CHALMERS
UNIVERSITY OF TECHNOLOGY

BIODIVERSITY IN LIFE CYCLE ASSESSMENT (LCA)

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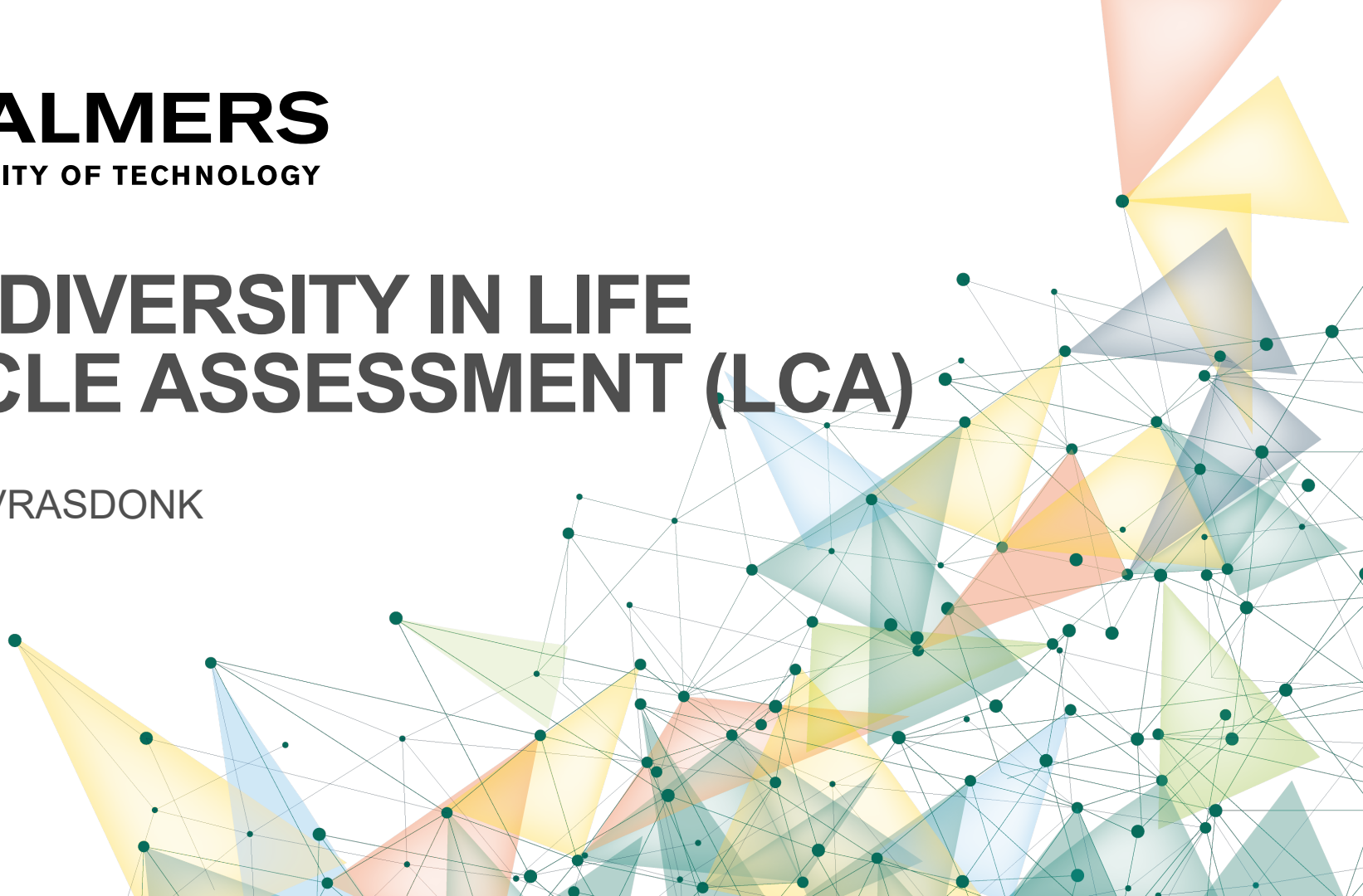


