System of Environmental Economic Accounting

Biodiversity Accounting

November 2018

United Nations

Outline

- Learning objectives
- Key concepts
- Policy linkages
- Exercise
- How to compile
- Data sources
- Country examples

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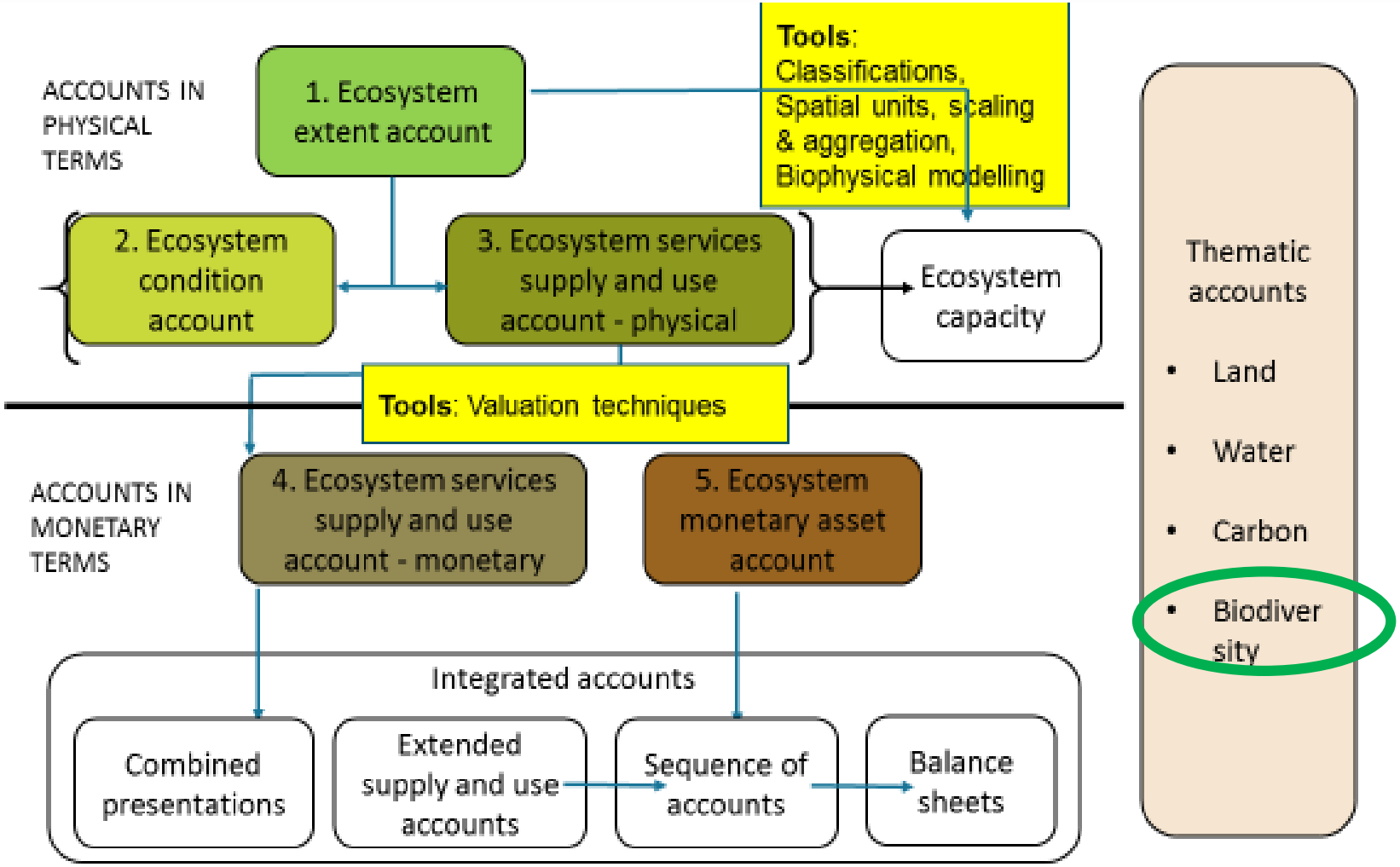
SEEA EEA accounts, tools and linkages



Biodiversity accounting : key concepts

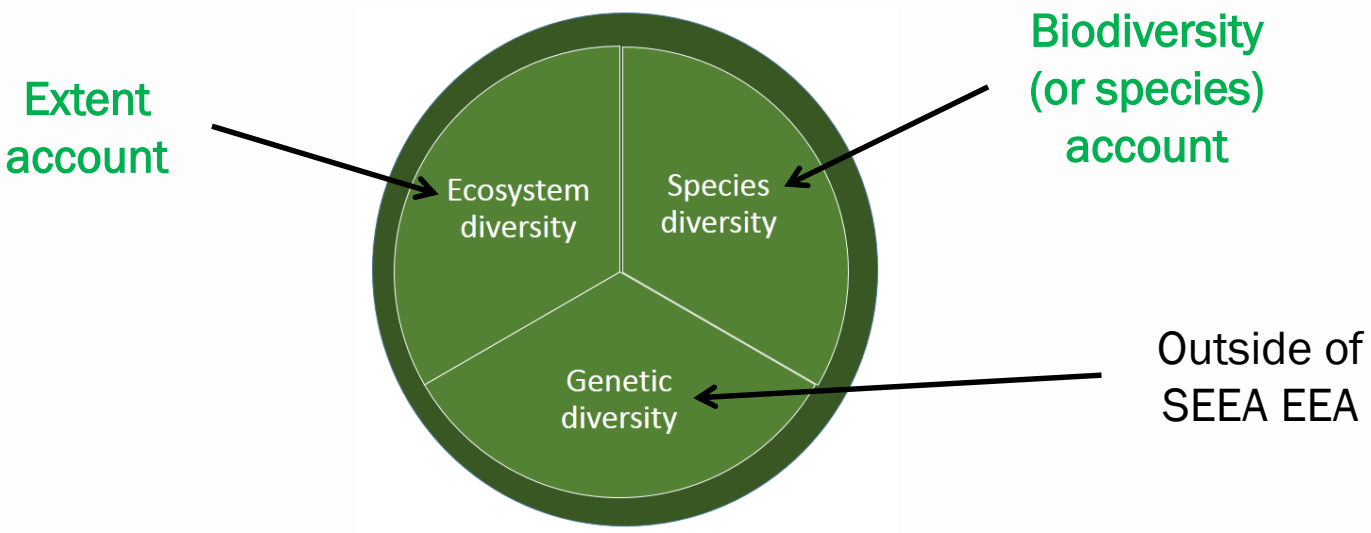
What is biodiversity?

Convention on Biological Diversity (CBD), 1992 defines biodiversity as:

> *"Biological diversity means 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"*

Biodiversity in the SEEA-EEA

- Three components to biodiversity:



- …the measurement of biodiversity is focused on the assessment of diversity of species, although changes in the diversity of ecosystems is also an important output, derived from the measurement of changes in ecosystem extent and condition. (SEEA EEA, p 152).

Link to SEEA EEA

- In SEEA EEA: biodiversity is a characteristic relevant in measurement of condition of ecosystem assets.
  - > Measures of biodiversity are considered to relate primarily to ecosystem assets in the accounting model.
  - > E.g. birdwatching or fishing not seen as flows of biodiversity services
  - > Consistent with a view that biodiversity can be degraded or enhanced over time, an attribute that applies only to assets in an accounting context.
- Measures of biodiversity can be indicators of flows of final ecosystem services (e.g. biodiversity indicators related to value of recreational services from wildlife related activities, where people gain benefit from experiencing the diversity of nature (as distinct from services received from appreciation of individual species)

Concepts

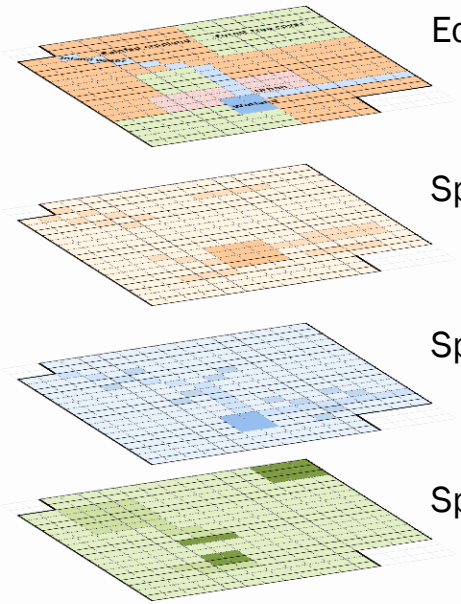
- **Species population**: The summation of all the organisms of the same species or species group that live in a particular geographical area and have the capability of interbreeding.
- **Species richness**: The number of a species within a given sample, community or area (usually from a particular taxa, e.g. plant species richness) (MA, 2005c).
- **Species abundance**: The total number of individuals of a taxon or taxa in an area, population or community (or, where counts are not feasible, other measures, such as biomass and percentage cover, may be used) (MA, 2005c).
- **Species diversity**: Diversity at the species level, often combining aspects of species richness, their relative abundance, and their dissimilarity (MA, 2005b).
- **Taxon (plural taxa):** A taxonomic category or group, such as phylum, order, family, genus or species.
- **Threatened species:** Any species vulnerable to endangerment in the near future. Comprises the IUCN
- **Red List** categories of 'Vulnerable Species', 'Endangered Species' and 'Critically Endangered Species'.

Scope

- **What do biodiversity accounts contain?**
  - Biodiversity information linked to areas of ecosystems (from extent account)
  - Spatially detailed information on key species:
    - Abundance
    - Richness
    - Conservation status
    - Other characteristics (e.g. health)
  - Spatially detailed summary statistics (index) on species diversity (used in condition account)

What does a biodiversity account look like?

Maps



Tables

	Priority species and ecosystems								
	Species 1		Species 2		Species 3		Species ...		
	Pop.	Ecosys. Area	Pop.	Ecosys. Area	Pop.	Ecosys. Area	Pop.	Ecosys. Area	Index
Reference									
Opening									
Closing									
Net change									

Species data:
- abundance
- richness
- classification
- conservation status
- characteristics
- health

Biodiversity accounting : policy linkages

Biodiversity accounting: Why?

