Geospatial information, Land Ecosystems and Biodiversity Statistics in FDES

1. Environmental Conditions and Quality
2. Environmental Resources and their Use
3. Residuals
4. Extreme Events and Disasters
5. Human Settlements and Environmental Health
6. Environmental Protection, Management and Engagement
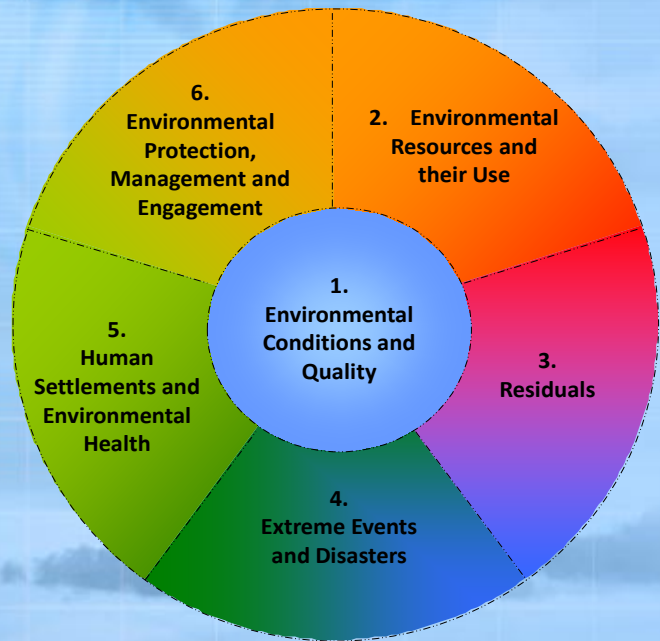
Regional Workshop on Environment Statistics and Climate Change Statistics for the Caribbean Community (CARICOM) Region