Challenges

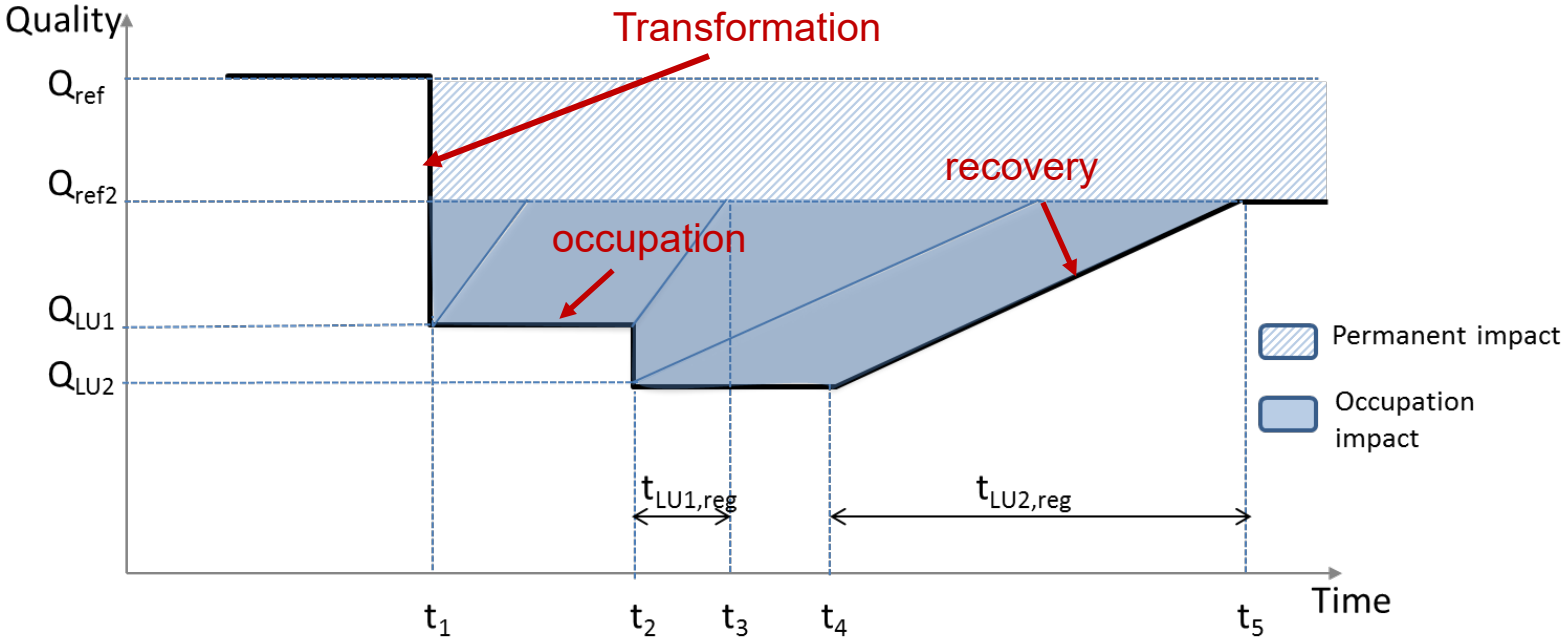
Conceptual

- What aspects of biodiversity to include?
- Indicators for biodiversity
- Scale- locality, region, planet?

