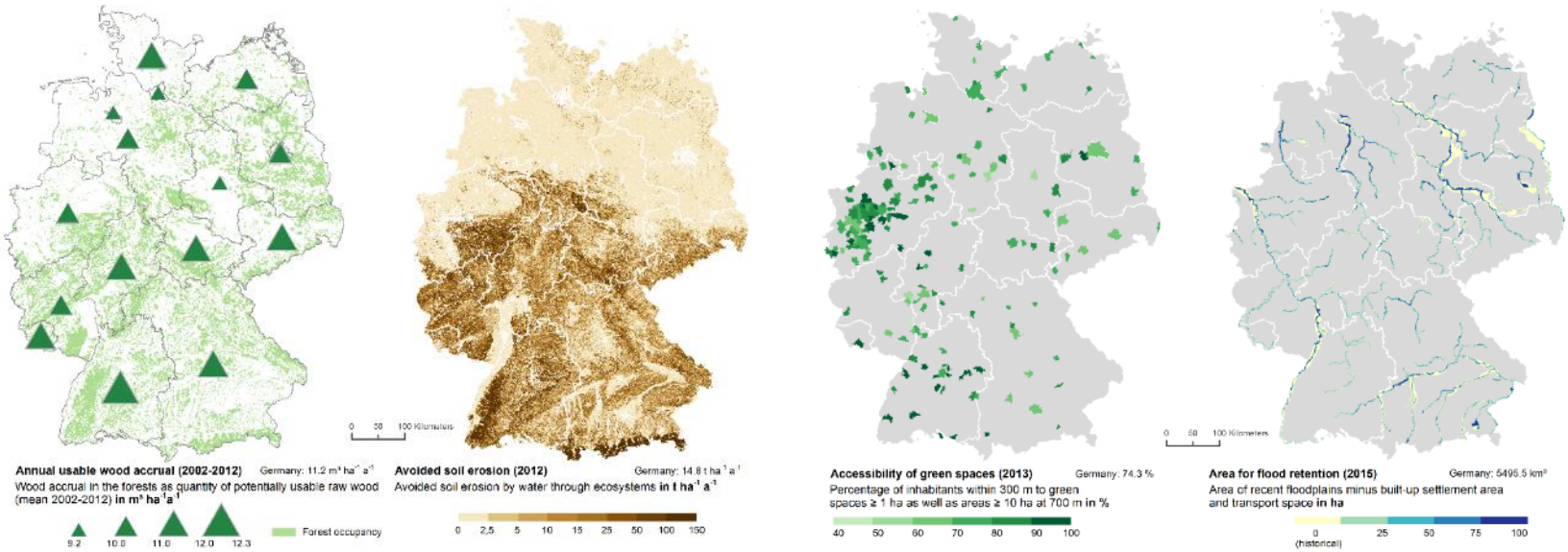
Virtual Expert Forum on SEEA Experimental Ecosystem Accounting, August 24-25, 2020

Biophysical quantification of ecosystem services in Germany



Benjamin Burkhard (Leibniz University Hannover)
Karsten Grunewald (IOER Dresden)
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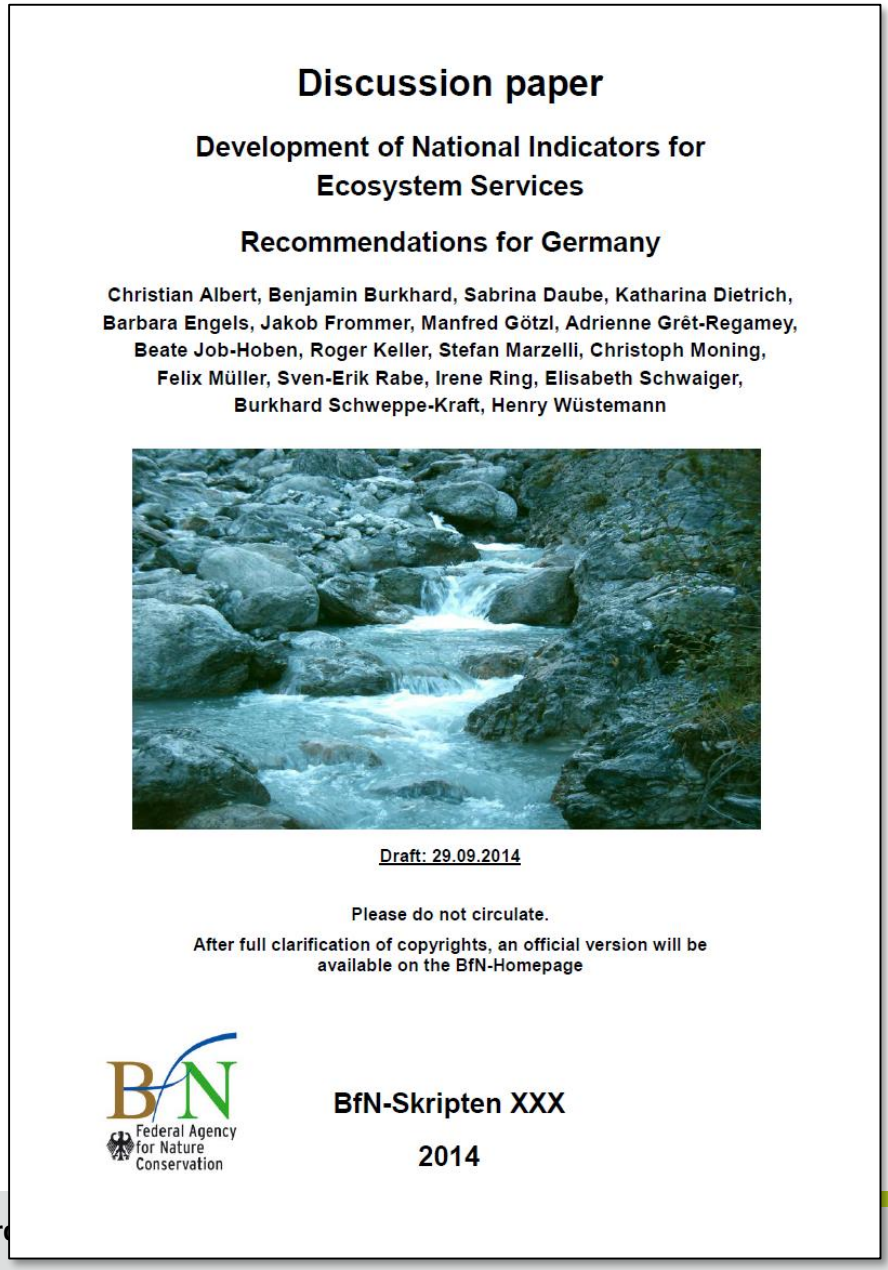
Background