St. George's, Grenada

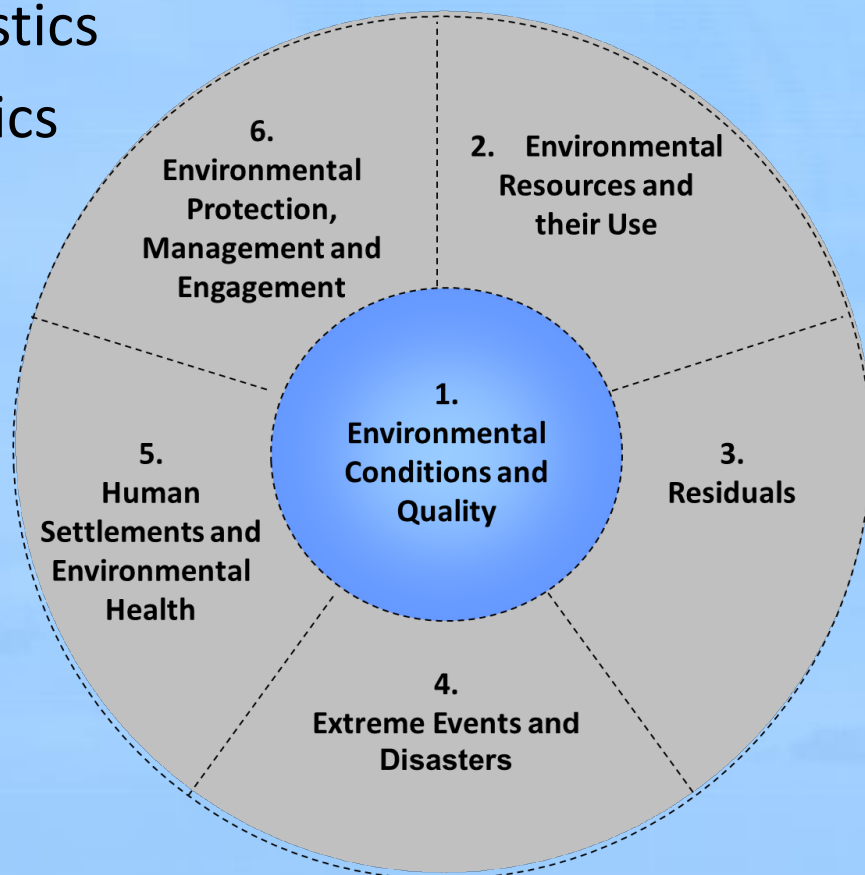4-8 November 2019

Environment Statistics Section, United Nations Statistics Division

Outline

1. GIS and Earth observation in FDES
2. Basic land-cover and land-use statistics
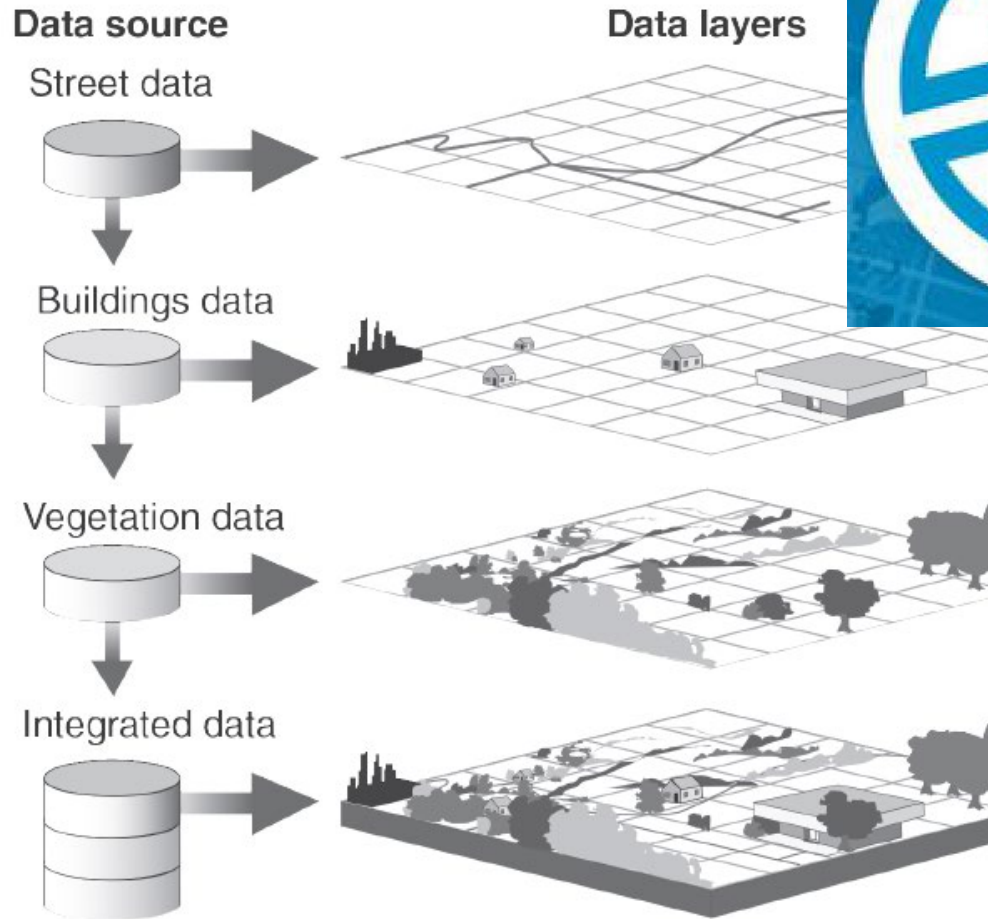3. Ecosystems and Biodiversity Statistics
4. Closing Discussion

GIS and Earth observation in FDES

Geospatial information adds significant value and utility to environment statistics

Example of GIS data layers or themes[16]

Data source — Data layers

Street data

Buildings data

Vegetation data

Integrated data

UN-GGIM
UNITED NATIONS INITIATIVE ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

Geological and geographical information and Statistics
(Topic 1.1.3)
of the Basic Set of Environment Statistics of the FDES 2013)

Draft Version 1.0
05April 2019

Elaborated by the Environment Statistics Section of the United Nations Statistics Division, in collaboration with the Expert Group on Environment Statistics.

Main concepts and definitions on Earth Observation

1. Remote sensing: the science and art of identifying, observing, and measuring an object without coming into direct contact with it. This process involves the detection and measurement of radiation of different wavelengths reflected or emitted from distant objects or materials, by which they may be identified and categorized by class/type, substance, and spatial distribution (NASA).

Measures continuous arrays of reflectance values and the (approximate!) geographic location of pixels or grid-cells
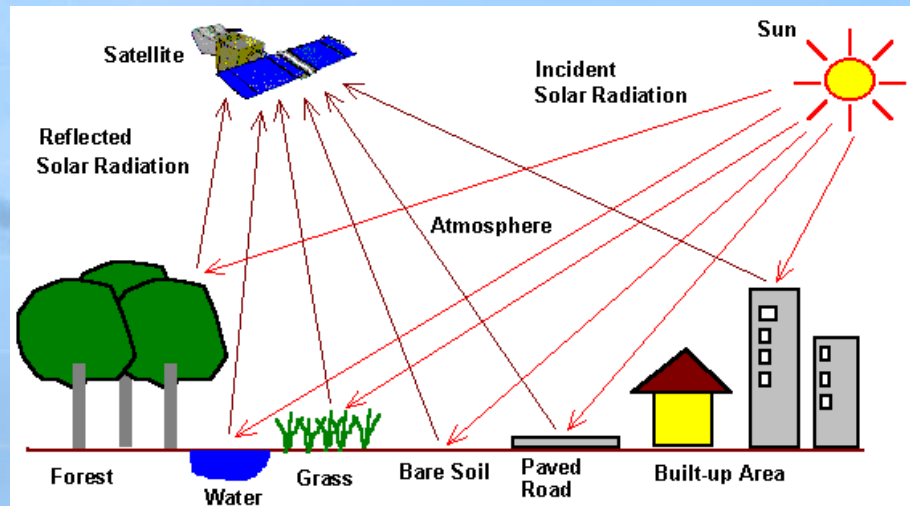
Main concepts and definitions on GIS

- GIS is "An integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes" Source: ESRI

- The underlying assumption is that any geographic entity can be depicted as a Feature (point, line or polygon), or group of Grid cells

- A set of feature data representing a concrete theme is called vector layer, for example layer of post offices (points), layer of roads, layer of rivers (lines), layer of cadastral properties (polygons). Multiple layers can be overlaid and visualized as composite landscape structures on a single layout map.

- A raster layer references a raster file as its data source and a raster renderer that defines how the raster data should be rendered and any additional display properties. Source: ESRI

- The single maps are 'fixed' as a Data frame (containing several layers and grids as separate files) and saved as a Project

- Geodatabase is a set of shapefiles (either points, lines, polygons) and grids linked in a single structure

- Complete list of terms available from ESRI here:
  http://webhelp.esri.com/arcgisserver/9.3/java/geodatabases/definition_frame.htm

Land cover and land use statistics in FDES

Why are land statistics needed?