- **Why would you create biodiversity accounts?**
  - To compare trends in biodiversity with economic and social activity in a spatially explicit manner
  - To link biodiversity information with other SEEA accounts (condition, services supply)
  - To meet global commitments under the Convention on Biological Diversity's Strategic Plan for Biodiversity (2011-2020)
  - To support sustainable development

  - Video: https://www.youtube.com/watch?v=IhBFNyfh0UQ

Living Planet Index

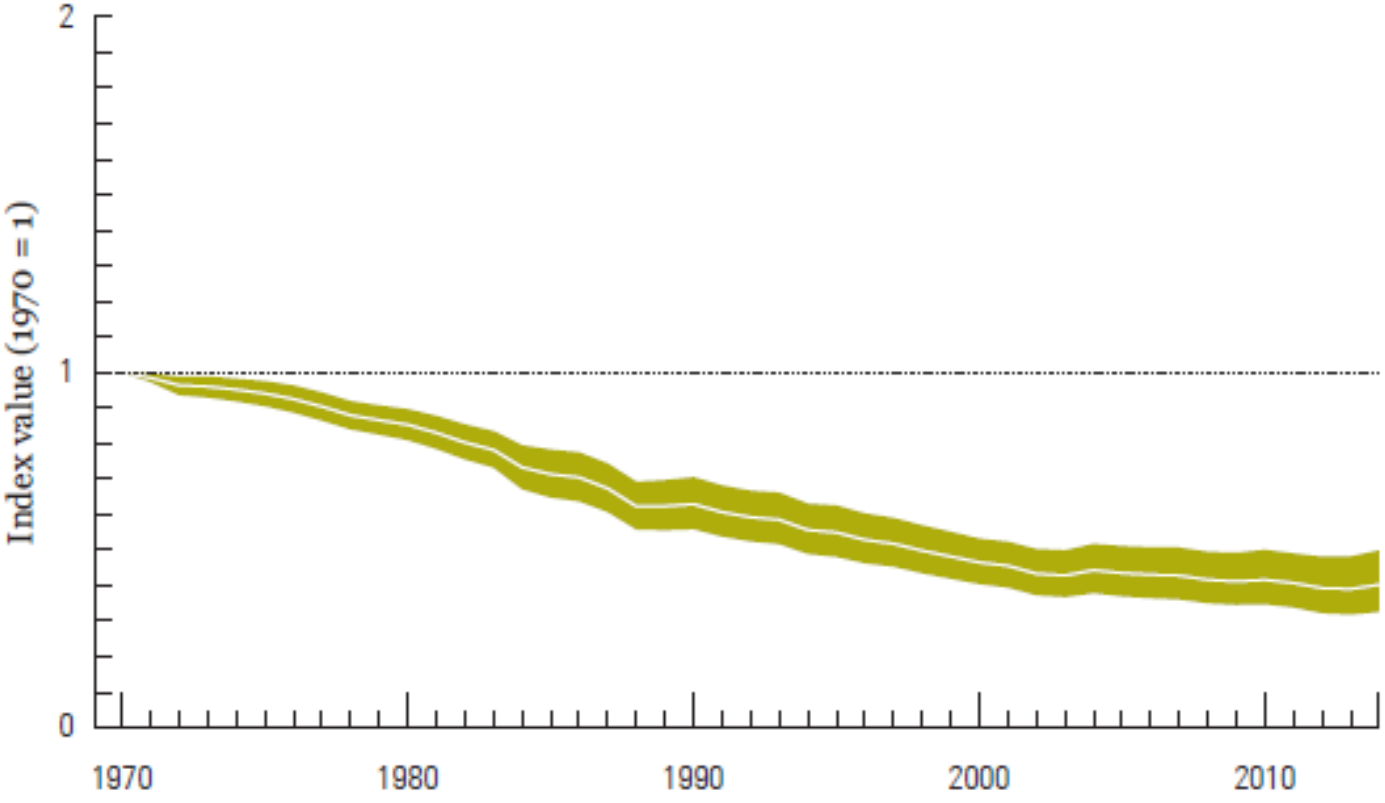


Figure 20: The Global Living Planet Index: 1970 to 2014

Average abundance of 16,704 populations representing 4,005 species monitored across the globe declined by 60%. The white line shows the index values and the shaded areas represent the statistical certainty surrounding the trend (range: -50% to -67%)[1].

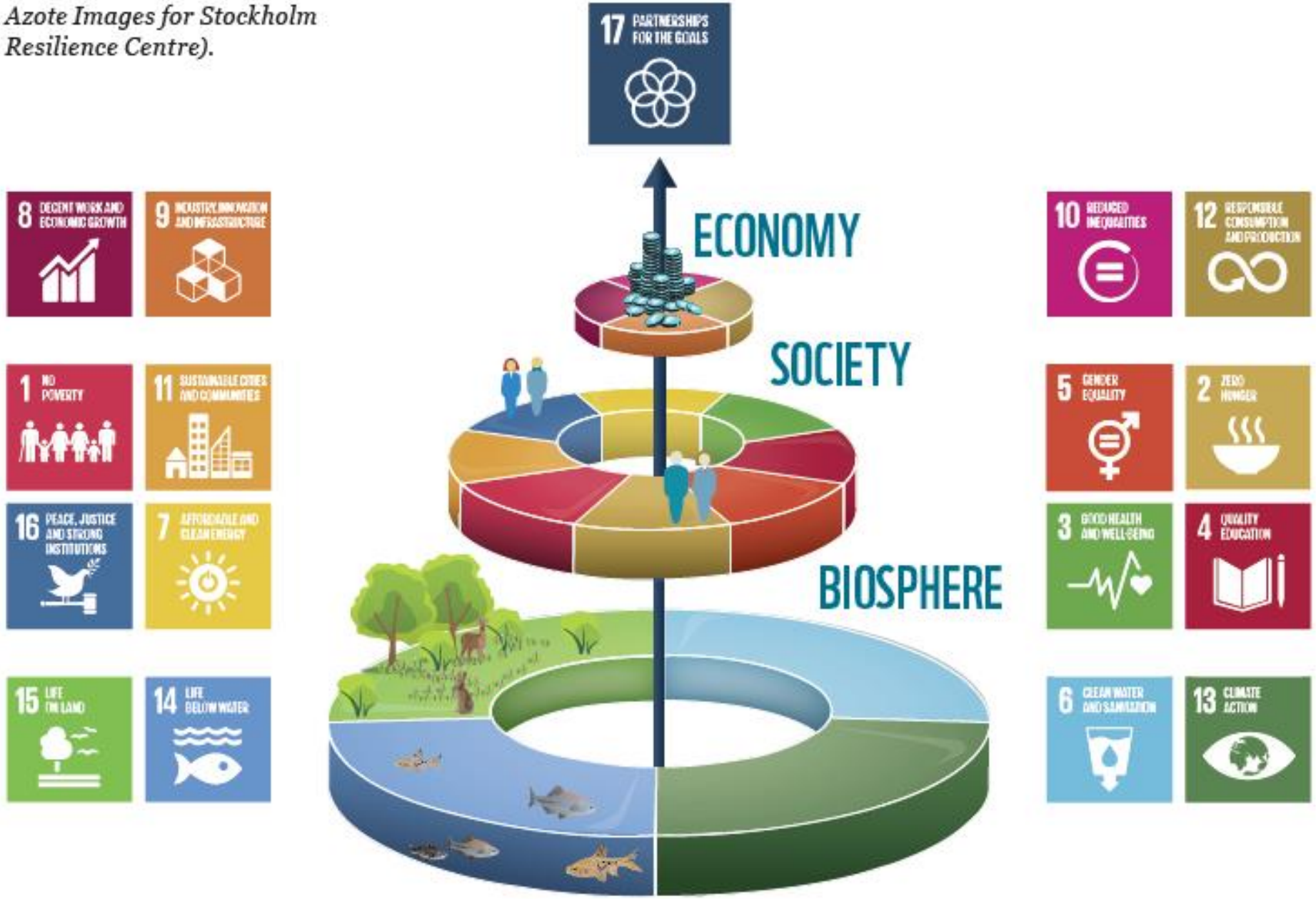
Key

Global Living Planet Index

Confidence limits

SEEA

those systems (credit: Azote Images for Stockholm Resilience Centre).



Aichi Targets

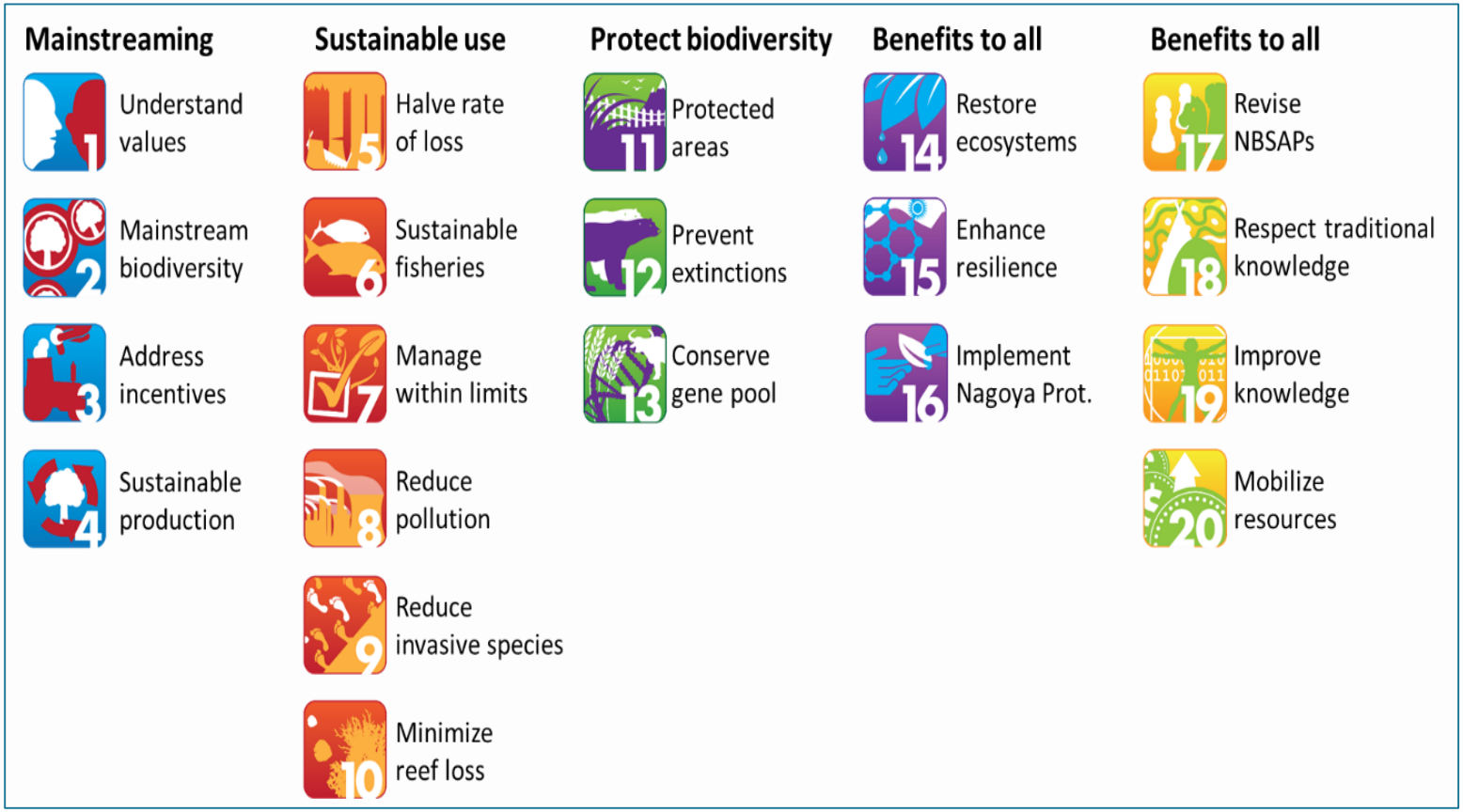


Figure 1: The 20 Aichi Biodiversity Targets set by the CBD. Source: www.cbd.int

EU Biodiversity Strategy

The EU Biodiversity Strategy aims to halt the loss of
2020. It reflects the commitments taken by the EU in

Protect species and habitats - Target 1

- By 2020, the assessments of species and habitats
  habitats and 50 % more species.