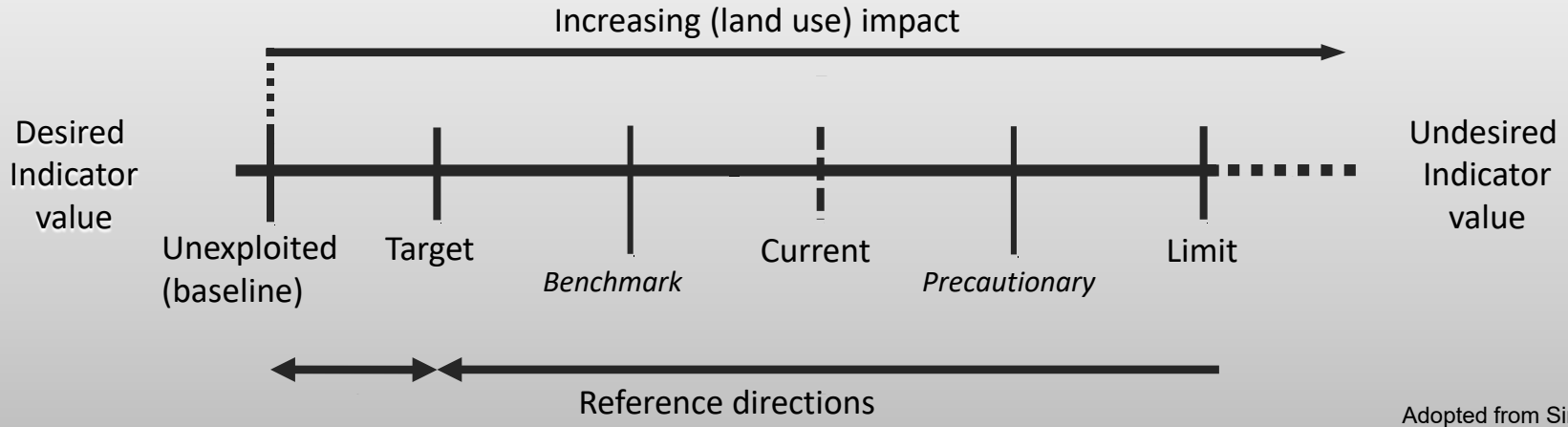
Data issues

- Data availability
- Knowledge on biological responses
- Land use maps and classification
- Traceability of supply chain

Current framework: Land use impacts in LCA



On reference situations



Adopted from Simon and Dulvy
ICES J. Mar. Sci. 2005;62:397-404

Baseline: Reference free from human pressure

- i.e. Pre-anthropogenic, protected / remote areas, Potential Natural Vegetation (PNV)

Biodiversity conservation frameworks

- “Living in harmony with nature” and “By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people” (UN CBD, 2010)

- European Species and habitats Directive: maintaining or restoring protected habitats and species (council directive 92/43 EEC)

So far, LCIA models are rarely based on reference situations used in society’s conservation frameworks

Black-tailed godwit (*Limosa limosa*)

https://www.flickr.com/photos/mukluk/4404494350

Which indicators for Biodiversity?

'the variability among living organisms from all sources, including, inter alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'

