

Towards ecosystem indicators that maintain a 'Safe Operating Space' for humanity



Expert meeting on SEEA Indicators for SDGs and the post-2020 Biodiversity Framework February 2019



- Timebound targets yes, but also look beyond the 2030 horizon
- National data yes, but also monitor system behaviours
- Money measures yes, but <u>also</u> keep an eye on the physical state of ecosystems
- Remember that *Quantification* = *Power*



* https://seea.un.org/sites/seea.un.org/files/sdg_cover_note_broadbrush.pdf



* https://seea.un.org/sites/seea.un.org/files/sdg_cover_note_broadbrush.pdf





Aiming higher..., Mace et al 2018



Examples of large-scale 'teleconnectors':

- Moisture recycling/LUC
- Transboundary pollution
- Marine plastic
- Migratory birds
- Climate warming

SEEA \rightarrow visibility??

See also earthsystemdatacube.net

ightarrow Essential Earth System Variables (with ESA, MPI Jena

SDG Indicators that have full alignment with the SEEA – through a PB lens

- 6.3.1 Proportion of wastewater safely treated
- 6.3.2 Proportion of bodies of water with good ambient water quality
- 6.4.1 Change in water-use efficiency over time
- 6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources
- 6.6.1 Change in the extent of water-related ecosystems over time
- 8.9.1 Tourism direct GDP as a proportion of total GDP and in growth rate
- 11.3.1 Ratio of land consumption rate to population growth rate
- 11.7.1 Share of built-up area of cities that is open space for public use
- 14.1.1 Index of coastal eutrophication and *floating plastic debris* density
- 14.3.1 Average marine acidity (pH) measured at agreed suite of representative sampling stations
- 14.4.1 Proportion of fish stocks within biologically sustainable levels
- 14.5.1 Coverage of protected areas in relation to marine areas
- 14.7.1 Sustainable fisheries as a proportion of GDP in SIDS, LDCs, and all countries
- 15.1.1 Forest area as a proportion of total land area
- 15.1.2 Proportion of important sites for terrestrial and freshwater biodiversity as protected areas
- 15.2.1 Progress towards sustainable forest management
- 15.3.1 Proportion of land that is degraded over total land area
- 15.4.1 Coverage by protected areas of important sites for mountain **biodiversity**
- 15.4.2- Mountain Green Cover Index
- 15.5.1 Red List Index
- 15.9.1 Progress towards national biodiversity targets established in accordance CBD strategy 2011-2020

SDG Indicators that have full alignment with the SEEA – through a PB lens

- 6.3.1 Proportion of wastewater safely treated
- 6.3.2 Proportion of bodies of water with good ambient water quality
- 6.4.1 Change in water-use efficiency over time
- 6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwa
- 6.6.1 Change in the extent of water-related ecosystems over time
- 8.9.1 Tourism direct GDP as a proportion of total GDP and in growth rate
- 11.3.1 Ratio of land consumption rate to population growth rate
- 11.7.1 Share of built-up area of cities that is open space for public use
- 14.1.1 Index of coastal eutrophication and floating plastic debris density
- 14.3.1 Average marine acidity (pH) measured at agreed suite of representative sampling stat
- 14.4.1 Proportion of fish stocks within biologically sustainable levels
- 14.5.1 Coverage of protected areas in relation to marine areas
- 14.7.1 Sustainable fisheries as a proportion of GDP in SIDS, LDCs, and all countries
- 15.1.1 Forest area as a proportion of total land area
- 15.1.2 Proportion of important sites for terrestrial and freshwater biodiversity as protected
- 15.2.1 Progress towards sustainable forest management
- 15.3.1 Proportion of land that is degraded over total land area
- 15.4.1 Coverage by protected areas of important sites for mountain biodiversity
- 15.4.2- Mountain Green Cover Index
- 15.5.1 Red List Index
- 15.9.1 Progress towards national biodiversity targets established in accordance CBD strategy 2011-2020



No surprise this is a rather weak match – Science speaks a different language



Diverse ecological measures in 'planetary boundaries' science – maps show gaps

Blue: primary/research data Red: community synthesis Green: informing policy and decision-making

Timeframes of data acquisition

Cornell & Downing, 2014 PTB Environment Absolute

SDG Indicators that have full alignment with the SEEA – through a PB lens

6.3.1 - Proportion of wastewater safely treated 6.3.2 - Proportion of bodies of water with good ambient water quality \star 6.4.1 - Change in water-use efficiency over time 6.4.2 - Level of water stress: freshwater withdrawal as a proportion of available freshwater resources 6.6.1 - Change in the extent of water-related ecosystems over time 8.9.1 - Tourism direct GDP as a proportion of total GDP and in growth rate Chemical 11.3.1 - Ratio of land consumption rate to population growth rate pollution 11.7.1 - Share of built-up area of cities that is open space for public use and other 14.1.1 - Index of coastal eutrophication and floating plastic debris density novel entities 14.3.1 - Average marine acidity (pH) measured at agreed suite of representative sampling stations 14.4.1 - Proportion of fish stocks within biologically sustainable levels Land 14.5.1 - Coverage of protected areas in relation to marine areas system 14.7.1 - Sustainable fisheries as a proportion of GDP in SIDS, LDCs, and all countries change 15.1.1 - Forest area as a proportion of total land area 15.1.2 - Proportion of important sites for terrestrial and freshwater biodiversity as protected areas 15.2.1 - Progress towards sustainable forest management Freshwater 15.3.1 - Proportion of land that is degraded over total land area 15.4.1 - Coverage by protected areas of important sites for mountain biodiversity use 15.4.2- Mountain Green Cover Index 15.5.1 - Red List Index 15.9.1 - Progress towards national biodiversity targets established in accordance CBD strategy 2011-2020

Strong opportunities for coherence with SEEA Thematic Carbon, Biodiversity, Water and Land Accounts

- 9 years of information since R2009 progressive improvements in detail and coverage
 - New work on biodiversity, water system, N&P, land, chemicals (LCA/AESA, plastics)



Science in Action?

