



Risks and benefits of new genomic techniques (NGTs)

An ecological perspective on the EU Commission's proposal

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NGTs are...

an alleged **attempt to solve problems at a high organizational (ecological to global) level with methods on a molecular level**



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New genomic techniques from an ecological and environmental perspective: science-based contributions to the proposed regulations by the EU Commission

https://gfoe.org/sites/default/files/ngt_gfoe_final.pdf



Scales of ecological science

topics

biosphere

landscape

ecosystem

community

population

individual

cells

molecules

nutrient cycles
climate change

ecosystem function

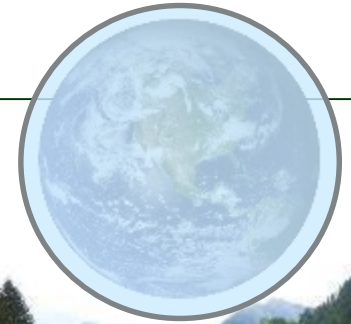
novel organisms

biodiversity

yield

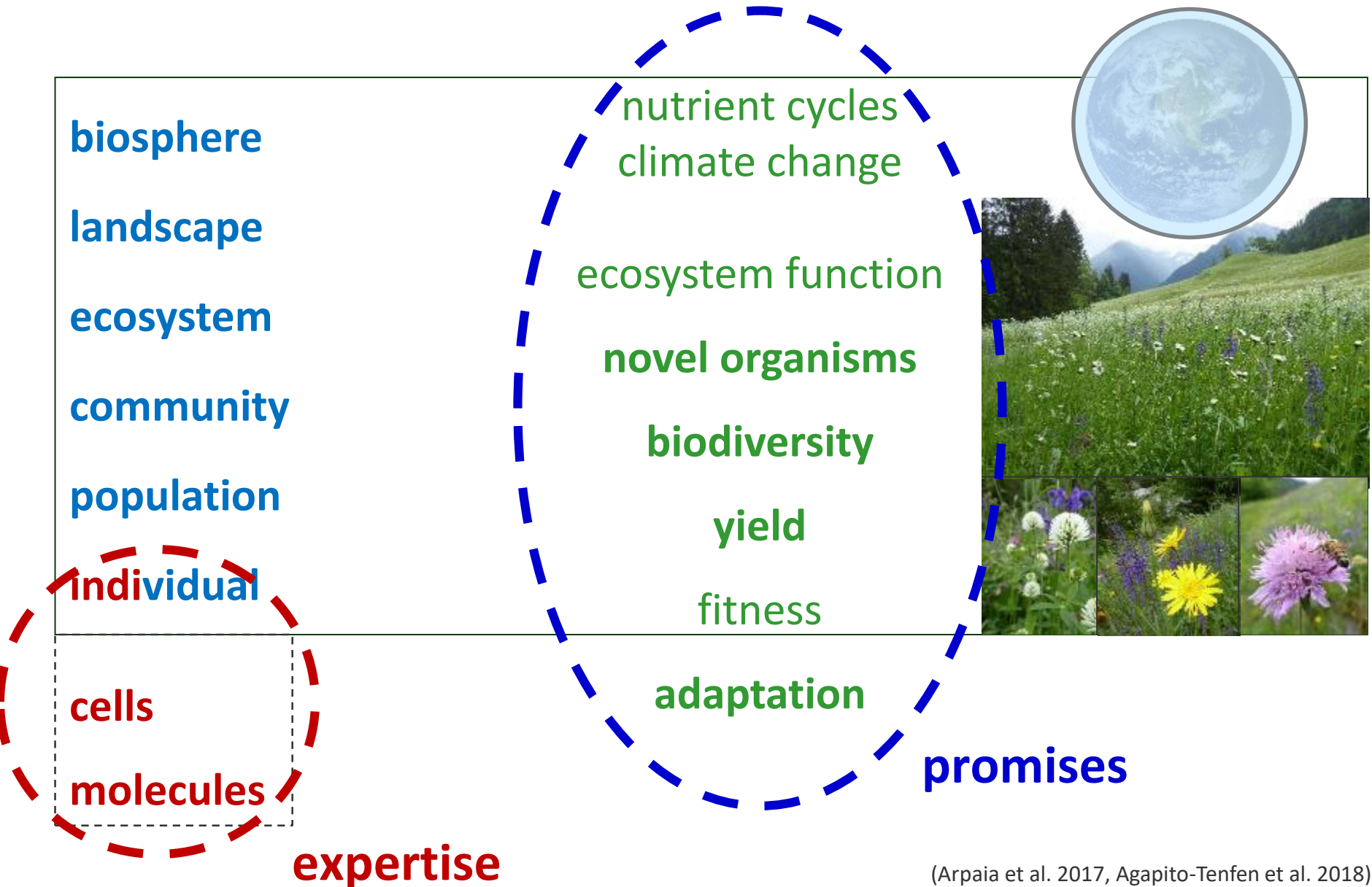