- Spatial foundation for all national administrative data and policies

- Land & resource management, conservation and restoration policies (biodiversity loss, desertification), land tenure

- Climate change: land use change, critical for understanding GHG emissions and removals; UNCCD

- Links to SEEA-CF (Forest, Soil); SEEA-Agriculture, Fisheries & Forests; Foundation for SEEA-EEA (Ecosystem Accounting)

- Indicators:
  - Land cover change - where are changes occurring?
  - Land cover by land use - who manages it?

Land statistics support many SDGs

Land cover & change

1 NO POVERTY

4 QUALITY EDUCATION

Distinguish urban/rural

6 CLEAN WATER AND SANITATION

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Distinguish freshwater areas

11 SUSTAINABLE CITIES AND COMMUNITIES

Provide detail within urban

14 LIFE BELOW WATER

Distinguish
- catchment areas
- marine and coastal areas

15 LIFE ON LAND

Distinguish
- forest area
- degraded land
- mountain areas

15 LIFE ON LAND

Distinguish forestry areas

Land use

2 ZERO HUNGER

Distinguish agricultural areas

14 LIFE BELOW WATER

Distinguish marine and costal protected areas

Land ownership

1 NO POVERTY

Agree on land tenure (who owns?)

5 GENDER EQUALITY

BSES tables

Component 1: Environmental Conditions and Quality			
Subcomponent 1.2: Land Cover, Ecosystems and Biodiversity			
Topic 1.2.1: Land cover			
Statistics and related information			
(Bold text—Core Set/Tier 1; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. **Area under land cover categories**	Area	• By location • By type of land cover (e.g., artificial surfaces, including urban and associated areas; herbaceous crops; woody crops; multiple or layered crops; grassland; tree-covered areas; mangroves; shrub-covered areas; shrubs and/or herbaceous vegetation, aquatic or regularly flooded; sparsely natural vegetated areas; terrestrial barren land; permanent snow and glaciers; inland water bodies; and coastal water bodies and inter-tidal areas)[a] • National • Subnational	• FAO Land Cover Classification System • System of Environmental-Economic Accounting (SEEA) Central Framework (2012) land cover categories • European Environment Agency (EEA)
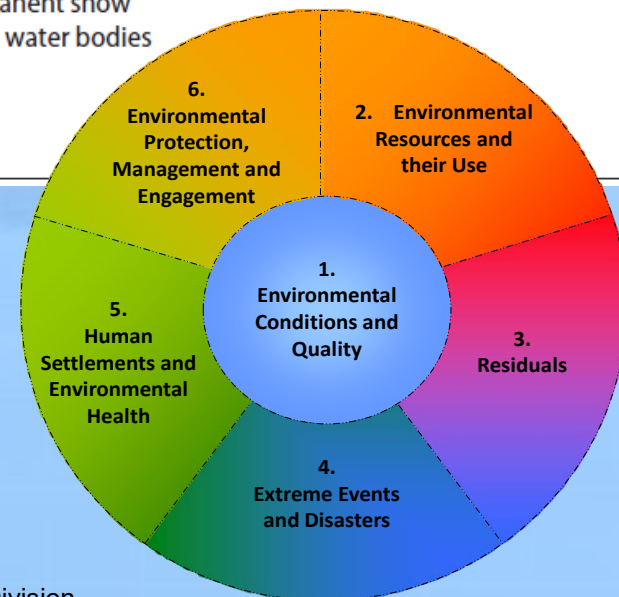
How do land cover and use statistics look like?

Component 2: Environmental Resources and their Use			
Subcomponent 2.3: Land			
Topic 2.3.1: Land use			
Statistics and related information			
(Bold text—Core Set/Tier 1; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. **Area under land use categories**	Area	• By type of land use (e.g., agriculture; forestry; land used for aquaculture; use of built-up and related areas; land used for maintenance and restoration of environmental functions; other uses of land not elsewhere classified; land not in use; inland waters used for aquaculture or holding facilities; inland waters used for maintenance and restoration of environmental functions; other uses of inland waters not elsewhere classified; inland water not in use; coastal waters (including area of coral reefs and mangroves); Exclusive Economic Zone (EEZ)) • National • Subnational	• FAO • UNECE Standard Classification of Land Use (1989) • SEEA Central Framework (2012) Annex 1
b. Other aspects of land use		• National • Subnational	
1. *Area of land under organic farming*	Area		• FAO Inter-departmental Working Group on Organic Agriculture
2. Area of land under irrigation	Area		
3. Area of land under sustainable forest management	Area		• Forest Stewardship Council
4. *Area of land under agroforestry*	Area		
c. Land ownership	Area	• By ownership category • National • Subnational	• FAO

How do land cover and use statistics look like?

Topic	Statistics and Related Information (**Bold Text - Core Set/Tier 1**; Regular Text - Tier 2; *Italicized Text - Tier 3*)		Area (ha) 2000	Area (ha) 2018
Topic 2.3.1: Land use	a.	Area under land use categories	Area	Area
	1.	Agriculture	Area	Area
	2.	Forestry	Area	Area
	3.	Aquaculture	Area	Area
	4.	Built up and related area	Area	Area
	5.	Land used for maintenance and restoration of environmental functions	Area	Area
	6.	Other land use not elsewhere classified	Area	Area
	7.	Land not in use	Area	Area
	8.	Inland waters used for aquaculture	Area	Area
	9.	Inland waters used for maintenance and restoration of environmental functions	Area	Area
	10.	Other uses of inland waters not elsewhere classified	Area	Area
	11.	Inland water not in use	Area	Area
	12.	Coastal waters (includes area of coral reefs, mangroves, etc.) (also in 1.1.3.b)	Area	Area
	13.	Exclusive Economic Zone (EEZ) (also in 1.1.2.e)	Area	Area
	b.	Other aspects of land use	Area	Area
	1.	*Area of land under organic farming*	Area	Area
	2.	Area of land under irrigation	Area	Area
	3.	Area of land under sustainable forest management	Area	Area
	4.	*Area of land under agroforestry*	Area	Area
	c.	Land ownership - private land	Area	Area
	c.	Land ownership - public land	Area	Area

What is land cover and land use?