Issue	Global assessments	Policy structures
Climate change	IPCC AR 1990, 1995, 2001, 2007, 2014; SRES; UNHDR	IPCC, UNFCCC SBSTA Many international conventions
Ecosystem change	MA 2005; CBD GBO1-3; UNEP GEO1-5; TEEB; FAO	IPBES and CBD SBSTTA CBD, CITES, other conventions
Biogeochemical change	UNEP GPNM 2013; WMO/IAEA/UNEP GESAMP	INI, GPNM, WHO, FAO, WMO, IPCC, GPRI. Several conventions.
Chemical pollution	UNEP; AMAP and other regional/topical	SETAC, SCI, WHO-IFCS, Many conventions.

Nykvist et al. (2013) National responsibility (SEPA/SEI/SRC); Cornell and Downing (2014) Environment, Absolute?

Science in Action?

Issue	Global assessments	Policy structures
Climate change	IPCC AR 1990, 1995, 2001, 2007, 2014; SRES; UNHDR	IPCC, UNFCCC SBSTA 1any international 1ventions
Ecosystem change	MA 2005; CBD GP UNEP GEO1	S and CBD SBSTTA ITES, other conventions
Biogeochemical change	UNE G SAMP	INI, GPNM, WHO, FAO, WMO, IPCC, GPRI. Several conventions.
Chemical pollution	UNEP; AMAP and other regional/topical	SETAC, SCI, WHO-IFCS, Many conventions.

Nykvist et al. (2013) National responsibility (SEPA/SEI/SRC); Cornell and Downing (2014) Environment, Absolute?

Is science ready for real world use?

	Science	Policy	Decision landscape
Climate change	Earth system knowledge, local gaps	Global agreement on targets and metrics	Big science
Biodiversity and ecosystem change	Local knowledge, system gaps	Global agreement on targets and metrics	Concerned coalitions
Biogeochemical change	Gaps in local and system knowledge	Partial regional agreements, emerging issue	Many different players
Chemical pollution	Local knowledge, system gaps	Partial agreements, weak metrics	Big business

Biodiversity – what basis for a planetary boundary?

Genetic diversity – evolution of life



All the major and many of the minor living branches of life are shown on this diagram, but only a few of those that have gone extinct are shown. Example: Dinosaurs - extinct

evogeneao.com

Genetic diversity – evolution of life Functional diversity – "efficiency" of life



All the major and many of the minor living branches of life are shown on this diagram, but only a few of those that have gone extinct are shown. Example: Dinosaurs - extinct

© 2008 Leonard Eisenberg. All rights reserved. evogeneao.com

Making progress on measuring and modelling biosphere integrity

- **Majer and Beeston 1996:** Biodiversity Integrity Index calculated for Australian phytogeographic regions
- Scholes and Biggs 2005: Biodiversity Intactness Index estimated by expert opinion for seven southern African countries (weighted)
- Alkemade et al. 2009: Mean Species Abundance modelled globally, using cause-effect relationships (eg, land use)
- **de Baan et al. 2012, Dao et al. 2015:** Biodiversity Damage Potential index assessed, similarly to MSA, for different land use types
- Newbold et al 2015, 2016: PREDICTS data and model used for global assessment by biome, 'hotspot', area
- **Other measures?** Living Planet Index tracks species counts against 1970 baseline, rather than primary or 'ideal' vegetation

Has land use pushed terrestrial biodiversity beyond the planetary boundary? A global assessment

Newbold et al, 2016 Science 353 288-291





Local biodiversity intactness (%)

https://www.linkedin.com/pulse/some-thoughts-going-beyondglobal-biodiversity-boundary-sarah-cornell/ Newbold et al. (2016) "Has land use pushed terrestrial biodiversity beyond the planetary boundary? A global assessment", Science 353:288-29, doi 10.1126/science.aaf2201.

(Red is bad!)



(A) Reduced abundance of species occurring in primary vegetation (BII)(B) Loss of richness of species occurring in primary vegetation.



A. Effect on organisms – direct 'local' effects, observed all around the world. Threshold *a* set *normatively* (e.g., maximum acceptable exposure of populations)

B. Effect on ecosystems – large-region, timelagged (Δ t) effects. Threshold *b* reflects a structural ecosystem-level shift (e.g., loss of keystone species) \rightarrow *models useful*

C. Cascading effect on global ecosystem function (e.g., globalised toxic bioaccumulation). **Hindsight!** – minimal effect seen until critical ecosystem shift (c)

Where do you set a boundary? Data + Modelling + Politics + Precaution

Villarrubia-Gomez et al 2017

The 'Resilience Loop' represents dynamics of ecosystem change, collapse and reconfiguration



connectedness -----

Amount Condition Species richness Abundance Biophysical properties \longleftrightarrow EValue The switch point means we want *both/and* not *either/or*

Adaptive cycle image: Holling et al. in Gunderson & Holling (2002) Panarchy.

And qualitative means political



Thank you!

sarah.cornell@su.se

Subscribe to our newsletter www.stockholmresilience.org/subscribe

Overlap between the environment-related SDG targets



science – policy – trade: a tangled nexus

- resource efficiency in consumption and production;
- decoupling of economic growth and development from resource
 use & environmental degradation

sustainable management and efficient use of natural resources

> For more information: Tiina.Häyhä@su.se Paul.Lucas@pbl.nl

Source: PBL Netherlands Environmental Assessment Agency