- The **EU Biodiversity Strategy 2020** asks all EU member state to map and assess the state of their biodiversity, ecosystems and the services they deliver
- Mapping and Assessment of Ecosystems and their Services (**MAES**) includes:
  (1) mapping the ecosystems,
  (2) assessing ecosystem conditions,
  (3) assessing ecosystem services and
  (4) integrated ecosystem assessment with connection to natural capital accounting.
- MAES outcomes are to be integrated in national as well as EU **reporting systems** (by 2020)
- In Germany, the Federal Nature Conservation Agency (the state authority responsible for MAES in Germany) has been funding related research and development projects
- Together with other related institutions and projects (such as "*Naturkapital Deutschland*" TEEB-DE or EU H2020 ESMERALDA and MAIA), ES indicators, maps and accounting systems for Germany have been developed

Indicator development

- Prioritization of ES classes based on expert assessment
- 21 of the 48 CICES classes (Common International Classification of Ecosystem Services) were most relevant for Germany in recent years



Discussion paper

Development of National Indicators for Ecosystem Services

Recommendations for Germany

Christian Albert, Benjamin Burkhard, Sabrina Daube, Katharina Dietrich, Barbara Engels, Jakob Frommer, Manfred Götzl, Adrienne Grêt-Regamey, Beate Job-Hoben, Roger Keller, Stefan Marzelli, Christoph Moning, Felix Müller, Sven-Erik Rabe, Irene Ring, Elisabeth Schwaiger, Burkhard Schweppe-Kraft, Henry Wüstemann

Draft: 29.09.2014

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BfN Federal Agency for Nature Conservation

BfN-Skripten XXX

2014

Indicator development

- A total of 51 indicators were accepted and published by the end of 2016
- Differentiation of ES delivery in ES supply and demand

Ecological Indicators 61 (2016) 38–48

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Towards a national set of ecosystem service indicators: Insights from Germany

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ABSTRACT

Target 2, Action 5 of the EU Biodiversity Strategy requests member states "to map and assess ecosystems and their services" (Mapping and Assessment of Ecosystems and their Services – MAES initiative). The objective of this paper is to present and discuss the preliminary outcomes of the approach taken to define indicators for implementing MAES in Germany. The paper introduces the requirements for using indicators from a perspective of nature conservation policy, in particular the need to discern the demand and supply of ecosystem services, including their potentials, actual and future use, as well as the natural contributions and human inputs to the generation of ecosystem services. An adapted, differentiated, ecosystem services terminology is presented and a first set of indicators is introduced and explained. The paper closes with an estimate of potential benefits of information produced by implementation of a