Land is a unique resource and asset, that delineates the space in which economic activities and environmental processes take place and within which environmental resources and economic assets are located (*FDES p. 43, also in SEEA-CF p. 174*). Land is finite, and is under pressure to serve the growing demands for human needs

The two primary aspects of land, land cover and land use, are separate but related concepts.   **Land cover** is the 'observed biophysical cover on the earth's surface (FAO, 2005) e.g., lakes, wetlands, forests, etc.; while **land use** refers to the socioeconomic or functional aspects of land, hence describing the activities, management and institutional arrangement put in place e.g., timber, fuelwood, commercial, recreation.

Statistics on land cover record systematically the areas by defined types (also termed extents with their characteristics). Land use statistics cover both land in use and land not in use.

Key definitions

- Area under land cover categories (FDES 1.2.1.a): The area of land cover is the area under each land cover category of the classification used. Land cover change is an equally important statistic and indicates the changes occurring to the land cover over time

- Area under land use categories (FDES 2.3.1.a): The area of land use is the area under each land use category of the classification used. Land use change is an equally important statistic and indicates the changes occurring to the land use over time.

- Area of land under organic farming (FDES 2.3.1.b.1): Organic agriculture (farming) is a specific and precise standard of production which aims at achieving optimal agroecosystems that are socially, ecologically and economically sustainable.

- Area of land under irrigation (FDES 2.3.1.b.2) …

- Area of land under sustainable forest management (FDES 2.3.1.b.3)

- Area of land under agroforestry (FDES 2.3.1.b.4)

- Land ownership (FDES 2.3.1.c)

Classifications and legends

❖ Land use or land cover products develop their legends based on a classification. There is often a lack of comparability between products as land use or land cover classification definitions can vary between dataset or map products

❖ A legend is the defined mapping

❖ Most relevant

1. Land Cover Cla
   SEEA Land cov
   p. 299)

SEEA CF Land cover classification
  1 Artificial surfaces (including urban and associated areas)
  2 Herbaceous crops
  3 Woody crops
  4 Multiple or layered crops
  5 Grassland
  6 Tree-covered areas
  7 Mangroves
  8 Shrub-covered areas
  9 Shrubs and/or herbaceous vegetation, aquatic or regularly flooded
  10 Sparsely natural vegetated areas
  11 Terrestrial barren land
  12 Permanent snow and glaciers
  13 Inland water bodies
  14 Coastal water bodies and intertidal areas

Classifications and legends

❖ Land use
   classifica
   as land u
   dataset c

❖ A legend
   defined n

❖ Most rele

2. IGBP Class

⬛	0 Water
🟩	1 Evergreen Needleleaf Forest
🟩	2 Evergreen Broadleaf Forest
🟩	3 Deciduous Needleleaf Forest
🟩	4 Deciduous Broadleaf Forest
🟩	5 Mixed Forests
🟪	6 Closed Shrublands
⬜	7 Open Shrublands
🟨	8 Woody Savannas
🟧	9 Savannas
🟧	10 Grasslands
🟦	11 Permanent Wetlands
🟨	12 Croplands
🟥	13 Urban and Built-Up
🟫	14 Cropland/Natural Vegetation Mosaic
⬜	15 Snow and Ice
⬜	16 Barren or Sparsely Vegetated

Classifications and legends

❖ Land use or land cover products develop their legends based on a classification. There is often a lack of comparability between products as land use or land cover classification definitions can vary between

3.

111: Continuous urban fabric	222: Fruit trees & berry plantations	331: Beaches, dunes, sands
112: Discontinuous urban fabric	223: Olive groves	332: Bare rocks
113: Diffuse constructions	224: Lavender	333: Sparsely vegetated areas
121: Industrial or commercial units	231: Pastures	334: Burnt areas
122: Road & rail networks	241: Ann. crops assoc. with peren.	335: Glaciers & perpetual snow
123: Port areas	242: Complex cultivation patterns	400: Undifferentiated wet areas
124: Airports	243: Agriculture + natural veg.	411: Inland marshes
131: Mineral extraction sites	244: Agro-forestry areas	412: Peat bogs
132: Dump sites	311: Broad-leaved forest	421: Salt marshes
133: Construction sites	312: Coniferous forest	422: Salines
141: Green urban sites	313: Mixed forest	423: Intertidal flats
142: Sport & leisure facilities	321: Natural grassland	511: Water courses
211/212: Arable land	322: Moors & heathland	512: Water bodies
213: Rice fields	323: Sclerophyllous vegetation	521: Coastal lagoons
214: Greenhouses	324: Transitional woodland-scrub	522: Estuaries
221: Vineyards	325: Moors	523: Sea & ocean

European guidance: CORINE Land cover and LUCAS

- CORINE land cover is an example of harmonized and decentralized production of land cover data

- Customized software tool ensures complete comparability between countries and time periods although input data differs

- LUCAS is a network of sample points for which land data is regularly observed and recorded

Available data from international sources

International data sources

- European Space Agency
- NASA
- Many more

A new time series of consistent global LC maps at 300 m spatial resolution on an annual basis from 1992 to 2015

•Source: https://www.esa-landcover-cci.org/?q=node/158
•Viewer: http://maps.elie.ucl.ac.be/CCI/viewer/index.php

