land use?

> 26 000 species

> 700 ecoregions



> 26 000 species

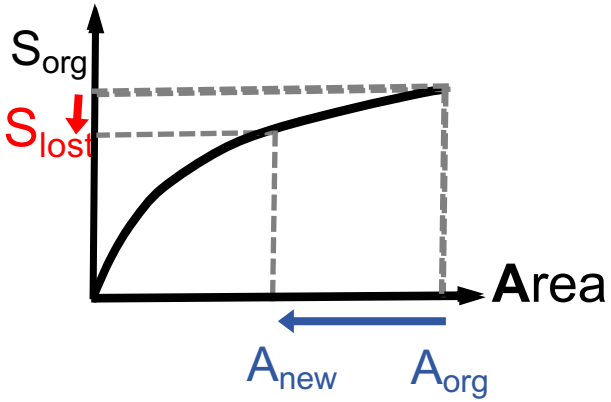


8 impact types

How to calculate biodiversity impacts from land use?

- Species-area relationship:
  Species = c*$\mathbf{A}$rea^z
- Commonly used model to assess species extinction due to habitat loss

$$S_{lost} = S_{org} - S_{org}\left(\frac{A_{new}}{A_{org}}\right)^z$$



How to calculate biodiversity impacts from land use?

Slide by K.Kuipers

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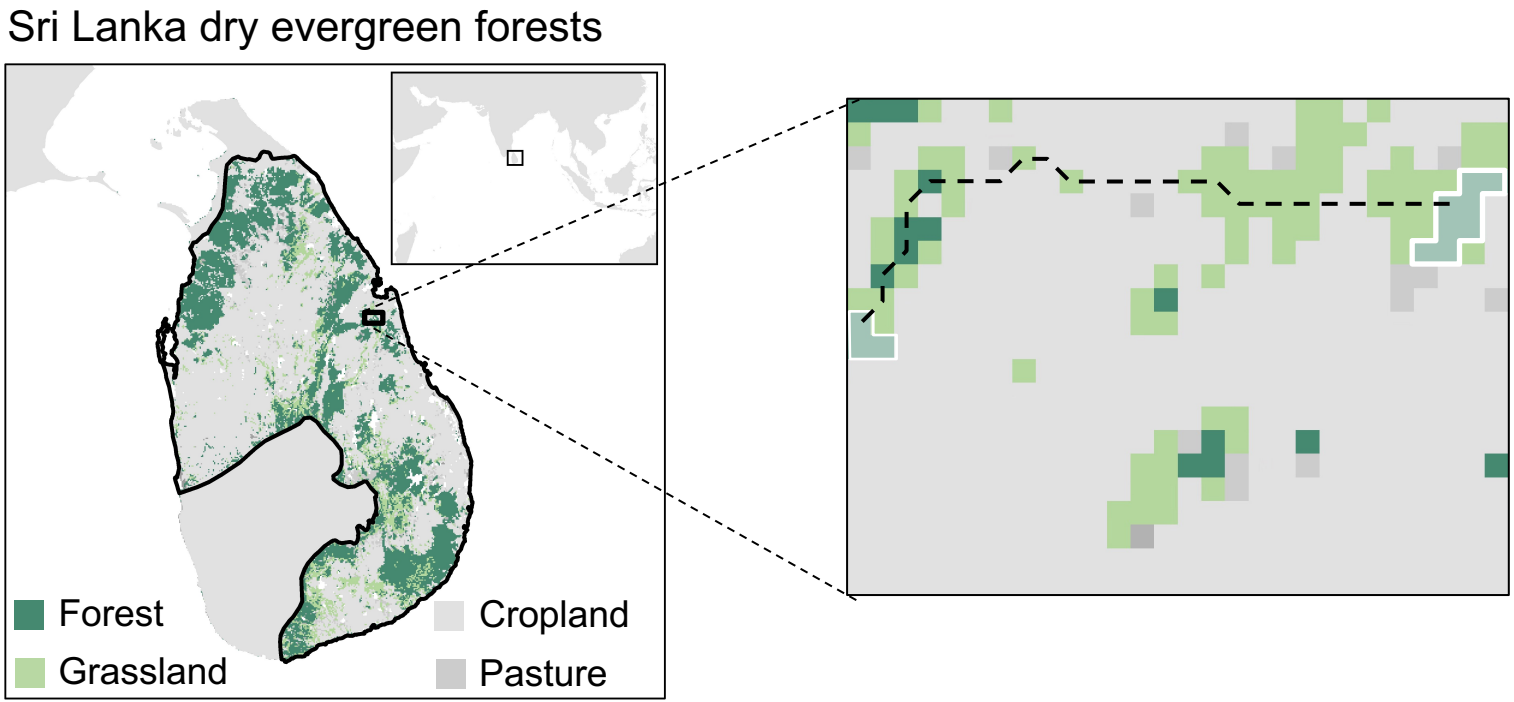
How to calculate biodiversity impacts from land use?