Maintain and restore ecosystems - Target 2

- By 2020, ecosystems and their services are maintai
  degraded ecosystems.

Achieve more sustainable agriculture and forestry - Target 3

- By 2020, the conservation of species and habitats depending on or affected by agriculture and forestry, and the provision of their ecosystem services show measurable improvements

Make fishing more sustainable and seas healthier - Target 4

- By 2015, fishing is sustainable. By 2020, fish stocks are healthy and European seas healthier. Fishing has no significant adverse impacts on species and ecosystems.

Combat invasive alien species - Target 5

- By 2020, invasive alien species are identified, priority species controlled or eradicated, and pathways managed to prevent new invasive species from disrupting European biodiversity.

Help stop the loss of global biodiversity - Target 6

- By 2020, the EU has stepped up its contribution to avert global biodiversity loss.

Action 5: Map and assess the state and economic value of ecosystems and their services in the entire EU territory; promote the recognition of their economic worth into accounting and reporting systems across Europe

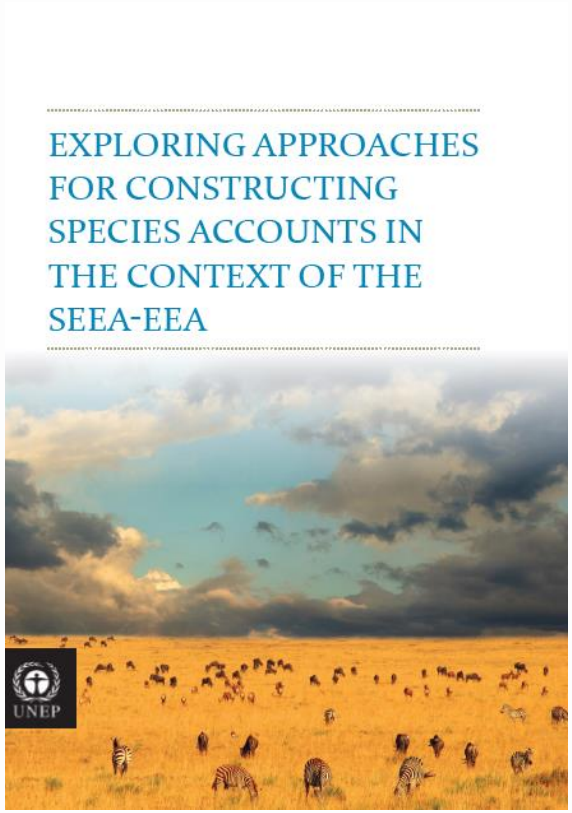
Aichi Target	Relevant environmental-economic and ecosystem accounts
2. By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.	All SEEA National Balance Sheet showing value of natural resources along with the value of other assets (SNA and SEEA CF) Ecosystem service accounts showing both physical levels and monetary values of services (SEEA-EEA)
10 By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.	Water emissions account (SEEA CF) Ecosystem extent account – of coral reefs and vulnerable ecosystems (Secades et al., 2013), Ecosystem condition account and Ecosystem services account (SEEA-EEA) Biodiversity account – species diversity / population / extinction risk trends in coral and reef fish (adapted from Secades et al., 2013)
11. By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes	Land cover/ecosystem extent and land use accounts (SEEA CF/SEEA-EEA) Ecosystem condition and ecosystem services accounts (SEEA-EEA)

SEEA

Source: Vardon et al., 2016

Biodiversity accounting : how to compile?

UNEP-WCMC



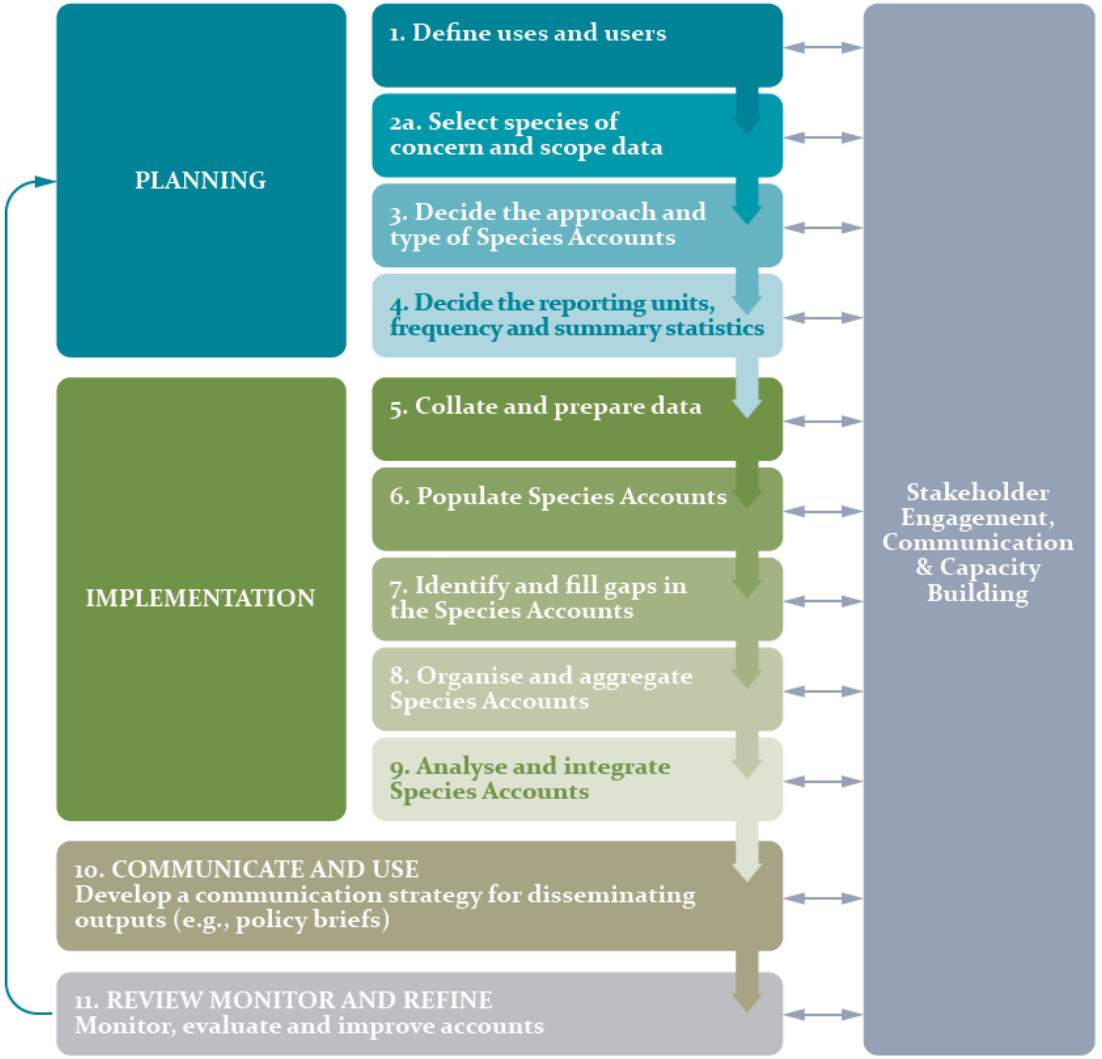


Figure A: Step-by-step approach for constructing Species Accounts

SEEA

Biodiversity account: requirements

- **What do you need to produce a biodiversity account?**
  - The key policy questions & goal of the biodiversity account
  - List of key or priority species
  - List of data sources (e.g., national, global) supported by a dialogue with data providers to ascertain data availability.
  - Expertise to mobilise data and plug data gaps:
    - Species measurement
    - Biophysical modelling, GIS
    - Indicator development
    - Statistical analysis

Biodiversity account: requirements

- **What do you need to produce a biodiversity account?**
  - Information on key or priority species
    - Species classifications (family, genus)
    - Species measures (ranges, richness, population counts over time)
    - Characteristics (e.g., habitat, specialist/generalist, health)
    - Conservation status
  - **Extent account** or some form of spatial infrastructure for ecosystems (**spatial units**)

Measurement of biodiversity

- **How do we select species to prioritise?**
  - > **Taxonomic groups**:

    refers to the units of a rank that designates an organism to particular rank based on shared characteristics. 5 ranks:

    Kingdom, e.g., animals
    Phylum, e.g., vertebrates
    Class, e.g., mammals, birds, amphibians...
    Order, e.g., carnivores
    Family, e.g., cats
    Genus, e.g., panthers
    Species, e.g., lions

  - > **Trophic groups**:

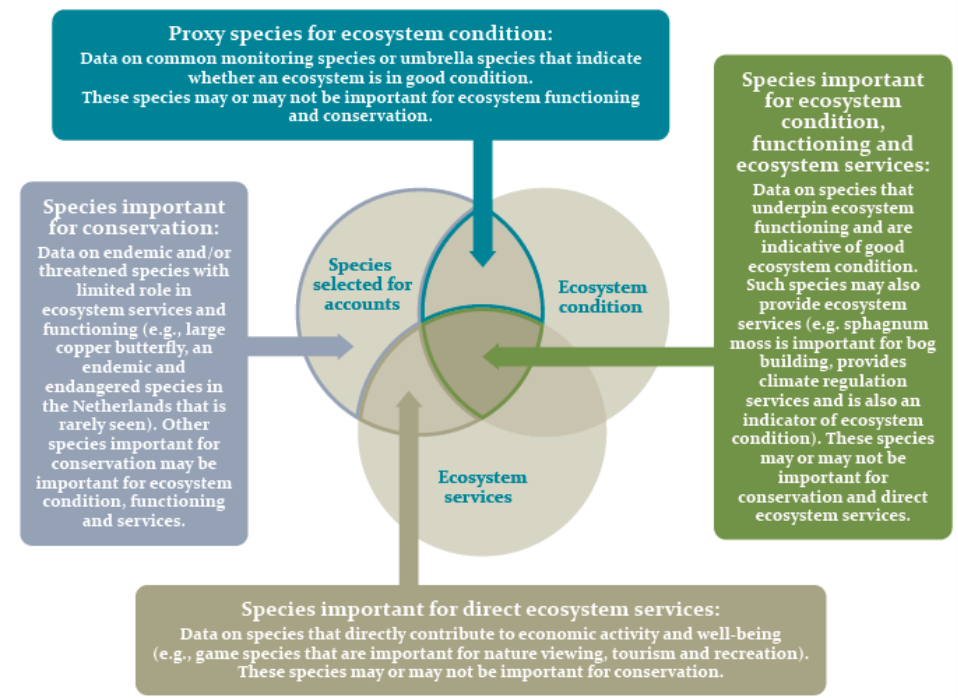
    refers to the level an organism occupies in a food chain:

    Producers, i.e., plants
    Consumers, i.e., animals that eat plants (herbivores) or other animals (carnivores)
    Decomposers, i.e., organisms that break down dead plants and animals

Factors for selecting species

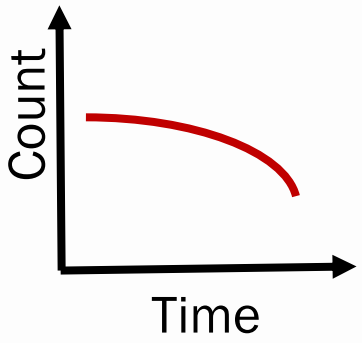
Individual species or species groups

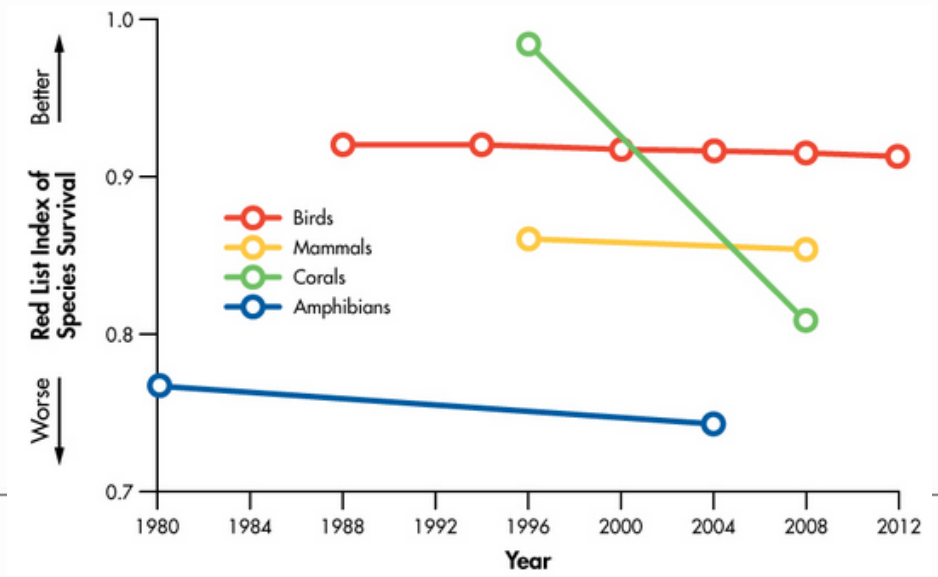
- Conservation
  - > Threatened species
  - > Endemic / restricted range
  - > Migratory and/or congregatory
  - > Phylogenetically unique or distinct species
- Species important for condition and functioning
  - > Keystone species
  - > Proxy species
  - > Specific functions (trophic groups e.g decomposers; predators etc.
- Ecosystem services
  - > Charismatic / iconic species
  - > Direct use benefits
  - > Indirect use benefits



Measurement of biodiversity

- **How do we communicate measures of biodiversity?**
  - **Measure** is the phenomenon to be measured in a data set and are the basis for deriving indicators.
  - **Indicator** is a data element that represents statistical data for a specified time, place, and other characteristics.
  - **Index** is composed when a number of measures or indicators is combined.





Biodiversity index

- **The Shannon Index**
  - Provides information on the richness and proportion of each species in a community

$$H' = -\sum_{i=1}^{R} p_i \, ln(p_i)$$

    - H' is the Shannon index
    - R is the total number of species in the sample
    - ln is the *natural logarithm*
    - p_i is the proportion of individuals in the i^{th} species in the sample
  - Maximum value depends on number of species = $ln(R)$

Biodiversity index

- **Shannon's equitability** (species evenness)
  - > Can provide information on the species evenness

$$E_{H'} = \frac{H'}{\ln(R)}$$

  - $E_{H'}$ is the equitability, with a value between 0 and 1, 1 is complete evenness
  - R is the number of species in the sample
  - *ln* is the *natural logarithm*
  - H' is the Shannon diversity index value

Biodiversity index (example)

- **The Shannon Index**
  - Example: two ecosystems, three species, 270 individuals

Species	Ecosystem A			Ecosystem B		
	Individuals	p_i	$[p_i * ln(p_i)]$	Individuals	p_i	$[p_i * ln(p_i)]$
Lions	50	0.185	-0.31	90	0.333	-0.37
Tigers	200	0.741	-0.22	140	0.519	-0.34
Bears	20	0.074	-0.19	40	0.148	-0.28
Total	**270**		**H' = 0.73**	**270**		**H' = 0.99**

  - Calculation: Ecosystem A, lions

$$[pi*\ln(pi)] = [(50/270) * \ln(50/270)]$$
$$= [0.19 * -1.69]$$
$$= -0.31$$

Biodiversity index (example)

- **Shannon's equitability**
  - > Example: two ecosystems, three species, 270 individuals

$$Evenness = \frac{Shannon\ index}{\ln(no.\ of\ species)}$$

	Ecosystem A	Ecosystem B
No. species	3	3
No. of individuals	270	270
Shannon Index	0.73	0.99
Evenness	0.66	0.90

  - > Both the diversity and evenness is greater in Ecosystem B

Biodiversity accounting : group exercise

Compilation group exercise

- Situation:
  - > EAs defined in spatial units
  - > Have population counts for three key species
  - > Need to calculate Shannon Index for three forest EAs
- Objective (in groups of 3-5):
  1. Decide which three species you will prioritise and why
  2. Record species population data in appropriate cells in species table for each forest EA
  3. Using formulae provided, calculate a Shannon index and the species evenness for each forested EA
  4. Record this in the summary table

Step 1: Choose three species

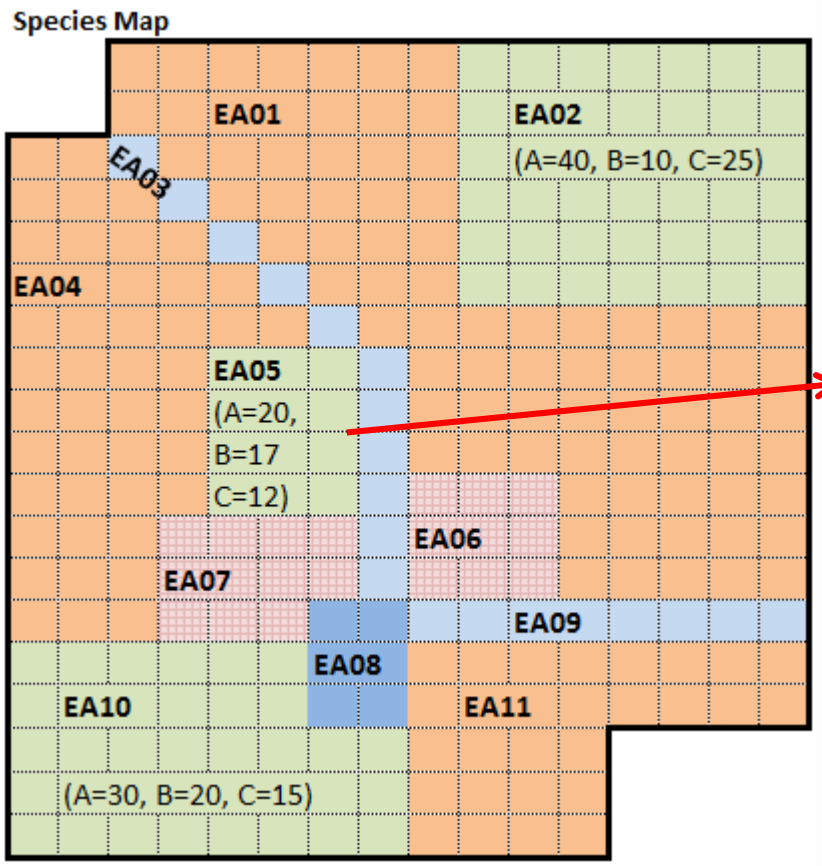
Species prioritization and rationale

Species	Species name	Reason for selection
A		
B		
C		

Instructions:

Write down the three key species you will prioritize and why. When picking your key species, keep in mind the goal of the biodiversity account and how including that species will provide information to achieve that goal.