Three global LC maps for the 2000, 2005 and 2010 epochs

The CCI-LC team has successfully produced and released its 3-epoch series of global land cover maps at 300m spatial resolution, where each epoch covers a 5-year period (2008-2012, 2003-2007, 1998-2002). These maps were produced using a multi-year and multi-sensor strategy in order to make use of all suitable data and maximize product consistency. The entire 2003-2012 MERIS Full and Reduced Resolution (FR and RR) archive was used as input to generate a 10-year 2003-2012 global land cover map. This 10-year product has then served as a baseline to derive the 2010, 2005 and 2000 maps using back- and up-dating techniques with MERIS and SPOT-Vegetation time series specific to each epoch.
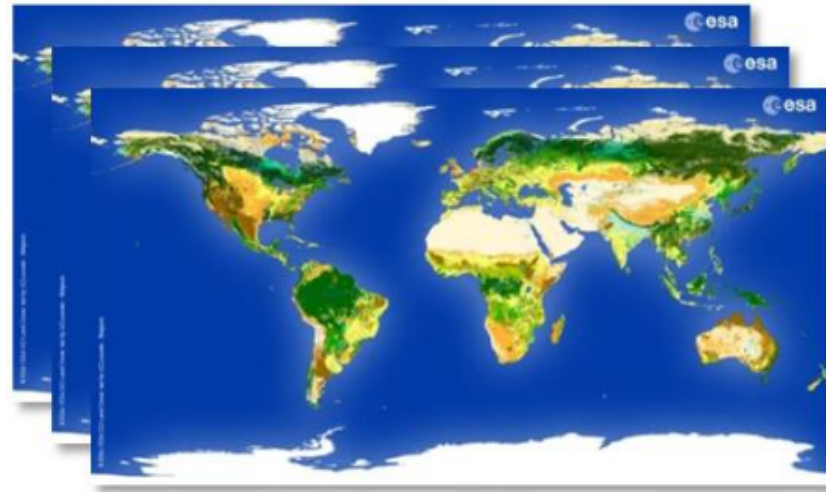
In order to meet the user requirement set in this project, the map proposes a legend based on the UN Land Cover Classification System (LCCS) with the view to be as much as possible compatible with the GLC2000, GlobCover 2005 and 2009 products. The level of thematic details was found to be improved with respect to previous global LC products. Each map is characterized by a set of quality flags.

For more information on the products, go to: http://maps.elie.ucl.ac.be/CCI/viewer.

LAND USE/LAND COVER MAP FOR GRENADA

What do you need to compile land statistics?

1. GIS platform

2. Maps

3. Expertise (EO, vegetation)

4. Ground truthing and statistics

**Assess inputs,
Confusion matrix, Kappa**

5. Classification(s) and units

**International ones
Re-classify
Harmonize inputs**

6. Compilation template

**At least 2 time periods
Changes in additions and reductions
Aggregate and allocate statistics**

Review available data sources
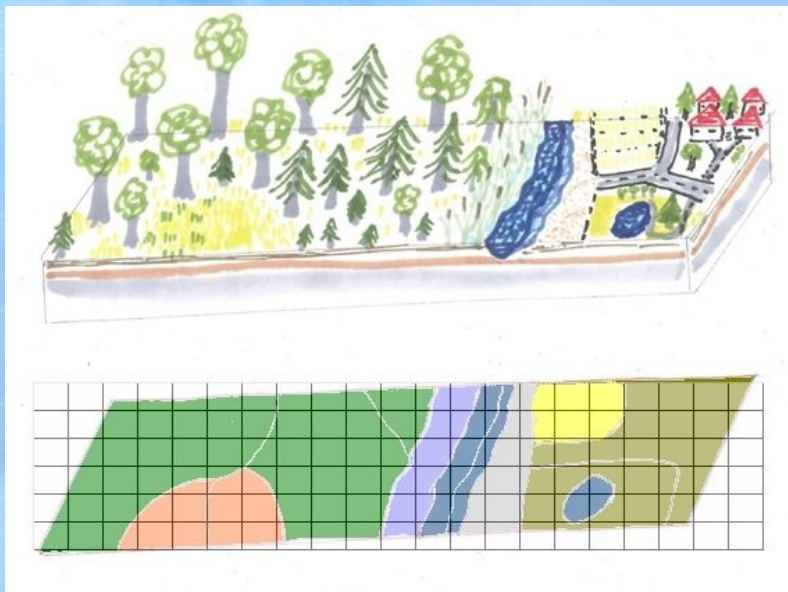
Input data types

earthexplorer.usgs.gov

ID: L1C_T20PPU_A012134_20190703T143800
Acquisition Date: 2019/07/03
Platform: SENTINEL-2B
Tile Number: T20PPU

25

ID: L1C_T20PPU_A021014_20190701T144736
Acquisition Date: 2019/07/01
Platform: SENTINEL-2A
Tile Number: T20PPU

26

ID: L1C_T20PPU_A011991_20190623T143800
Acquisition Date: 2019/06/23
Platform: SENTINEL-2B
Tile Number: T20PPU

27

ID: L1C_T20PPU_A020871_20190621T144735
Acquisition Date: 2019/06/21

Leaflet | Tiles © Esri — Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, UPR-EGP, and the G

The provided maps are not for purchase or for download; it is to be used as a guide for reference and search purposes only.

Source: https://earthexplorer.usgs.gov/

22

Key point: one official map for multiple uses

- Different departments often use different classifications and sources

- Key objective is to agree on one map able to serve multiple purposes

- Consistency with international sources will facilitate reporting obligations

Ecosystems and Biodiversity Statistics (Topic 1.2.2)

What are Ecosystems and Biodiversity statistics?