fitness

adaptation





Scale of NGT promises and risk assessments

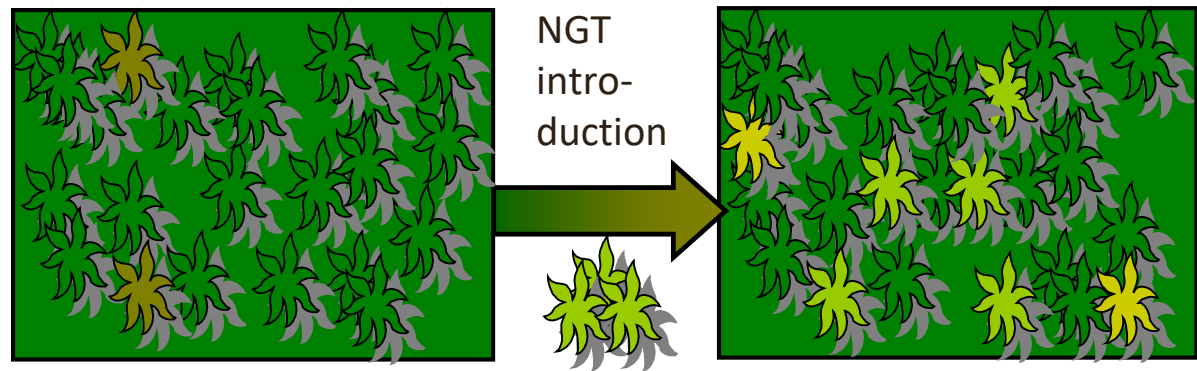




Main risk: negative consequences of outcrossing of novel plants into the wild

a) Outbreeding depression: overlooked (e.g. Montalvo & Ellstrand 2001)

'genetic swamping'
with maladapted
genotypes



→ International (Convention of Biodiversity, CBD) and national (e.g. §40 Abs. 2 Satz 3 BNatSchG) laws protect **genetic integrity of natural populations** by not permitting introductions of non-local genotypes into wild populations

b) Aggressive spread – insights from invasion ecology



“The movement of transgenes beyond their intended destinations is a virtual certainty.” Marvier and Van Acker 2005

Ellstrand 2018: meta-study on existing GMOs (>1000 populations): 14 examples for introgression of GMO genetic material into the wild

Outcrossing is promoted by:

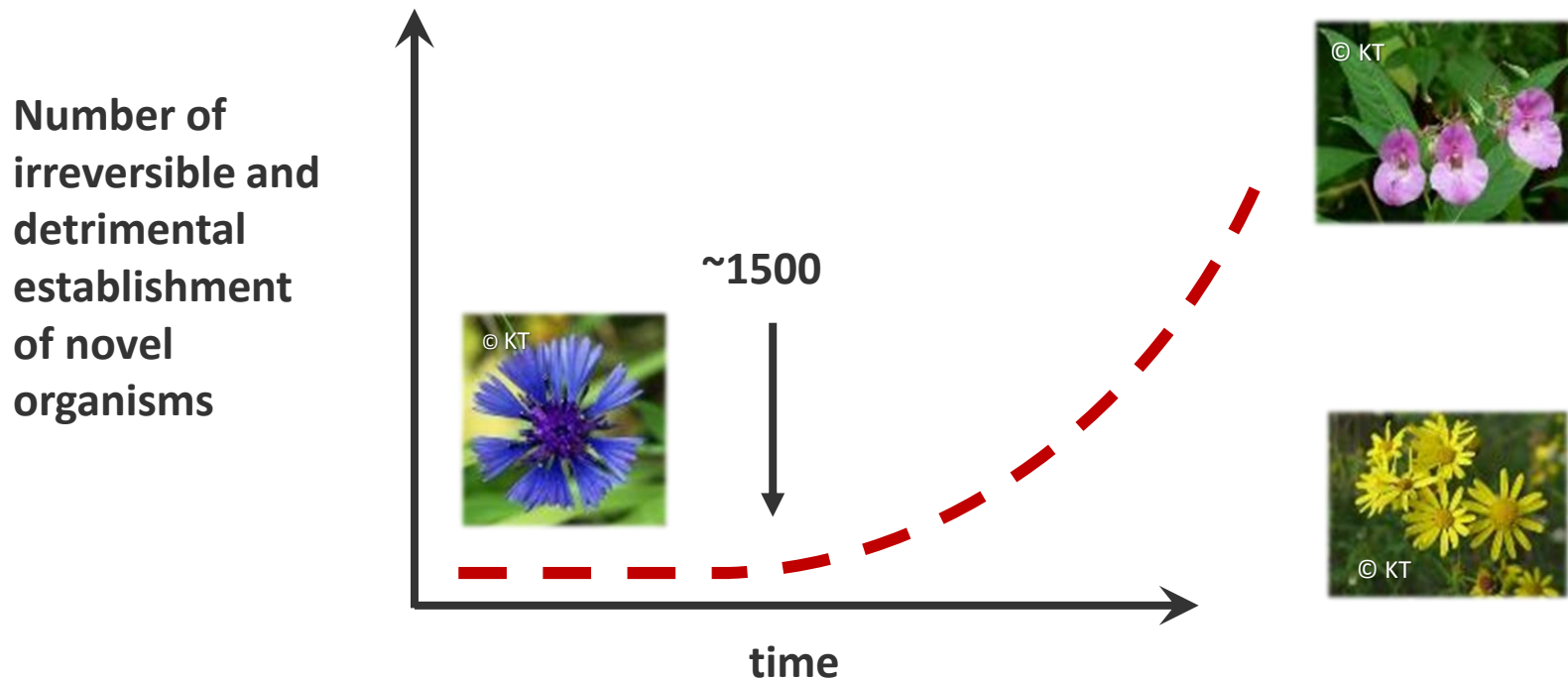
- a) **Relatedness** (intraspecific: 100%, crop → wild relative: very high)
- b) **Proximity** (wild to wild: 100%, crop-to-wild: distance-dependent)
- c) **Number** of novel genotypes and individuals
- d) **Time** since introduction



1) Unwanted effects of novel organisms is a virtual certainty if the number of newly introduced organisms is large

“law of large numbers”

Lockwood et al. 2009





2) Invasions manifest after a **lag phase**
(i.e. initial monitoring does not detect the risk)



3) Invasions are irreversible

4) Invasions are inherently unpredictable!

Scientific ecological knowledge must call for precautionary principle and case-by case risk assessment prior to introduction



EU-Commissions proposal(s):

categorization into NGT1 and NGT2 based solely on quantitative molecular criteria, **none of which has a solid scientific basis**

(→ random change among different versions of the proposal)

Science does know:

a) environmental risk : **SOLELY DETERMINED BY THE PHENOTYPE**

b) number of genetic changes is immaterial, it is the location and depth of change determining the phenotype

→ categorization of 'risk' or 'equivalence to' based on quantitative **molecular criteria is meaningless** for risk



What is NEW in NGT vs. classical breeding?

1) Large numbers

→ larger likelihood of outcrossing & larger risk

2) Completely novel phenotypes (larger depth of manipulation)

→ larger likelihood for unprecedented ecological effects

3) In the EU-Commission's proposal:

Application deregulated for ALL PLANT SPECIES*

→ i.e. almost 100% likelihood of outcrossing, very high risk

4) new proposal

bacteria on the horizon

*ca. 300,000 species (Mora et al. 2011)





Application to all plants is irresponsible

Genetic integrity of wild plants must be maintained to enable natural evolutionary processes

release of wild plant NGTs into wild populations is **at odds with international and national legislation** preventing 'genetic contamination'

Unregulated NGT applications in the wild pose an unprecedented danger to wild populations, communities and ecosystems