Step 2: Transfer data for forest EAs



Species Table

EA	Individuals	p_i	$\ln(p_i)$	$p_i * \ln(p_i)$
EA02 = Forest tree cover				
Species (A)				
Species (B)				
Species (C)				
EA05 = Forest tree cover				
Species (A)				
Species (B)				
Species (C)				
EA10 = Forest tree cover				
Species (A)				
Species (B)				
Species (C)				

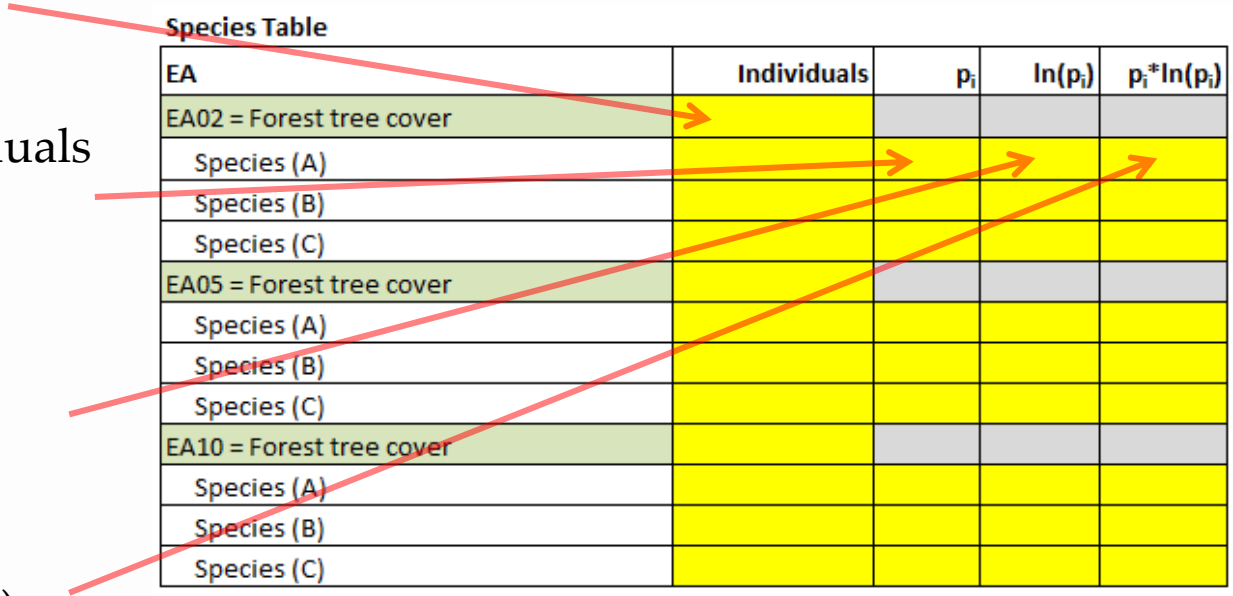
Step 3: Fill the table

Total individuals =
A + B + C

p_i is proportion of individuals
(e.g., 40 Species (A) /75 individuals = 0.53)

$ln(p_i)$ is natural logarithm
(e.g., $ln(0.53)$ = -0.63)

Multiply p_i by $ln(p_i)$
(e.g., 0.53 * -0.63 = -0.34)



Species Table

EA	Individuals	p_i	$ln(p_i)$	$p_i * ln(p_i)$
EA02 = Forest tree cover				
Species (A)				
Species (B)				
Species (C)				
EA05 = Forest tree cover				
Species (A)				
Species (B)				
Species (C)				
EA10 = Forest tree cover				
Species (A)				
Species (B)				
Species (C)				

Step 4: Calculate Shannon Index and Evenness

Add results for [$p_i * ln(p_i)$] for each forest EA

Multiply by -1

Record in summary table for each forest EA

Calculate

$$Evenness = \frac{Shannon\ index}{\ln(no.\ of\ species)}$$

Species Table

EA	Individuals	p_i	$\ln(p_i)$	$p_i * \ln(p_i)$
EA02 = Forest tree cover				
Species (A)				
Species (B)				
Species (C)				
EA05 = Forest tree cover				
Species (A)				
Species (B)				
Species (C)				
EA10 = Forest tree cover				
Species (A)				
Species (B)				
Species (C)				

Summary Table

EA	Shannon Index	Evenness
EA02 = Forest tree cover		
EA05 = Forest tree cover		
EA10 = Forest tree cover		

Finalization

- Is everyone clear on the objectives?
- 30 minutes group work
- Please ask questions
- Results:
  - > Each group report:
    - Shannon Index result for each forest EA
    - Species evenness
  - > Which is the least diverse (lowest Shannon Index)?
  - > Why is this less diverse than the other two EAs?

Summary Table

EA	Shannon Index	Evenness
EA02 = Forest tree cover		
EA05 = Forest tree cover		
EA10 = Forest tree cover		

Answers

EU02 is the least diverse

This is because species A dominates the number of individuals (p_i = 0.53), giving a lower evenness score (0.88)

Species Table

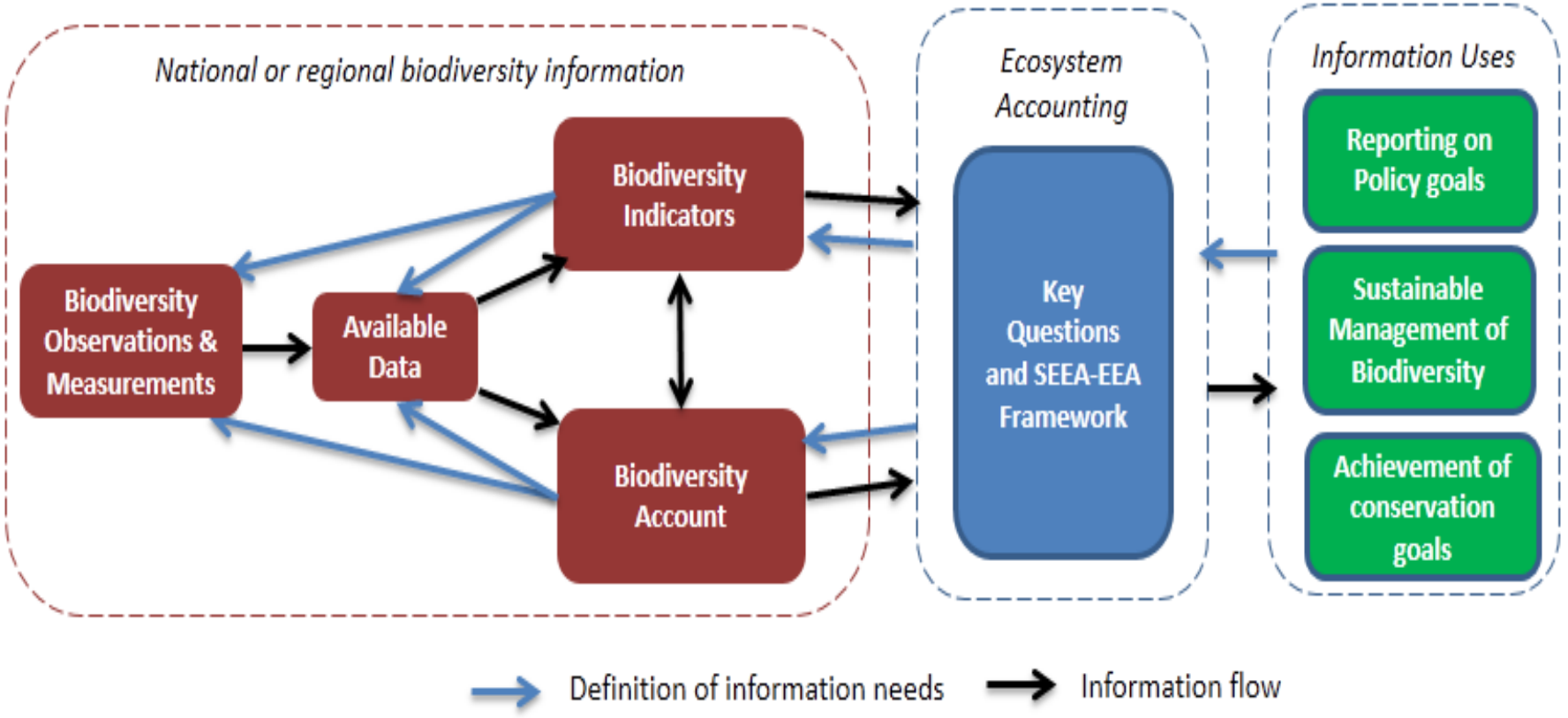
EA	Individuals	p_i	$\ln(p_i)$	$p_i * \ln(p_i)$
EA02 = Forest tree cover	75			
Species (A)	40	0.53	-0.63	-0.34
Species (B)	10	0.13	-2.01	-0.27
Species (C)	25	0.33	-1.10	-0.37
EA05 = Forest tree cover	49			
Species (A)	20	0.41	-0.90	-0.37
Species (B)	17	0.35	-1.06	-0.37
Species (C)	12	0.24	-1.41	-0.34
EA10 = Forest tree cover	65			
Species (A)	30	0.46	-0.77	-0.36
Species (B)	20	0.31	-1.18	-0.36
Species (C)	15	0.23	-1.47	-0.34

Summary Table

EA	Shannon Index	Evenness
EA02 = Forest tree cover	0.97	0.88
EA05 = Forest tree cover	1.08	0.98
EA10 = Forest tree cover	1.06	0.96

Biodiversity accounting : data sources

Information uses and data requirements



Adapted from a diagram produced in the EU BON Project

Data options and sources

- Conduct an inventory of existing species diversity information, including:
  - National and sub-national monitoring schemes
  - National Red List
  - Governmental agencies, NGOs, universities and museums
  - Reporting to regional processes and international conventions
- Ecosystem diversity
  - Some information captured by the extent account
    - Land cover, vegetation maps (spatially-detailed)
    - River system maps (e.g., linearly delineated by Strahler stream order)
    - Marine habitat maps (spatially delineated on basis of Bathymetry and others characteristics)

Format of biodiversity data

- Measures
  - This includes raw, on the ground data (e.g. species abundance or richness for different taxonomic groups)
- Relative Measures
  - This compares the measure to a reference condition.
  - Normalized around 1 or 100
  - Sources: minimal human disturbance (SEEA), ecological sustainability (NNI), first accounting period (accrual, Living Planet Index) or aspirational.
- Headline output indicator(s)
  - Index of all relevant biodiversity data in account
  - May need more than one (e.g., one for ecosystem condition, one conservation goals)
  - Will need expert ecological knowledge

Plugging Species Diversity Data Gaps

- Develop national species monitoring programme
- Estimation approaches
  - Human drivers based models (e.g. Alkemade, 2009)
  - Statistical habitat suitability models (Phillips, 2006)
  - Expert judgement (e.g. Scholes and Biggs, 2005)
  - Species-area curve (Brooks et al., 2002).
  - Issues: Species may not exist in areas of suitable habitat.
  - Solutions: Validation and calibration of species diversity measures using targeted monitoring programmes
- Qualitative Approaches
  - For example 'very abundant', 'abundant', 'common', 'rare' and 'very rare' as broad classes for species abundance.