- Ecosystems and their biodiversity are essential for life: provide provisioning services, regulatory services, habitat and supporting services and cultural services

- Natural ecosystems - currently under threat from climate change, pollution, land use change, human settlement encroachment, over-exploitation and invasive species (sixth mass extinction)

- Latest IPBES report (2019) 'finds that around 1 million animal and plant species are now threatened with extinction, more than ever before in human history', further:

- 75% of the land- and about 66% of the marine environment have been significantly altered by human actions (less severe or avoided in areas held or managed by Indigenous Peoples and Local Communities.. at least a quarter of land area, 35% of which is formally protected)

- More than a third of the world's land surface and nearly 75% of freshwater resources are now devoted to crop or livestock production.

- Land degradation has reduced the productivity of 23% of the global land surface

- In 2015, 33% of marine fish stocks were being harvested at unsustainable levels; 60% were maximally sustainably fished, with just 7% harvested at levels lower than sustainably fished.

- Urban areas have more than doubled since 1992.

Source: https://www.ipbes.net/global-assessment-report-biodiversity-ecosystem-services

- https://www.un.org/sustainabledevelopment/blog/2019/05/nature-decline-unprecedented-report/

Why are Ecosystems and Biodiversity statistics needed?

- Policy context: CBD's Aichi Biodiversity Targets and the 2030 Agenda for Sustainable Development (SDG15)
- Uses: subsistence, tourism support
- Gaps: data gaps, biodiversity statistics are not common in NSS
- Needs: integrate and streamline into official statistics production processes

Biodiversity and ecosystems in SDGs

6 CLEAN WATER AND SANITATION

Indicator 6.6.1 Change in the extent of water-related ecosystems over time

14 LIFE BELOW WATER

Indicator 14.1.1 Index of coastal eutrophication and floating plastic debris density

Indicator 14.3.1 Average marine acidity (pH) measured at agreed suite of representative sampling stations

Indicator 14.5.1 Coverage of protected areas in relation to marine areas

15 LIFE ON LAND

Indicator 15.1.2 Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type

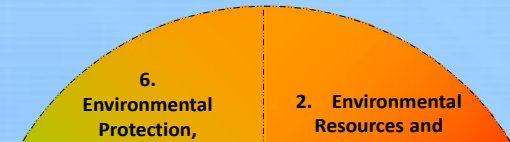Indicator 15.3.1 Proportion of land that is degraded over total land area

Indicator 15.4.1 Coverage by protected areas of important sites for mountain biodiversity

Indicator 15.5.1 Red List Index

Indicator 15.9.1 Progress towards national targets established in accordance with Aichi Biodiversity Target 2 of the Strategic Plan for Biodiversity 2011–2020 (Tier III)

BSES tables

	6. Environmental Protection,	2. Environmental Resources and

Topic 1.2.3: Biodiversity	a.	Flora - terrestrial, freshwater and marine (also in 1.2.2.c)		• By class (e.g., mammals, fishes, birds, reptiles, etc.) • By status category (e.g., extinct, extinct in the wild, threatened, near threatened, least concern) • National • Sub-national	• Millennium Ecosystem Assessment • CBD • IUCN Red List of Threatened Species • UNECE Standard Statistical Classification of Flora, Fauna and Biotopes (1996) • FAO FISHSTAT (Species population and number of invasive alien species)
		1. **Number of known species by status category**	Number		
		2. Species population	Number		
		3. Number of endemic species	Number		
		4. Number of invasive alien species	Number		
		5. *Habitat fragmentation*	Area, Description, Location, Number		
	b.	Fauna - terrestrial, freshwater and marine (also in 1.2.2.c)			
		1. **Number of known species by status category**	Number		
		2. Species population	Number		
		3. Number of endemic species	Number		
		4. Number of invasive alien species	Number		
		5. *Habitat fragmentation*	Area, Description, Location, Number		
	c.	Protected areas		• By location • By management category (c) • By ecosystem • National	• IUCN Protected Area Management Categories • UNSD: Millennium Development Goal (MDG) Indicator 7.6 Metadata
		1. **Protected terrestrial (including inland water) and marine area** (also in 1.2.4.a)	Area		
	d.	Protected species		• By relevant species • By ecosystem • By status category	• IUCN Red List of Threatened Species • UNSD: MDG Indicator 7.7 Metadata
		1. Number of terrestrial, freshwater and marine protected flora	Number		
		2. Number of terrestrial, freshwater and marine protected fauna species	Number		

(c) IUCN reporting categories: Strict natural reserves; Wilderness areas; National parks, Natural monuments and features; Habitat (species) protected areas; Protected landscapes; and Protected areas with sustainable use of natural resources

How do ecosystem statistics look like?

Basic table template

		1.2.2 Ecosystems	2000	2005	2010	2015
a.		General ecosystem characteristics, extent and pattern				
	1	**Area of ecosystems**	Area	Area	Area	Area
		Mangroves	Area	Area	Area	Area
		…	Area	Area	Area	Area
		…	Area	Area	Area	Area
		…	Area	Area	Area	Area
		…	Area	Area	Area	Area
	2	*Proximity of relevant ecosystem to urban areas and*	Distance	Distance	Distance	Distance
b.		Ecosystems' chemical and physical characteristics				
	1	*Nutrients*				
	2	*Carbon*				
	3	*Pollutants*	Concentration	Concentration	Concentration	Concentration
c.		Biological components of ecosystems (also in 1.2.3.a-b)				
	1	Flora and fauna species	Number	Number	Number	Number
	2	Number of endemic species	Number	Number	Number	Number
	3	**Number of known species by status category**	Number	Number	Number	Number

What are Ecosystems and Biodiversity?