Indicator

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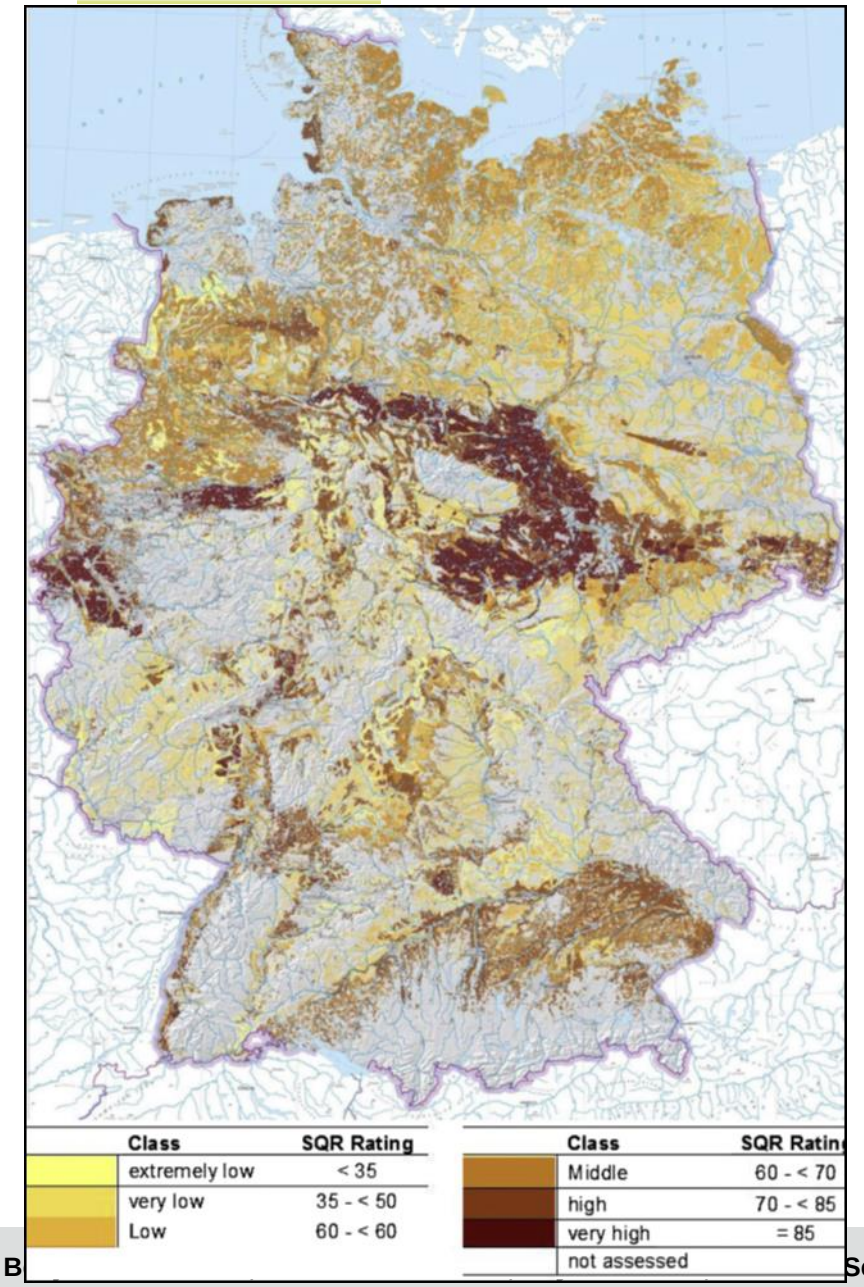
Table 1
First set of ecosystem service indicators, juxtaposing supply and demand. Respective indicator values can be used to identify and quantify supply and demand mismatches of individual ecosystem services.

CICES "Section"	CICES "Division"	Ecosystem services	Supply indicators (using: ecosystem services potentials as a proxy)	Demand indicators
Provisioning services 1*)	Nutrition materials energy	Providing food and bio-energy from fields	Natural fertility of arable soils	2*)
		Providing fodder from grasslands	Proportion of grasslands in agricultural areas (contribution to animal production)	2*), 3*)
		Providing timber products	Timber stocks (sustainable yield by logging)	2*)
Regulation & maintenance services	Regulation (decomposition, sequestration, etc.) of toxins and waste	Regulating water quality by waterways	Naturalness of river beds and floodplains	Current water quality below water quality standards
		Regulating groundwater quality	Proportion of forest and grassland	Proximity of drinking water wells, water protection areas
			Protection of soils and geological layers	
	Mediation of flows	Mitigating erosion	Proportion of area with a certain minimum ground coverage by continuous vegetation cover	Active floodplains, areas of steep slopes, areas with sandy soils (easily blown away when dry)
			Proportion of natural and semi-natural small structures in the agricultural landscape	
		Mitigating flood hazards	Water retention capacity in flood plains	4*)
	Maintenance of physical, chemical, biological conditions	Facilitating pollination and biological pest control	Proportion of natural and semi-natural small structures in agricultural landscapes	Proportion of arable crops demanding insect pollination
		Storing greenhouse gases	Surfaces of drained/rewetted peatlands	2*)
		Mitigating greenhouse gas emissions	Contribution of land use change and forestry	2*)
		Regulating local climate and air quality	Proportion of green spaces in settlement areas	Degrees of population density, settlement extent, exposure to air pollutants and adverse urban climate effects
Cultural services	Physical and intellectual interactions with biota, ecosystems, and landscapes	Providing opportunities for recreation	Recreational functions of variable ecosystem characteristics (e.g. naturalness, diversity, privacy, supply of specific uses)	Degree of population density, proximity to settlement centres, and designated recreational regions
		Providing opportunities for recreation in urban areas	Proportion of green spaces in urban areas, accessibility of urban green areas	Degree of population density and settlements of certain size