Conceptual issues

- Data on species **ranges and characteristics** are often incomplete
- **Migration and mobility** (e.g., birds are often recorded where they breed and bears can range over many habitat types)
- **Functional diversity**: some species are more important to the functioning of the ecosystem; some overlap in function
- **Conservation priority** species may not be of high importance for ecosystem condition
- May need **more than one account** to answer different policy questions
- **Invasive species** (more information required)
- **Reference conditions** (more information required)
- May need **more than one indicator** to track policy progress and report ecosystem condition
- How to aggregate biodiversity measures across ecosystems?

Biodiversity accounting: examples

UK

Table 4.2 The importance of different biodiversity groups in underpinning the final ecosystem services based on expert opinion. Importance is colour-coded: high (maroon), medium (beige), low (green), unimportant on the basis of available evidence (blank). The size of the circle in each cell is used to illustrate the level of uncertainty in the available evidence. Further details are given in Appendix 4.1.

Final ecosystem services (based on the UK NEA Conceptual Framework)	Biodiversity groups																
	Microorganisms		Fungi		Lower plants			Higher plants		Invertebrates		Fish		Amphibians	Reptiles	Birds	Mammals
	Terrestrial	Marine	Non-lichens	Lichens	Phytoplankton	Macroalgae	Bryophytes	Seagrasses	Land plants	Terrestrial	Marine	Freshwater	Marine				
Crops, livestock, fish	●	●	●		●	●		●	●	●	○	●	●			●	●
Trees, standing vegetation & peat	●		●	●		○	●	○	●	○				●			○
Climate regulation	●	●	●		●	●		○	●		●		•				○
Water supply	●	●	•		●		○		●								
Hazard regulation	●	○	○	○		●	●	●	●		●						
Waste breakdown & detoxification	●	●	●		●	○		●	○	●	●		•	●			
Wild species diversity	●	●	●	●	●	●	●	●	●	●	●	○	○	○	●	●	●
Purification	•	●	○						●	•	○			●			
Disease & pest regulation	●	○	●	●	○	•	●	•	○	●	○	○	●	●	●	○	●
Pollination										●						●	●
Meaningful places*	●	●	○			○	○	•	●	●	●	●	●	●		●	●
Socially valued land & waterscapes*	○	○	○	○		○	●	○	●	●	○	●	○	●	○	●	●

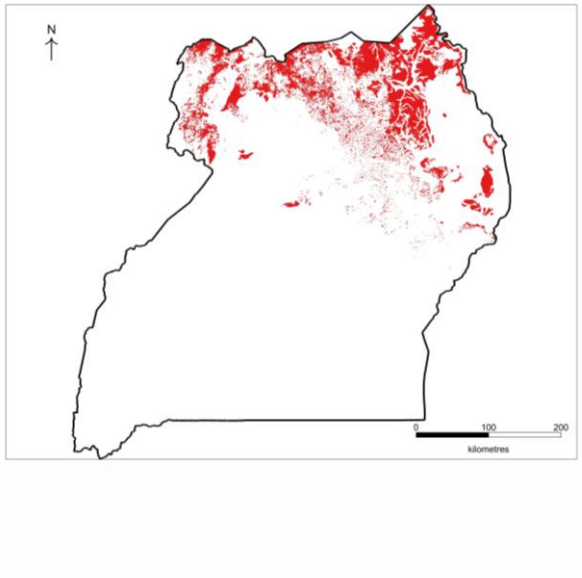
High importance	Amount of evidence (theory, observations, models) →
Level of agreement ↑	

Medium importance	Amount of evidence (theory, observations, models) →
Level of agreement ↑	

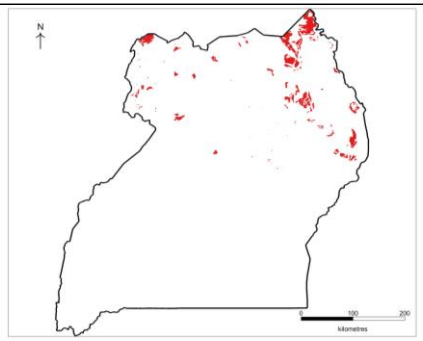
Low importance	Amount of evidence (theory, observations, models) →
Level of agreement ↑	

SEEA

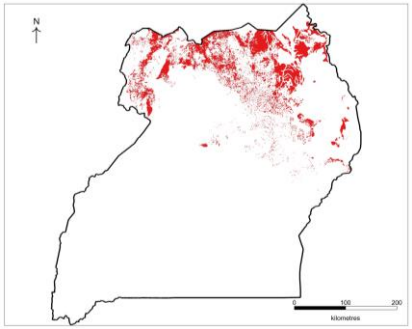
Application: shea butter nut Trees



Closing Stock (2015)



Protected Stock (2015)

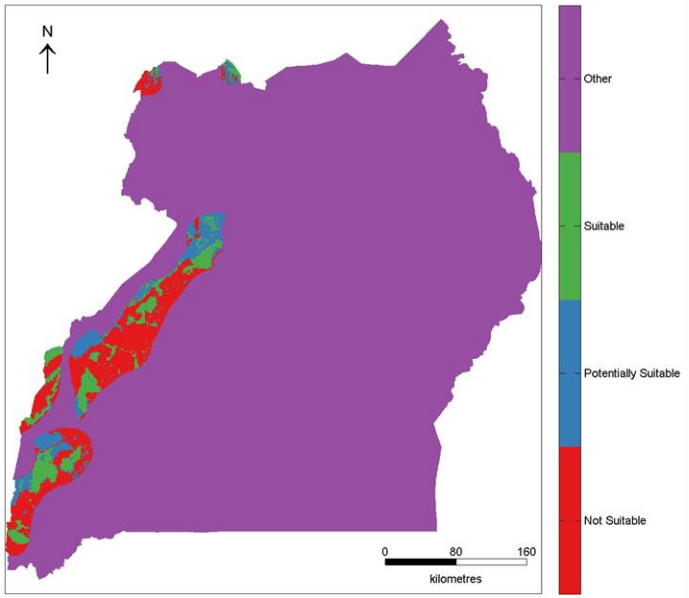


Unprotected Stock (2015)

Simplified Shea Butter Nut Tree Account

	Extent (ha)
Opening Stock (1990)	2,706,485
Net change	*-605,561*
Closing Stock (2015)	2,100,924
Protected Stock (2015)	442,466
Unprotected Stock (2015)	1,658,458

Chimpanzee account

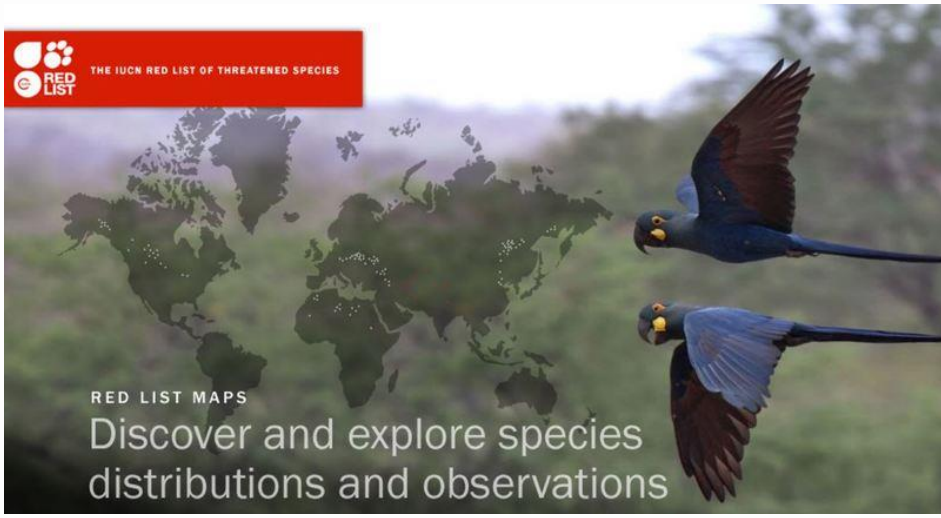


	SOUTH WESTERN	WEST NILE	WESTERN	UGANDA
Extent IUCN Range	497,896	117,290	1,416,963	2,032,149
Opening Stock (2005)				
Fully Suitable in IUCN Range	146,847	16,686	401,905	565,438
Partially Suitable in IUCN Range	104,573	50,866	375,625	531,064
Unsuitable in IUCN Range	246,476	49,738	639,433	935,647
Net Changes				
Fully Suitable in IUCN Range	9,493	4,335	-86,154	-72,326
Partially Suitable in IUCN Range	-18,765	-17,435	-71,016	-107,216
Unsuitable in IUCN Range	9,272	13,100	157,170	179,542
Closing Stock (2015)				
Fully Suitable in IUCN Range	156,340	21,021	315,751	493,112
Partially Suitable in IUCN Range	85,808	33,431	304,609	423,848
Unsuitable in IUCN Range	255,748	62,838	796,603	1,115,189
Extent of fully suitable habitat in IUCN Range protected (2015)	149,851	15,598	265,193	430,642
% of fully suitable habitat in IUCN Range protected (2015)	96%	74%	84%	87%
% of Uganda's total extent of fully suitable habitat in IUCN Range protected (2015)	35%	4%	62%	100%

2nd Forum on nca for better decision-making, November, 2017

IUCN Red List of Species

- The IUCN Red List of Threatened Species™ contains global assessments for over 93,500 species, of which about two-thirds have spatial data.
- The spatial data provided are for comprehensively assessed taxonomic groups and selected freshwater groups.
- The data are available in Esri shapefile format and contain the known range of each species, although sometimes the range is incomplete.
- Ranges are depicted as polygons, except for the freshwater HydroSHED tables. The shapefiles contain taxonomic information, distribution status, IUCN Red List Category, sources and other details about the maps (see metadata document).