'An ecosystem is defined as a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit'

'Biodiversity is "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'

Definitions

❖ Area of ecosystem (FDES 1.2.2.a.1): The area covered by an individual ecosystem; also termed 'Ecosystem extent'

❖ Proximity of ecosystem to urban areas and cropland (FDES 1.2.2.a.2): The distance from the urban or cropland ecosystems to other types of ecosystem within a geographical area

❖ Nutrients (FDES 1.2.2.b.1): Amount of nutrient found in soil, freshwater and marine water

❖ Carbon (FDES 1.2.2.b.2): Amount of soil organic carbon stock. Soil organic carbon is the amount of organic carbon stored in the soil

❖ Pollutants (FDES 1.2.2.b.3): Amount of pollutants found in soil, freshwater and marine water

❖ Known flora and fauna species (FDES 1.2.2.c.1): Number of known flora and fauna species present in the specific ecosystem

❖ Endemic flora and fauna species (FDES 1.2.2.c.2): Population of a species that is native to the region, and which area of distribution is restricted to a small place

❖ Invasive alien flora and fauna species (FDES 1.2.2.c.3): A subset of introduced

Classifications

❖ Most relevant classifications: IUCN classification of protected areas

Category	Description
Ia: Strict Nature Reserve	Category Ia are strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.
Ib: Wilderness Area	Category Ib protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.
II: National Park	Category II protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.
III: Natural Monument or Feature	Category III protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.
IV: Habitat/Species Management Area	Category IV protected areas aim to protect particular species or habitats and management reflects this priority. Many category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.
V: Protected Landscape/Seascape	A protected area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.
VI: Protected area with sustainable use of natural resources	Category VI protected areas conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

Classifications

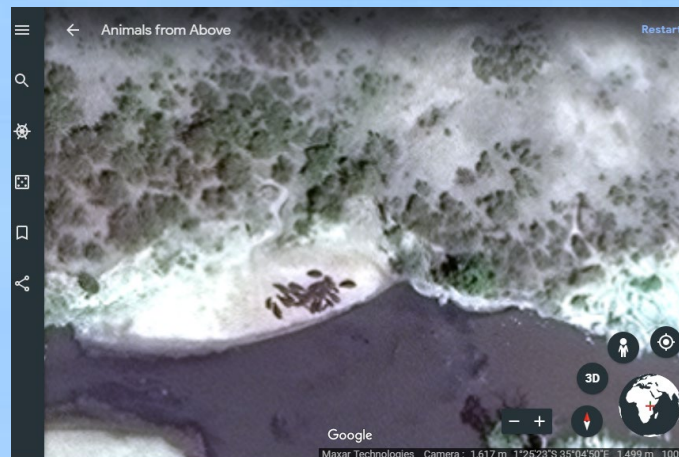❖ Most relevant classifications: IUCN species conservation status
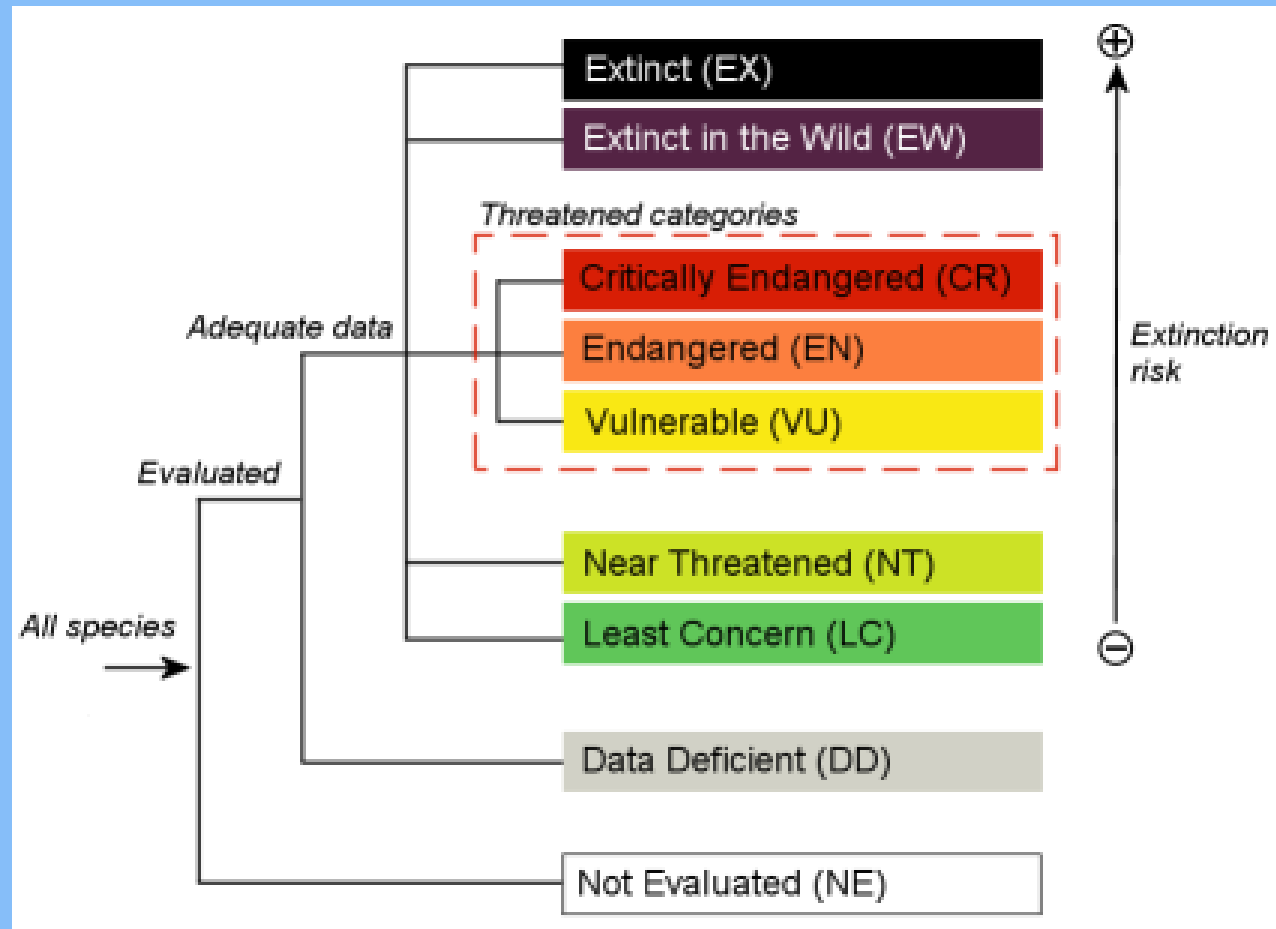
Input data on species and ecosystems