Background: Preliminary set of ecosystem service indicators as suggested by Marzelli et al. (2014a) and supplemented by additional expert consultations and literature considerations.
Explanations:
1*) The suggested indicators do not address ecosystem services supply as the combination of natural and human contributions to ecosystem services generation as this might be contradictory to nature conservation purposes. Instead, indicators for ecosystem services potentials are used. This is particularly relevant for provisioning ecosystem services. For more detailed explanation, please see the manuscript text.
2*) Global supply and demand patterns, spatial localisation difficult and not required in this context.
3*) The indicator "area of grasslands used for fodder production" would be, of course, more targeted on fodder production, whereas the "proportion of grasslands" can better help to point out additional grassland services e.g. for freshwater supply, erosion mitigation or cultural services more explicitly. A decision between alternatives should be based on a test of the whole set.
4*) Relationship between water retention and reduced damage currently only inaccurately modelled in Germany.

Albert et al. (2016) – *Ecological Indicators*

Biophysical quantification of ecosystem services in Germany



Provisioning ES (potential) food and bio-energy from fields

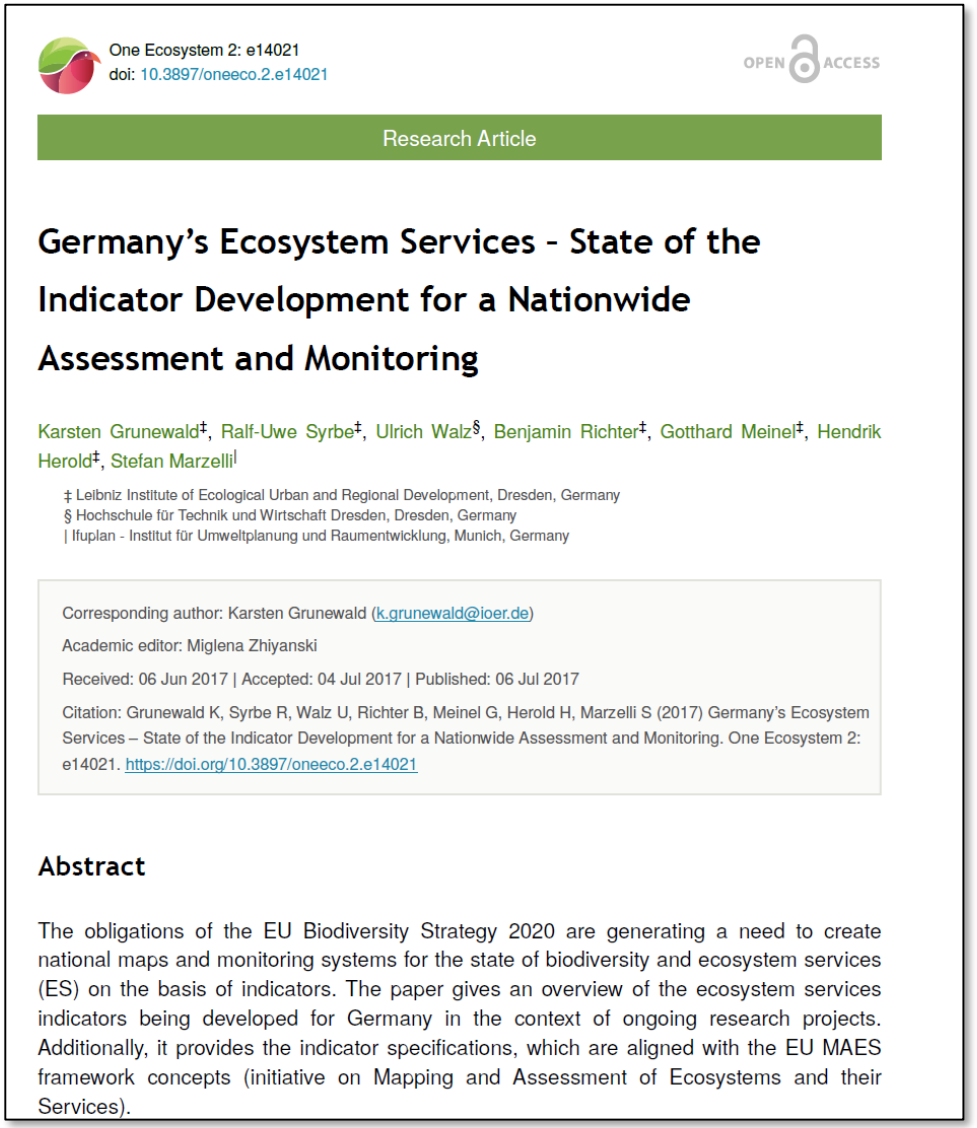
Based on agricultural yield potential (Müncheberg Soil Quality Rating)

Data source: SQR1000 V1.0, (C) BGR, Hannover (2013).