NGT plants, and more so bacteria, can NOT be removed from nature





Application to all plants is not needed

Proposal and debate: exclusively about application of NGT for food and feed

→ extension to wild plants is not only dangerous, but not even relevant, raising the question why it has been introduced

No 'history of safe use' for genetic modification or breeding of 300,000 wild plant species and introduction into the wild

'Equivalence to breeding-idea' is **irrelevant for wild populations**

NGT1- criteria can (and must) not apply





Science calls for a clear protection of wild plant species from any type of deregulation, i.e. a case-by-case risk assessment prior to release into the wild, consistent with the precautionary principle*

and no release of bacteria

*not precluding domestication





Proposal: NGT contributes to sustainability /EU Green Deal

**Benefits for sustainability and environmental protection:
no scientific evidence**

**Benefits for climate adaptation
no scientific evidence**

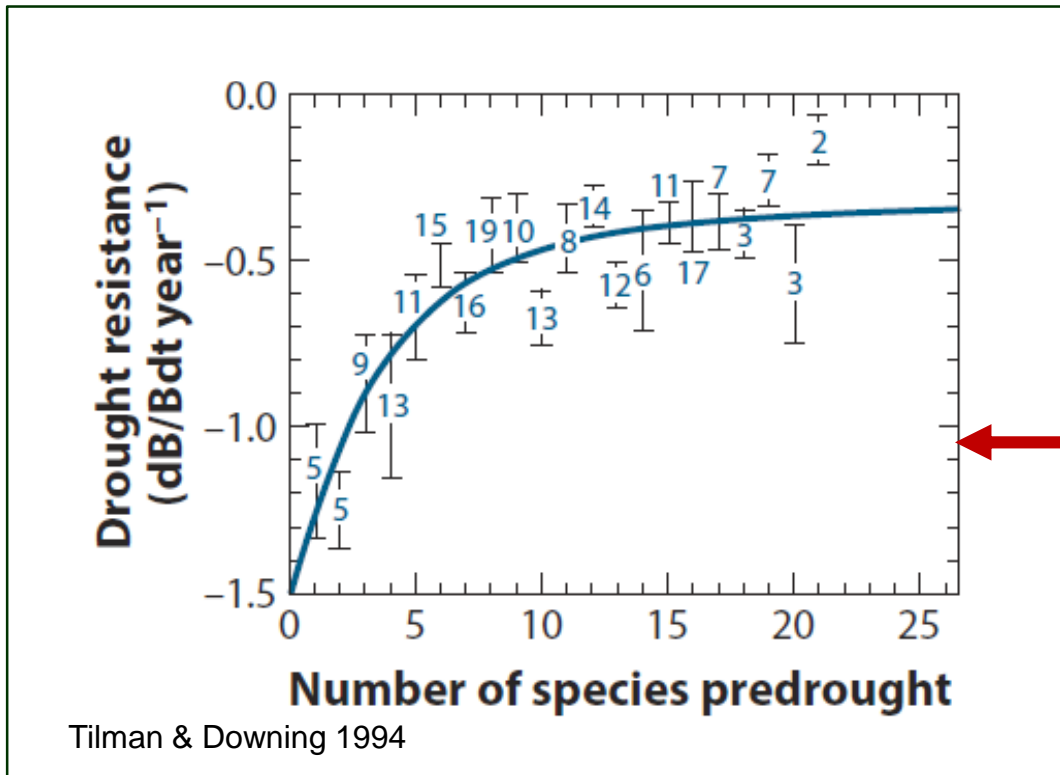


**Scientific evidence: monocultures = ultimate cause for
unsustainability and lack of resistance to (climate) change**

**Benefits are an assumption with no evidence in favor but
evidence against - if NGT are used within the current system**



What we know (myriads of agro-ecological studies)



Biodiversity promotes

Productivity (yield)

Yield stability

Resistance & resilience

nutrient cycle

pathogen resistance

resistance to weed invasion



e.g., insurance effect or portfolio-effect

(Markowitz 1952, Yachi & Loreau 1999, Tilman et al. 2014)