United Nations, 1992

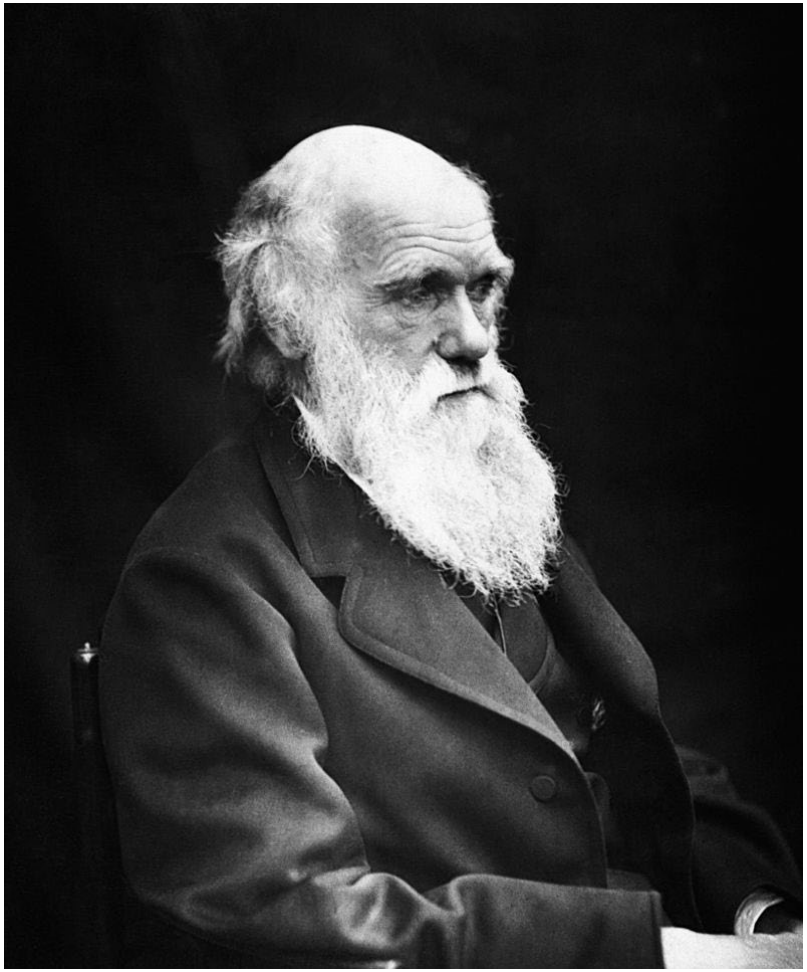
Current practice; indicators

No consensus on which indicators to use

Two main directions:

- Species richness
- Function of ecological conditions (i.e. deadwood availability)