Albert et al. (2016) – *Ecological Indicators*

Indicator development

- Only selected ES indicators of relevance are implemented and monitored in Germany (different to other countries)
- For each ES, detailed specification sheets describing the indicator were developed



One Ecosystem 2: e14021
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OPEN ACCESS
Research Article

Germany's Ecosystem Services - State of the Indicator Development for a Nationwide Assessment and Monitoring

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Abstract

The obligations of the EU Biodiversity Strategy 2020 are generating a need to create national maps and monitoring systems for the state of biodiversity and ecosystem services (ES) on the basis of indicators. The paper gives an overview of the ecosystem services indicators being developed for Germany in the context of ongoing research projects. Additionally, it provides the indicator specifications, which are aligned with the EU MAES framework concepts (initiative on Mapping and Assessment of Ecosystems and their Services).

https://oneecosystem.pensoft.net/article/14021/

Grunewald et al. (2017) – *One Ecosystem*

Indicator examples

CICES ES class	Indicators M = Main indicator S = supplementary indicator	Average value for all of Germany (year)
Fibres and other materials from plants, algae and animals for direct use or processing (forest wood material)	**M Annual usable wood accrual**	11.2 m^3 ha^{-1} a^{-1} (mean value 2002-2012)
	S1 Forest area	11,419,124 ha (2015)
	S2 Wood stock	forest area 336 m^3 ha^{-1} (2012)
	S3 Development of the annual logging and wood utilization	40.2 million tons (2013)
	S4 Change in wood stock as balance of growth and extraction	increase of 106.6% (2002-2012)
	S5 Proportion of near-natural forest areas	15% natural; 22% near-natural (2012)
	S6 Proportion of unfragmented forests > 50 km^2 in reference area	3.5% (2014)
Flood protection	**M Area for flood retention**	547,550 ha (2015)
	S Proportion of built-up areas in the current floodplain	3.9 % (22,076 ha) in 2015

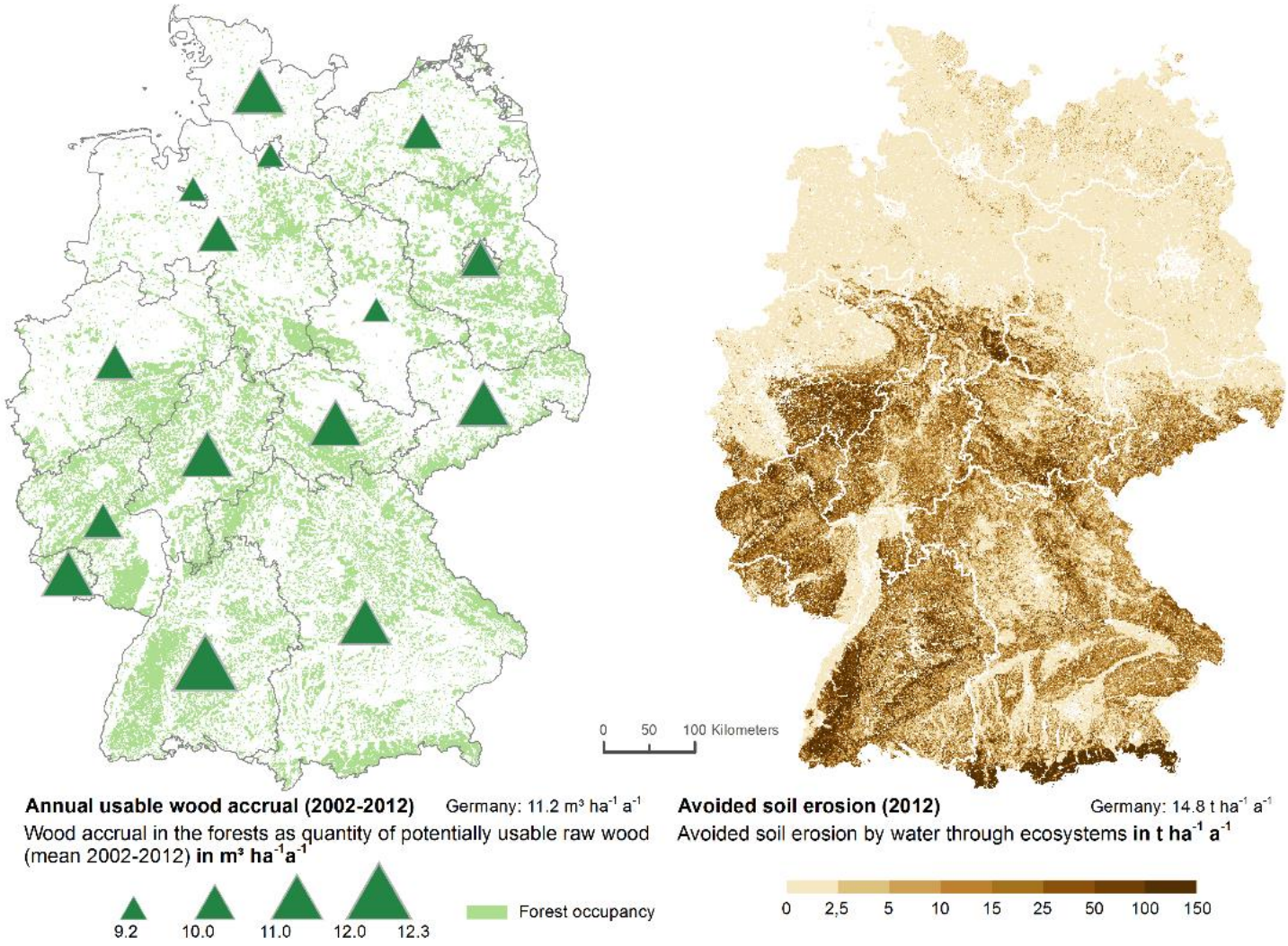
Grunewald et al. (2017) – *One Ecosystem*