RESEARCH

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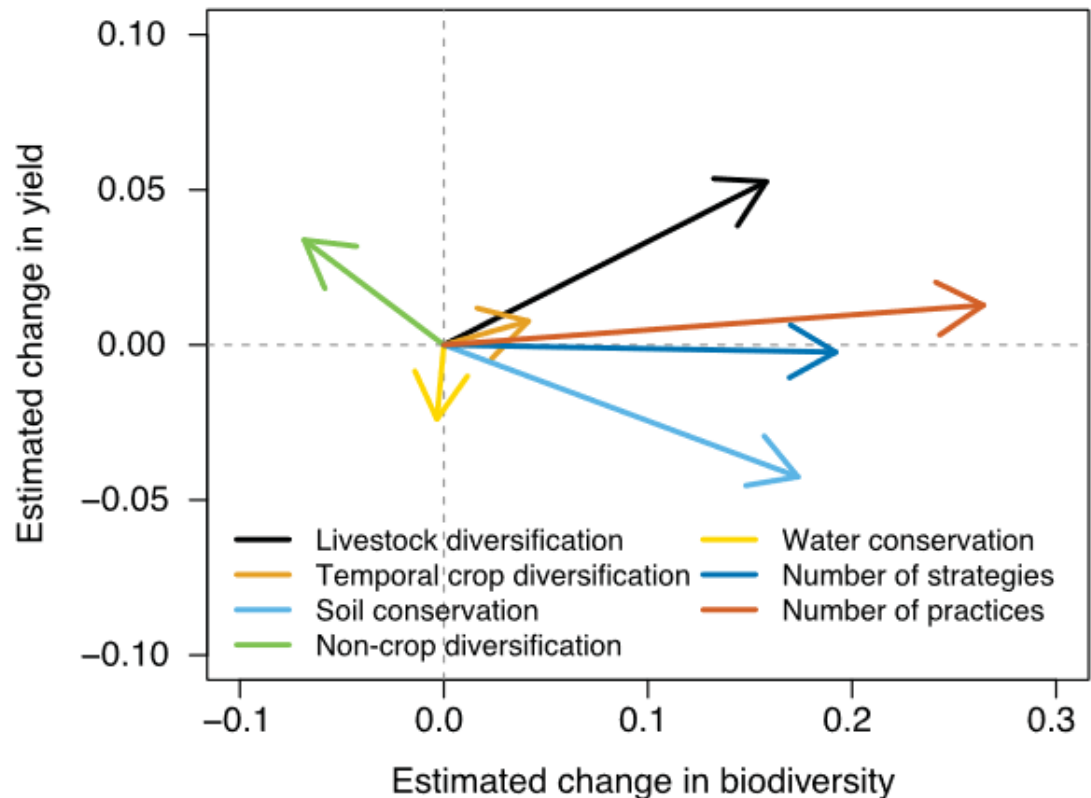
FARMING PRACTICES

Joint environmental and social benefits from diversified agriculture

Laura Vang Rasmussen^{1*,†}, Ingo Grass^{2,3,†}, Zia Mehrabi^{4,5,6}, Olivia M. Smith^{7,8}, Rachel Bezner-Kerr⁹, Jennifer Blesh¹⁰, Lucas Alejandro Garibaldi^{11,12}, Marney E. Isaac¹³, Christina M. Kennedy¹⁴, Hannah Wittman^{15,16}, Péter Rátár¹⁷, Damavanti Ruchori¹⁸, Rolando Cerda¹⁹, Julián Chará²⁰

diversification enhances:

- yield
- food security
- biodiversity
- ecosystem services
- social-well being
- (and many more)





Fast, safe, highly efficient, socially just solutions are at hand, that are supported by very extensive scientific evidence

NGTs may have a potential (in agriculture), but are still in a stage of promises

If Europe wants to be **spearheading an agricultural revolution**, we should apply attestedly fast, cheap, and efficient methods



Summary GFÖ-Statement

- 1) EU Commission proposal **ignores fundamental scientific principles** about environmental risks & benefits
- 2) **Deregulating NGT1 for all plant species** (and bacteria/animals) are a **serious threat for biodiversity conservation & sustainability**
- 3) **Quantitative molecular criteria** are **irrelevant** for environmental risks
→ **Precautionary principle** with case-by case risk assessment
- 4) **Diversification** guarantees **yield stability, low environmental impact, high resistance and resilience, and social justice**

Science-based, fast, and efficient solutions to the global polycrises **should be prioritized** for meeting the goals of the EU Green Deal





Questions?

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https://gfoe.org/sites/default/files/ngt_gfoe_final.pdf