- Other: Functional diversity

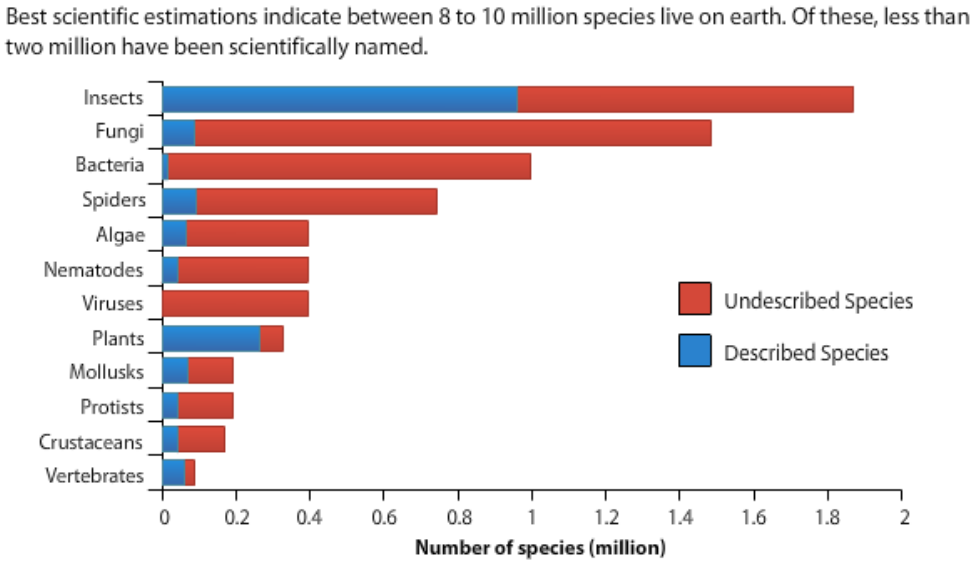


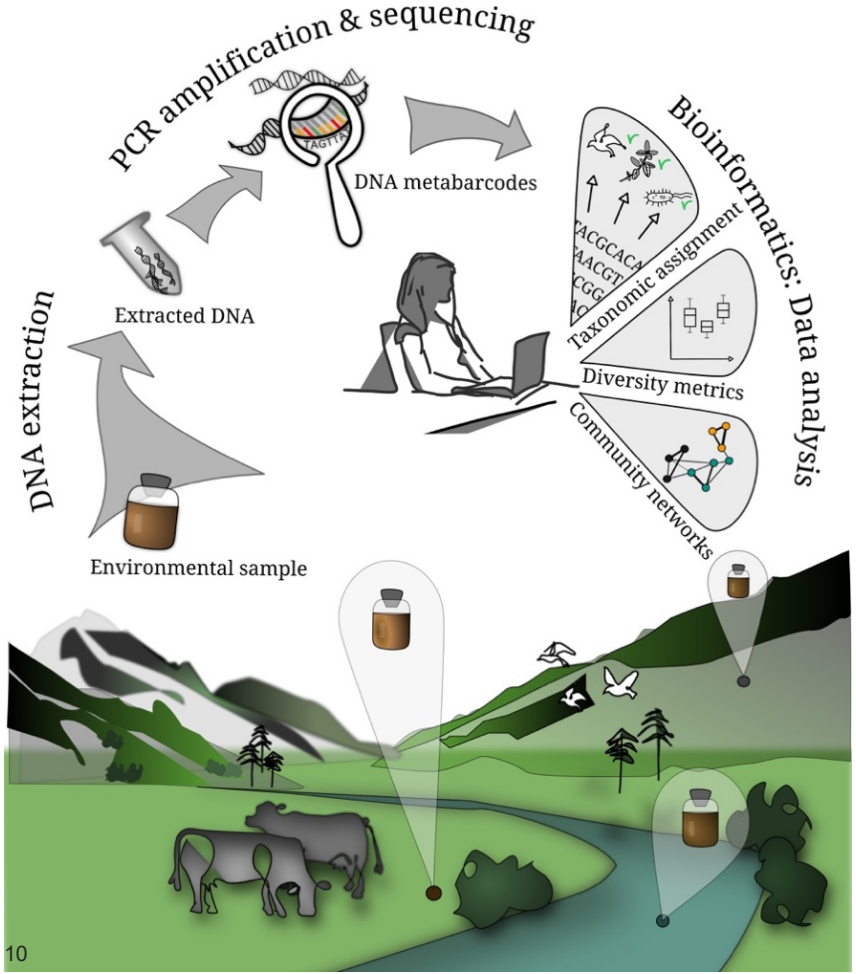
Genetics and resilience of ecosystems

- Evolutionary processes constitute the ‘option’ on future biodiversity; mutation, selection and diversification produce new biodiversity for new environments
- Genetics: currently a missing level in Life Cycle Impact Assessment Models

Why including a genetic indicator?

- Genetic samples from the environment cover a much larger proportion of the biodiversity, compared to conventional biodiversity inventories
  - Capturing biodiversity more effectively and efficiently
  - Besides macro-organisms, measure for micro-organisms, insects and fungi
  - No manual identification of specimens





eDNA metabarcoding

The workflow

Data availability

Globally available eDNA data

- Monitoring programs
  - Land Use /Cover Area frame Survey (LUCAS) (EU)
- International open-access repositories
  - Gathering individual studies
  - i.e. Dryad Digital Repository
  - Earth Microbiome Project

What is needed to include eDNA based indicators in LCA?

- Understanding uncertainties
- Standardisation and comparability
- Validation of approaches

Causes of uncertainties

False positive and false negative occurrences due to:

- Laboratory and bioinformatic workflow causing bias
- Knowledge about the ‘nature’ of eDNA: fate, transportation and leaching

What is needed to include eDNA based indicators in LCA?

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Standardisation

- In the lab
- Study design:
  - Indicators
  - Sample strategy
  - metadata

What is needed to include eDNA based indicators in LCA?

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Validation of approaches

- Case studies
- Recommendation: first attempts focussing on soil samples, targeting soil biodiversity

Take home messages

- ***Recommendations** for LCIA development*;
  - Align LCIA models with biodiversity conservation frameworks
  - Distance to target measures
- ***eDNA metabarcoding***; huge potential for biodiversity assessments
  - Some uncertainties and standardisation needed
  - soil biodiversity?

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