Indicator examples

CICES ES class	Indicators M = Main indicator S = supplementary indicator	Average value for all of Germany (year)
Mass stabilization and **control of erosion rates**	**M Avoided water erosion**	14.8 t ha^{-1} a^{-1} (2012)
	S1 Actual water erosion	1.4 t ha^{-1} a^{-1} (2012)
	S2 Water erosion avoided by small landscape structures	0.5 t ha^{-1} a^{-1} (2012)
	S3 Proportion of organic farming	1.9% of arable land (2012)
Experiential **use of plants, animals and land-/seascapes** and **physical use of land-/seascapes** in different environmental settings (= 2 CICES-classes)	**M Accessibility of green spaces**	74.3% of city dwellers (2013), calculated for all cities ≥ 50,000 inhabitants
	S Green-space provision per inhabitant related to total amount of green space	250 m² (2013)

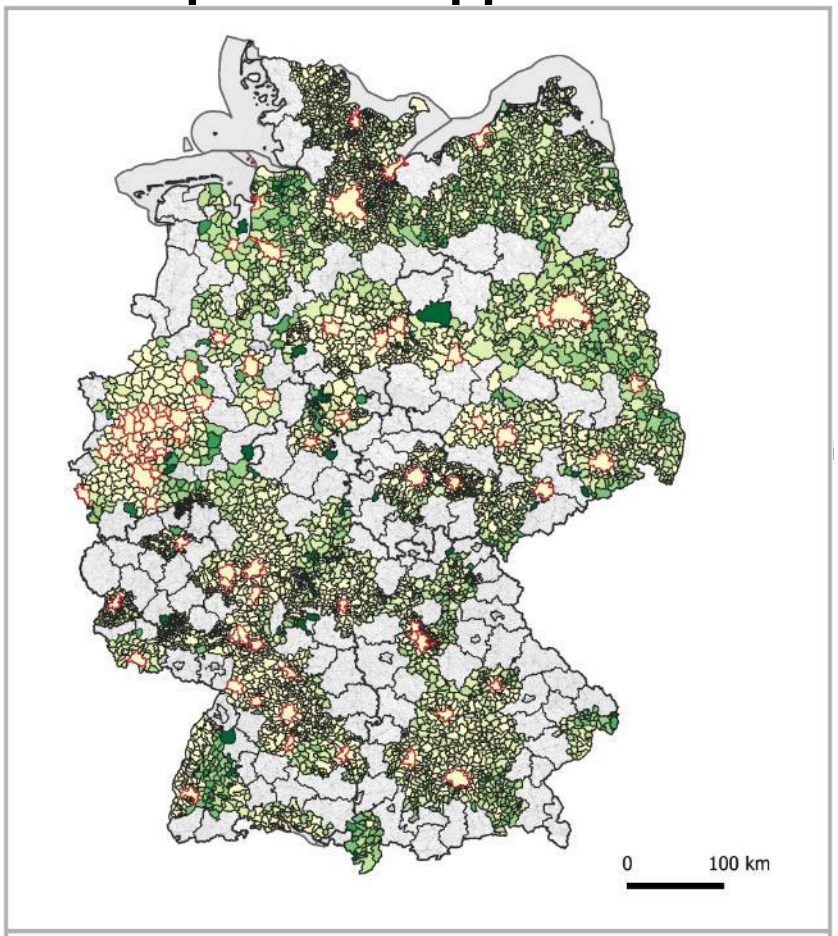
Grunewald et al. (2017) – *One Ecosystem*