1. NSDI, GIS platform: ArcGIS, qGIS, R, Python

2. Counts of species, with population size and distribution

3. EO instruments: ESA Sentinels, NASA MODIS, Landsat

Admin. units, boundaries: country boundary, coast and islands

Other helpful spatial data: e.g. deforestation, protected areas, infrastructure

From data to statistics

Ecosystem and biodiversity statistics need 'alternative' data sources

- EO+modelling for ecosystems/habitats
- Sampling, surveys for species and their populations
- Biodiversity is expressed at various scales (alfa, beta, gama) and assessed in various indexes, Simpson's index
  - Need to know:
    1. number of species
    2. Distribution of species

Simpson's Diversity Indices

The term 'Simpson's Diversity Index' can actually refer to any one of 3 closely related indices.

Simpson's Index (D) measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species). There are two versions of the formula for calculating **D**. Either is acceptable, but be consistent.

$$D = \sum (n / N)^2$$

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

n = the total number of organisms of a particular species
N = the total number of organisms of all species

The value of **D** ranges between 0 and 1

With this index, 0 represents infinite diversity and 1, no diversity. That is, the bigger the value of D, the lower the diversity. This is neither intuitive nor logical, so to get over this problem, D is often subtracted from 1 to give:

Simpson's Index of Diversity 1 - D

The value of this index also ranges between 0 and 1, but now, the greater the value, the greater the sample diversity. This makes more sense. In this case, the index represents the probability that two individuals randomly selected from a sample will belong to different species.

Species evenness:
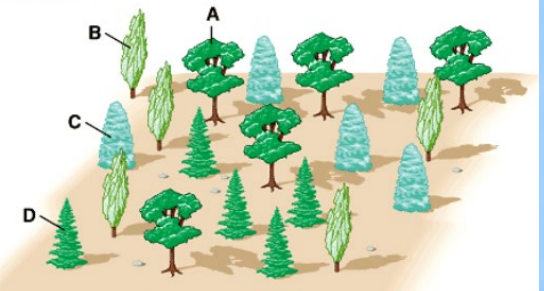
Community 1
A: 25%   B: 25%   C: 25%   D: 25%

Community 2
A: 80%   B: 5%   C: 5%   D: 10%

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https://socratic.org/questions/how-is-biodiversity-measured

Biodiversity in SDGs

Calculate "Red List Index": **The Red List Index provides an indicator of trends in species' extinction risk, as measured using the IUCN Red List Categories and Criteria (Mace et al. 2008, IUCN 2012a), and is compiled from data on changes over time in the Red List Category for each species, excluding any changes driven by improved knowledge or revised taxonomy.**

The RLI value is calculated by multiplying the number of species in each red list category by the category weight (0 for LC, 1 for NT, 2 for VU, 3 for EN, 4 for CR and 5 for EX) these products are summed, divided by the maximum possible product (number of species multiplied by the maximum weight of 5) and subtracted from one (Bubb et al. 2009) This produces an index value that ranges from 0 to 1.

Weightings

5	Extinct (EX)
4	Critically Endangered (CR)
3	Endangered (EN)
2	Vulnerable (VU)
1	Near Threatened (NT)
0	Least Concern (LC)
-	Data Deficient (DD)

Calculating the index

Sum of the current threat score

$$RLI_{t_i} = 1 - \frac{\sum_{s=1}^{N} W_{c(t_i, s)}}{W_{EX} \cdot N}$$

Scaling the index from 0 (all EX) to 1 (all LC)

Total possible threat score

International data

SPATIAL DATA & MAPPING RESOURCES

Spatial Data Download

RED LIST MAPS
Discover and explore species distributions and observations

The IUCN Red List of Threatened Species™ contains global assessments for 105,732 species. More than 75% of these (81,323 species) have spatial data.

IUCN data:
https://www.iucnredlist.org/resources/spatial-data-download

One official set of statistics for multiple uses

- Data sources and studies on biodiversity are numerous

- The subject is lagging in official statistics

- Key objective is to agree on a set of statistics of selected species and ecosystems (or habitats) able to serve multiple policy purposes

- Consistency with international sources will facilitate reporting obligations

References

IPBES. 2019. Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science- Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES Secretariat, Bonn, Germany.

Questions and comments?

Thank you for your attention!

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