IUCN National Red List

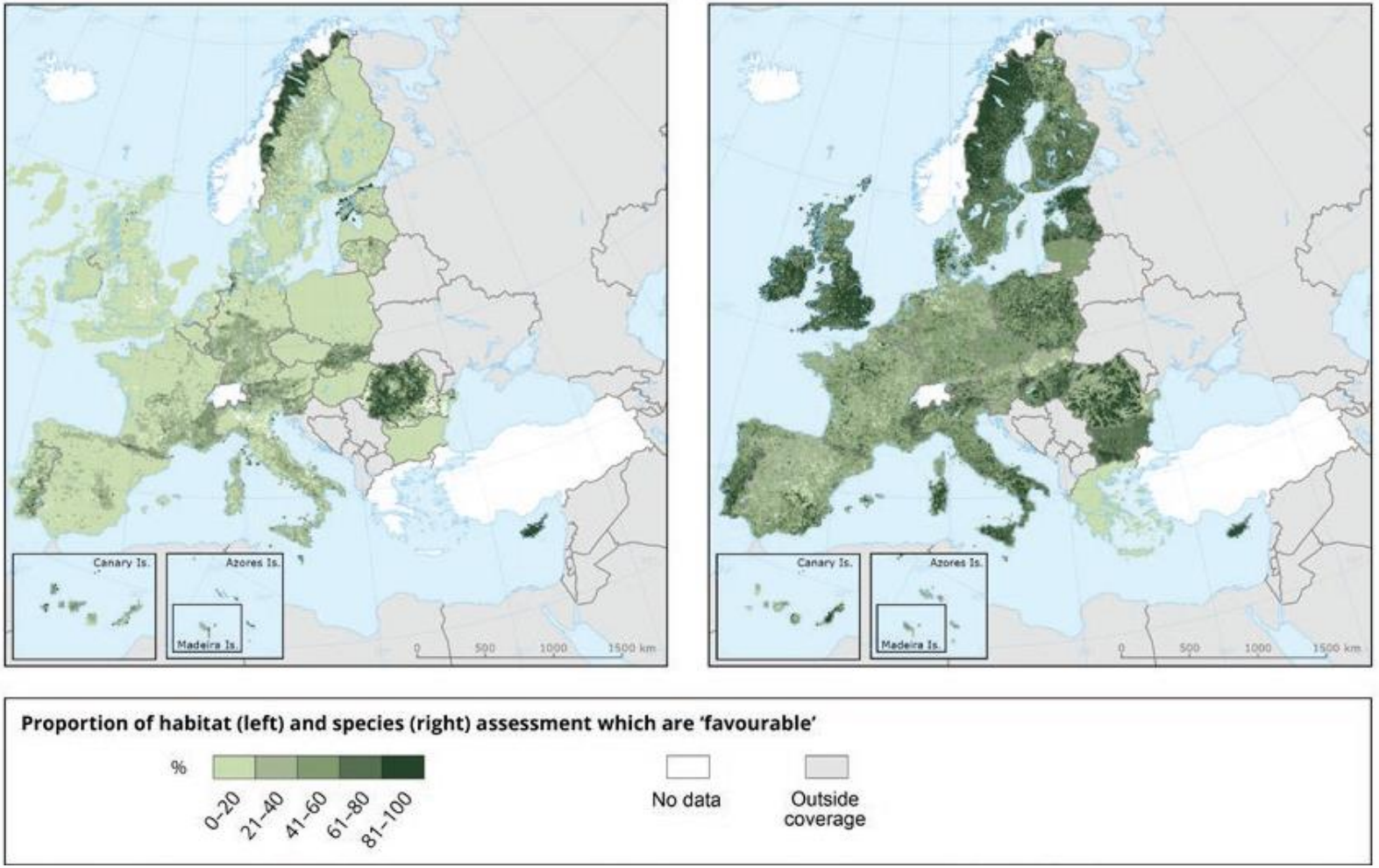
- Information relevant to species' extinction risk is considered from published and grey literature, museum records and specimen databases. Specifically relating to:
  - Species distribution
  - Population trend information
  - Habitat, ecology and life history information
  - Threats to the species
  - Conservation measures currently in place
- Supported by national workshops that rely on local species experts to provide validation.
- Implemented in many countries: Ecuador, Finland, Norway, Spain, Sri Lanka, Thailand etc.

Peru - example

The extent and condition of ecosystems San Martin in 2009; condition scores are scaled from 0-1

Time 2009		San Martín				
Ecosystem asset		Extent		Condition scores		
		Current area (ha)	% Original	Fragmentation	Biodiversity retained (%)	Composite index
Forests	Palm swamps	27,997	98.7%	0.91	89.50%	0.90
	Humid forest with high hills	203,601	53.3%	0.39	87.00%	0.63
	Humid forest with low hills	159,703	82.7%	0.72	86.50%	0.79
	Humid montane forest	2,966,134	82.0%	0.72	89.90%	0.81
	Lowland terra firme forest	53,179	51.7%	0.42	84.50%	0.63
	Floodplain forest	189,224	40.0%	0.28	85.10%	0.57

EU - example



SEEA

EU – species accounts (birds)

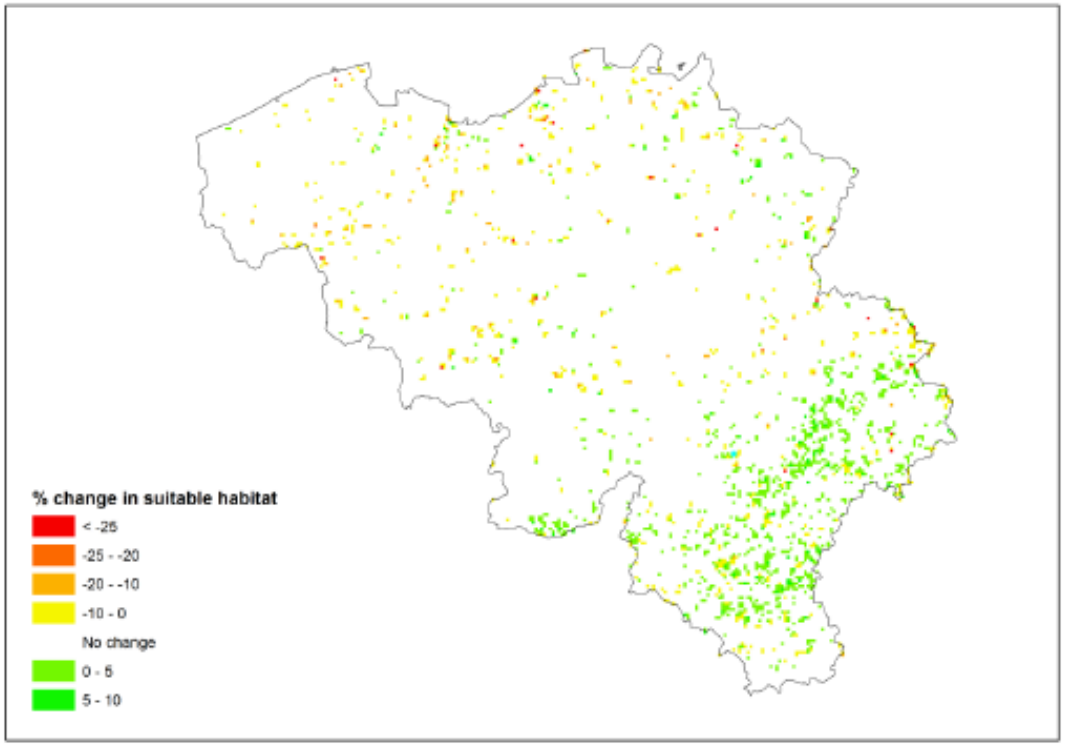


Figure 8 Percentage change in suitable habitat between 2006 and 2012 for 95 common bird species in Belgium based on Corine land cover classes

Table 16 Account for Slovakia using Article 17 Approach

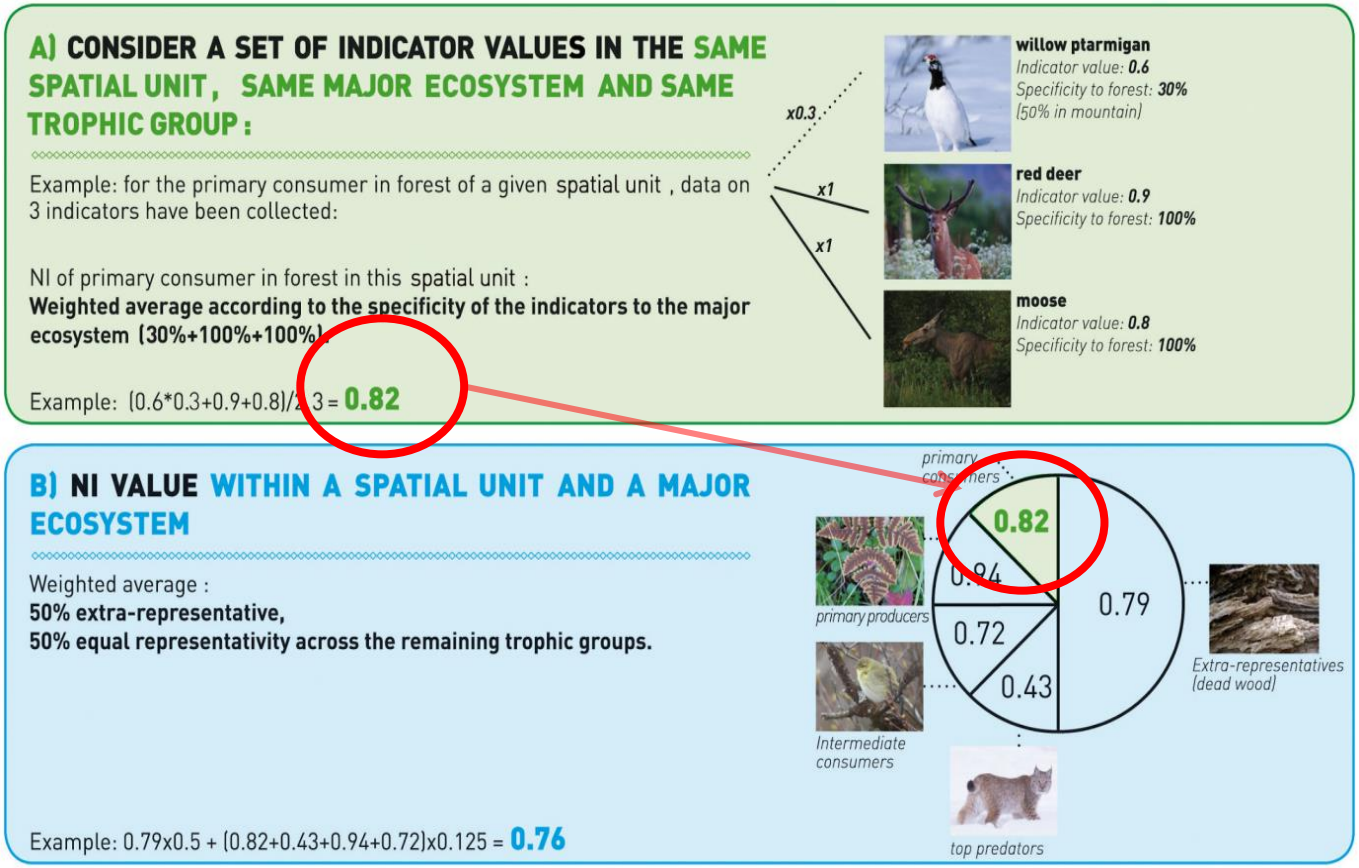
Bioregion		1 Urban	2 Cropland	3 Grassland	4 Forest	5 Heathland and shrub	6 Sparsely vegetated land	7 Inland wetlands	8 Rivers and lakes	Total by CS
Conservation status 2006										
Alpine	FV Favourable			14	15	5	6	7	7	39
	U1 Inadequate	2	2	18	20	5	6	16	17	63
	U2 Bad	1	1	13	8	3	2	4	8	27
	XX Unknown	8		4	18	4	6	3	8	34
	Total	11	3	49	61	17	20	30	40	163
Pannonian	FV Favourable		1	10	10	4	1	6	6	28
	U1 Inadequate	6	2	14	19	7	4	19	23	59
	U2 Bad	1		16	8	4	1	10	7	35
	XX Unknown	6	1	2	12	2	1	4	6	25
	Total	13	4	42	49	17	7	39	42	147
Conservation status 2012 and trend in CS										
Alpine	1 Favourable			12	15	5	3	7	7	36
	2 Unfavourable - Improving		1	2	1		1	2	1	4
	3 Unfavourable - Unknown trend								1	1
	4 Unknown	8		4	18	4	6	3	8	34
	5 Unfavourable - Stable			20	14	6	6	10	12	50
	6 Unfavourable - Declining	3	2	11	13	2	4	8	11	38
	Total	11	3	49	61	17	20	30	40	163
	Overall indexes									
	ART17 condition in CS	0.0	33.3	28.6	26.2	29.4	20.0	30.0	20.0	24.5
	ART17 trend in CS	-18.2	-33.3	-18.4	-19.7	-11.8	-15.0	-20.0	-25.0	-20.9
	Intensity of changes in CS	36.4	100.0	26.5	23.0	11.8	25.0	33.3	30.0	25.8
	Coverage of changes in CS	27.3	100.0	91.8	70.5	76.5	70.0	90.0	77.5	78.5
Pannonian	1 Favourable		1	9	10	3		6	6	26
	2 Unfavourable - Improving		1	2	2	1		1		4
	3 Unfavourable - Unknown trend			1					1	2
	4 Unknown	6	1	2	12	2	1	4	6	25
	5 Unfavourable - Stable	1		17	13	7	4	15	7	42
	6 Unfavourable - Declining	6	1	11	12	4	2	13	22	48
	Total	13	4	42	49	17	7	39	42	147
	Overall indexes									
	ART17 condition in CS	0.0	50.0	26.2	24.5	23.5	0.0	17.9	14.3	20.4
	ART17 trend in CS	-15.4	0.0	-21.4	-20.4	-17.6	0.0	-30.8	-47.6	-29.3
	Intensity of changes in CS	76.9	50.0	31.0	28.6	29.4	57.1	35.9	57.1	36.1
	Coverage of changes in CS	53.8	75.0	92.9	75.5	88.2	85.7	89.7	83.3	81.6
Conservation status 2013										