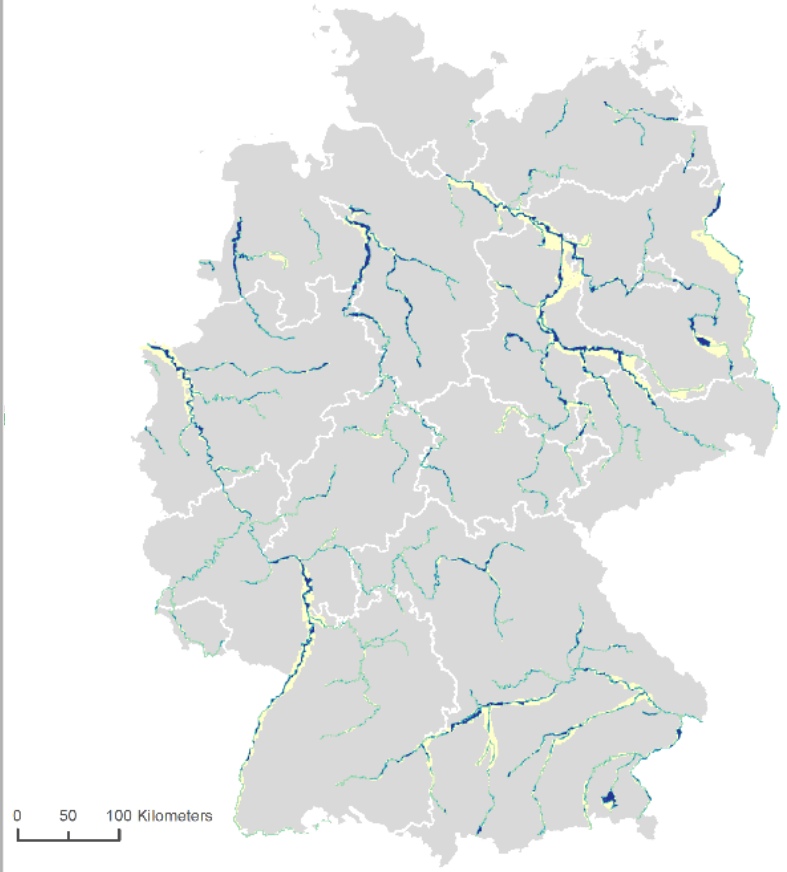
Examples of mapped main indicators



Grunewald et al. (2017) – *One Ecosystem*

Examples of mapped main indicators





Grunewald et al. (2017) – *One Ecosystem*

Further proposed nationwide ES indicators

(some are currently still under development and/or negotiation)

	ES class (according to CICES)	Indicators (first pre-proposal)
Provisioning ES	Groundwater for drinking	M proportion of drinking water extracted (from groundwater) with respect to newly formed groundwater
	Cultivated crops	M Change in yield potential S1 Harvest statistics grain units S2 Proportion of agricultural area S3 Proportion of organic farming
	Reared animals and their outputs	M Stocking density (administrative area) S1 Stocking density (agricultural area) S2 Animal nitrogen fertilizer
	Materials from plants, algae and animals for agricultural use	M Grassland area S Grassland area (agricultural area)
	Plant-based resources	M Area for cultivating non-wood energy crops

Grunewald et al. (2017) – *One Ecosystem*

Further proposed nationwide ES indicators

(some are currently still under development and/or negotiation)

Regulating and maitenance ES

ES class (according to CICES)	Indicators (first pre-proposal)
Filtration/sequestration/storage/accumulation by ecosystems	M Protection potential of the groundwater cover (zone of aeration) S1 Nitrate pollution of groundwater S2 Extraction of drinking water from groundwater S3 Superposition of demand from GW aquifers of different levels of protection potential
Dilution by atmosphere, freshwater and marine ecosystems	M Proportion of waterbodies with good hydromorphological state S1 Biological water quality S2 Demand through use of drinking water S3 Demand by residents for recreational use S4 Chemical state of the surface waters
Pollination and seed dispersal	M Pollination potential S1 Bee colonies in Germany S2 Yield of tree fruits

Grunewald et al. (2017) – *One Ecosystem*

Further proposed nationwide ES indicators

(some are currently still under development and/or negotiation)

Regulating and maitenance ES

ES class (according to CICES)	Indicators (first pre-proposal)
Global climate regulation by reduction of greenhouse gas concentrations	M Annual net effect of ecosystems S1 Absolute value of the CO_2 stock S2 Index of the change in CO_2 stock
Ventilation and transpiration; Micro and regional climate regulation (we combined these two CICES-classes for practical reasons)	M Specific green volume S Population density / degree of sealing
Chemical condition of freshwaters	M1 Denitrification in the waterbody M2 Phosphorus retention in the waterbody
Pest control	M Density of small-scale structures in farmland or in specialty crops
Maintaining nursery populations and habitats	M Main areas of distribution with cultured species of related wild plants