Slide by K.Kuipers

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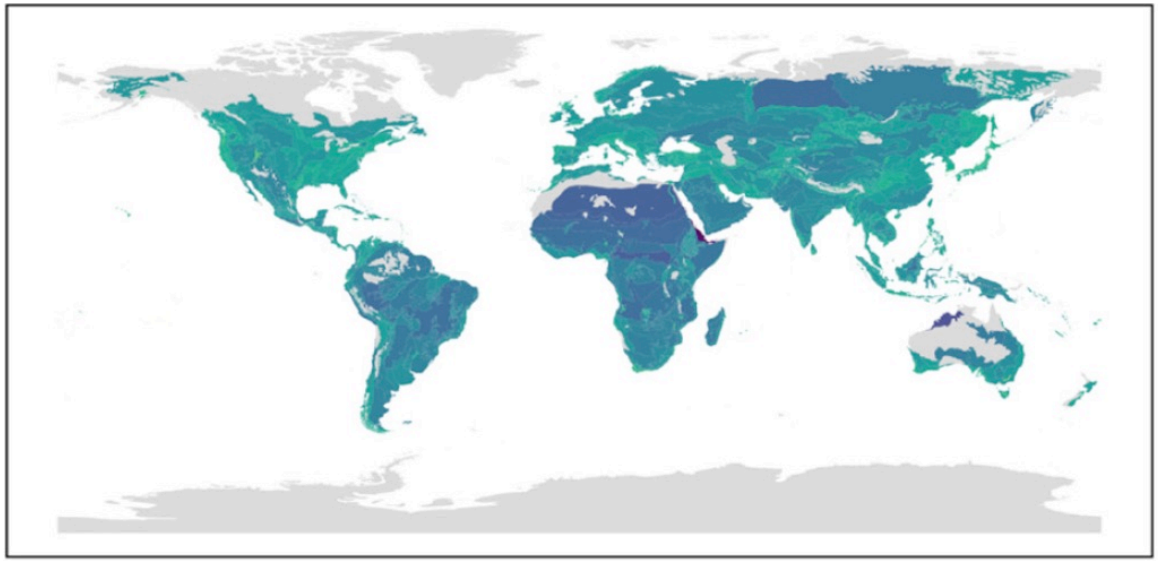
How are impacts of land stress distributed?