Norway's Nature Index

- Norway's Nature Index (Certain and Skarpaas, 2011) records for each species in index (of about 300):
  - Taxonomic group
  - Red list status
  - Presence in region
  - Specificity to habitat
  - Trophic group (primary producer, herbivore, predator, carnivore)
  - Keystone species
  - Generality (specialist or generalist species)
  - Community (indicator refers to population or community),
  - Sub-habitat (description)
  - Ecosystem service (contributing to)
  - Quick response to environmental change
  - Sensitive to which pressure
  - Migrating
  - Multiple major habitats
  - Reference value (i.e., value of "reference state" chosen)

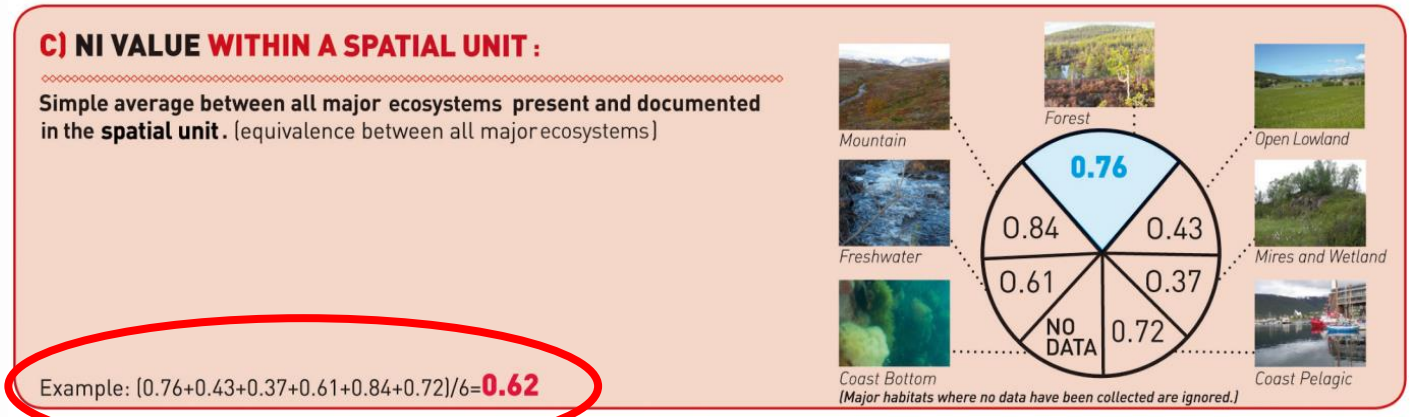
Norway's Nature Index

- **Construct** an index for a species group based on relative measures of key species in an ecosystem.
- **Combine** several indexes for ecosystem area

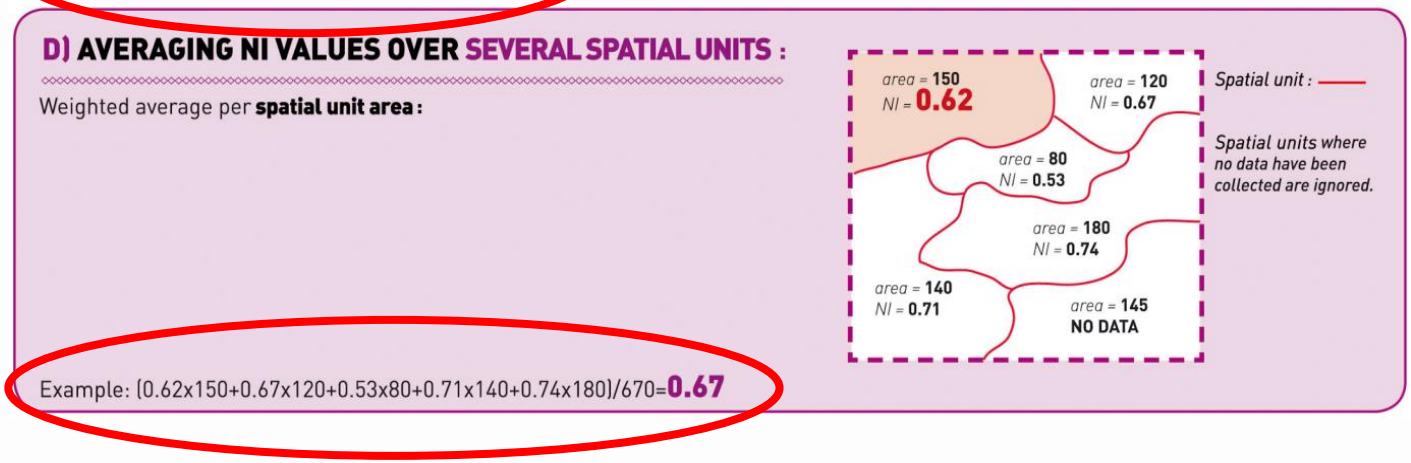


Norway's Nature Index

- **Aggregate across all ecosystems** in a spatial area



- **Aggregate across all spatial areas**



References

- Alkemade, R., van Oorschot, M., Miles, L., Nellemann, C., Bakkenes, M., & ten Brink, B. (2009). GLOBIO3: a framework to investigate options for reducing global terrestrial biodiversity loss. Ecosystems, 12(3), 374-390. https://link.springer.com/article/10.1007/s10021-009-9229-5

- Bond, S., McDonald, J., & Vardon, M. (2013) Experimental Biodiversity Accounting in Australia. Paper for 19th London Group Meeting, London, UK. 12-14 November 2013. https://unstats.un.org/unsd/envaccounting/londongroup/meeting19/LG19_16_1.pdf

- Brooks, T. M., R. A. Mittermeier, C. G. Mittermeier, G. A. B. Da Fonseca, A. B. Rylands, W. R.Konstant, P. Flick, J. Pilgrim, S. Oldfield, G. Magin, and C. Hilton-Taylor. 2002. Habitat Loss and Extinction in the Hotspots of Biodiversity. Conservation Biology **16**:909-923. http://onlinelibrary.wiley.com/doi/10.1046/j.1523-1739.2002.00530.x/abstract

- Certain, G., Skarpaas, O., Bjerke, J.-W., Framstad, E., Lindholm, M., Nilsen, J.-E., … Nybø, S. (2011). The Nature Index: a general framework for synthesizing knowledge on the state of biodiversity. *PloS One*, *6*(4), e18930. https://doi.org/10.1371/journal.pone.0018930

- IUCN. (2012a). Guidelines for Application of IUCN Red List Criteria at Regional and National Levels: Version 4.0. Gland, Switzerland and Cambridge, UK: IUCN. iii + 41pp. http://s3.amazonaws.com/iucnredlist-newcms/staging/public/attachments/3101/reg_guidelines_en.pdf

- Phillips, S. J., Anderson, R. P., & Schapire, R. E. (2006). Maximum entropy modeling of species geographic distributions. Ecological modelling, 190(3), 231-259.

- Scholes, R. J., & Biggs, R. (2005). A biodiversity intactness index. *Nature*,*434*(7029), 45-49. http://www.nature.com/nature/journal/v434/n7029/abs/nature03289.html?foxtrotcallback=true

- Weber, J., 2014. *Ecosystem Natural Capital Accounts: A Quick Start Package*. 77 (Technical Series). Montreal: Secretariat of the Convention on Biological Diversity. https://www.cbd.int/doc/publications/cbd-ts-77-en.pdf

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