Grunewald et al. (2017) – *One Ecosystem*

Further proposed nationwide ES indicators

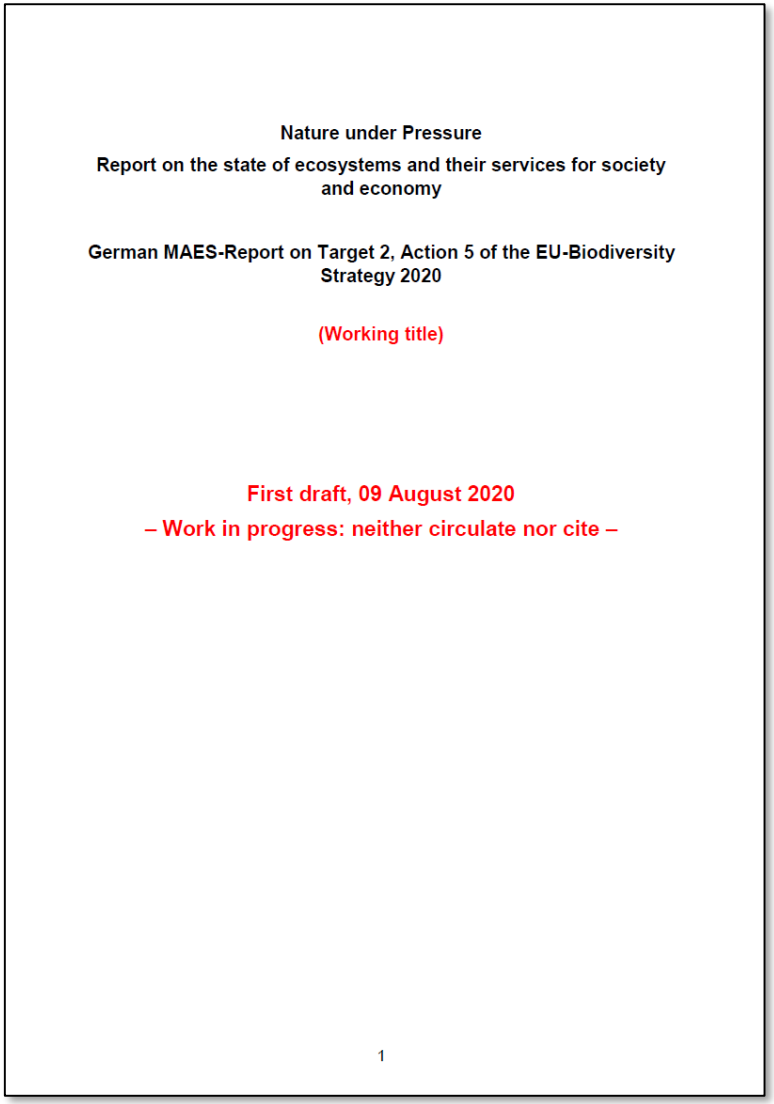
(some are currently still under development and/or negotiation)

	ES class (according to CICES)	Indicators (first pre-proposal)
Cultural ES	Experiential use of plants, animals and land-/seascapes in different environmental settings	M Agricultural potential for leisure-time, daily and weekend recreation
	Aesthetics	M Aesthetic value of the landscapes
	Existence value	M Landscape diversity

Grunewald et al. (2017) – *One Ecosystem*

Outlook

- Finalization of the MAES-related work
- Improvement of the selected quantifications
- Integration of biophysical and social-cultural as well as economic indicators
- MAES-DE indicators to be used in different policies (e.g. agriculture, forestry, tourism, planning, flood control)
- MAES-DE indicators as a nationwide data base for enhanced landscape planning



Nature under Pressure

Report on the state of ecosystems and their services for society and economy

German MAES-Report on Target 2, Action 5 of the EU-Biodiversity Strategy 2020

(Working title)

First draft, 09 August 2020

– Work in progress: neither circulate nor cite –

1

Outlook

- National Ecosystem Assessment (NEA-DE)?

Towards a *National Ecosystem Assessment* in Germany

A Plea for a Comprehensive Approach

We present options for a National Ecosystem Assessment *in Germany* (NEA-DE) *that could inform decision-makers on the state and trends of ecosystems and ecosystem services. Characterizing a* NEA-DE, *we argue that its cross-sectoral, integrative approach would have the advantages of increased scientific understanding, addressing specific policy questions and creating science-policy dialogues. Challenges include objections against a utilitarian perspective, reservations concerning power relations, and responsibilities concerning the funding.*

Christian Albert, Carsten Neßhöver, Matthias Schröter, Heidi Wittmer, Aletta Bonn, Benjamin Burkhard, Jens Dauber, Ralf Döring, Christine Fürst, Karsten Grunewald, Dagmar Haase, Bernd Hansjürgens, Jennifer Hauck, Mandy Hinzmann, Thomas Koellner, Tobias Plieninger, Sven-Erik Rabe, Irene Ring, Joachim H. Spangenberg, Ulrich Stachow, Henry Wüstemann, Christoph Görg

Towards a *National Ecosystem Assessment* in Germany. A Plea for a Comprehensive Approach | *GAIA* 26/1 (2017): 27–33
Keywords: assessment, biodiversity, ecosystem services, science-policy dialogue, transdisciplinary approach

Conclusions on the process

- Lot of capacity and data available in Germany
- Bringing together expertise (and data) is challenging
- Federal structure of Germany with varying policies (also concerning data collection and distribution) is also challenging
- Lots of work done on regional/local scales (focus here was on national scale studies)
- Expectations (from science and policy) are massive → pressure …
- Outcomes of biophysical ES accounting feed into overall German NCA, including extent, condition and economic accounting (another respective follow-up R & D project has just started)
- Results will certainly (sooner or later) be implemented in policy and decision making, at least once they are in the official reporting systems

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