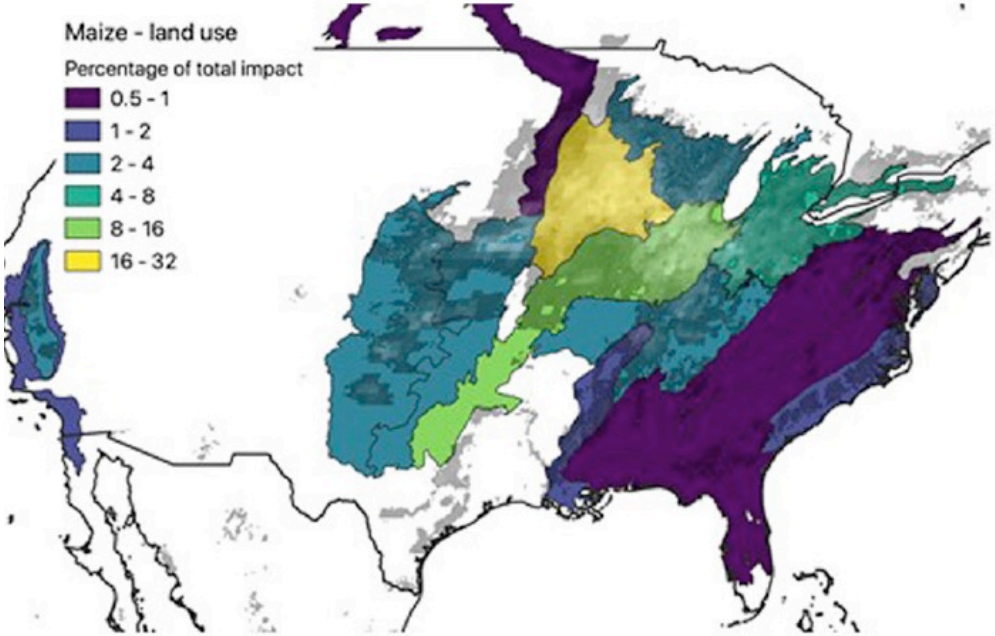


$CF_{reg,tra,avg}$ [PDF · years/m^2]

1e−11 1e−09 1e−07

Kuipers et al. 2021

How are impacts of land stress distributed?



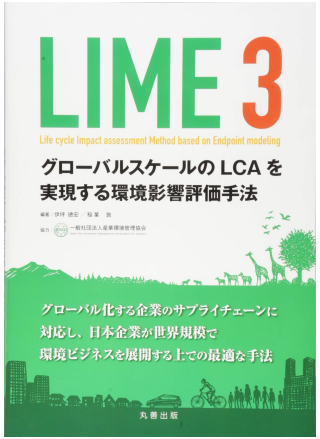
(a)

Verones et al. (2020)

How do existing LCIA methods cover biodiversity?

EDIP

LC-IMPACT



www.universiteitleiden.nl
CML-IA
Characterisation
Factors - Leiden
University

IMPACT World+ ™

TRACI
Tool for the Reduction and
Assessment Of Chemical and
Other Environmental Impacts

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How do existing LCIA methods cover biodiversity?

- Endpoint focus here

Name of AoP	Metric
Biodiversity	NEX
Biodiversity	EINES
Ecosystem quality	Species*yr
Ecosystem quality	PDF
Ecosystem quality	Global PDF

Based on Annex to Chapter 10 in Hauschild (2018)

PDF ≠ PDF

- local?
- global!
- include global extinction probability

http://www.thebluedotpost.com/why-biodiversity-and-the-interconnected-web-of-life-are-important/

Global extinction potential (GEP)

$$GEP_j = \sum_p \frac{\sum_s \frac{o_{s,p,j} \cdot TL_s}{\sum_{p,j} o_{s,p,j}}}{\sum_s TL_s}$$

- TL
  - 6 (7) classes (LC, NT, VU, EN, CR, EX, DD)
  - information about already occurring threats
- Endemism (o)
  - potential range area
  - indication about vulnerability towards habitat loss

o = occurrence
TL = threat level
s = species
p = cell/pixel
j = ecoregion

Kuipers et al. (2019)

https://www.flickr.com/photos/geografia/42571252497
https://en.wikipedia.org/wiki/Sooty_albatross

How do existing LCIA methods cover biodiversity?

	EPS 2000	Eco-Indicator99	IMPACT 2002+	LIME 1	LIME 2	ReCiPe	IMPACT World+	LC-IMPACT
Climate change						X	X	X
Photochemical ozone				X	X			X
Ecotoxicity	X	X	X	X	X	X	X	X
Eutrophication	X	X	X	X	X	X	X	X
Acidification		X	X	X	X	X	X	X
Land Use	X	X	X	X	X	X	X	X
Water Use						X	X	X
Waste					X			

Based on Annex to Chapter 10 in Hauschild (2018)

How do existing LCIA methods cover biodiversity?

	EPS 2000	Eco-Indicator99	IMPACT 2002+	LIME 1	LIME 2	ReCiPe	IMPACT World+	LC-IMPACT
SimaPro	X	superseded				X	(X)	(X)
openLCA		X	X			X	X	
Brightway	X	superseded	X			X		
GABI		X	X			X		

So… What have you learnt?

https://www.undp.org/publications/biodiversity-and-2030-agenda-sustainable-development

And now?

ATLANTIS

https://en.m.wikipedia.org/wiki/File:World_ocean_map_5_oceans.gif