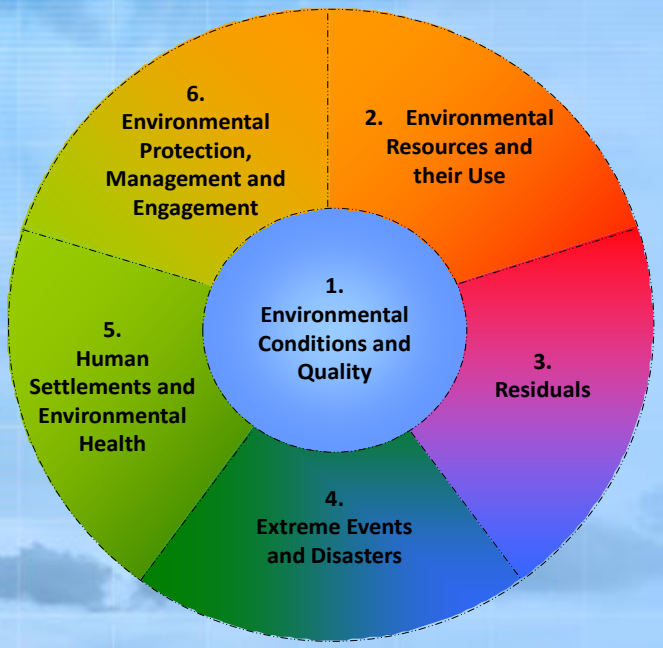
Ecosystems and Biodiversity Statistics (Topic 1.2.2)



National Workshop on Environment Statistics and Climate Change Statistics

St. George's, Grenada, 12-14 November 2019

Environment Statistics Section, United Nations Statistics Division

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

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

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

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

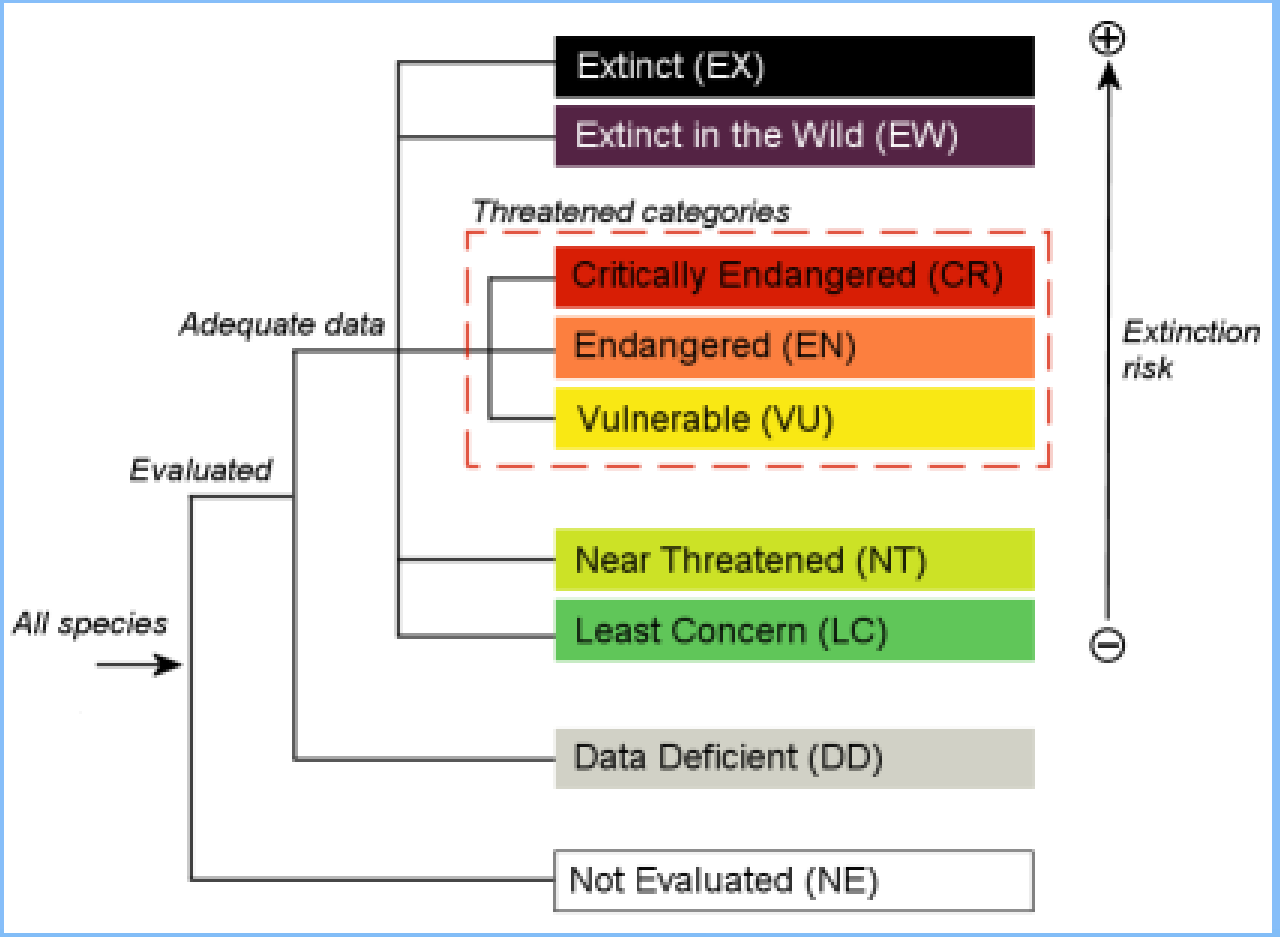
Classifications

- 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

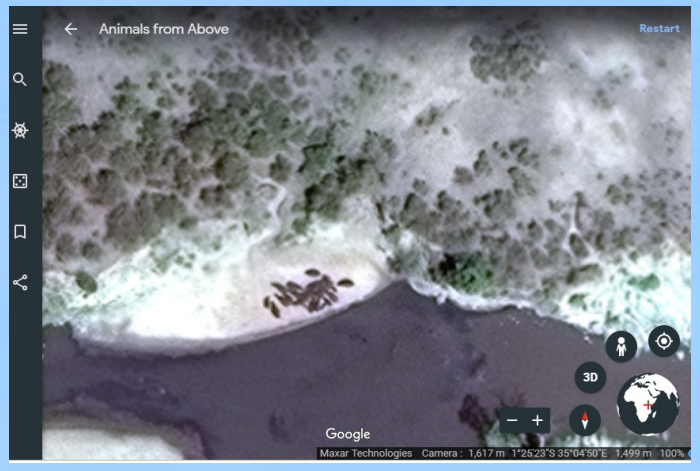
- Most relevant classifications: IUCN species conservation status



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.

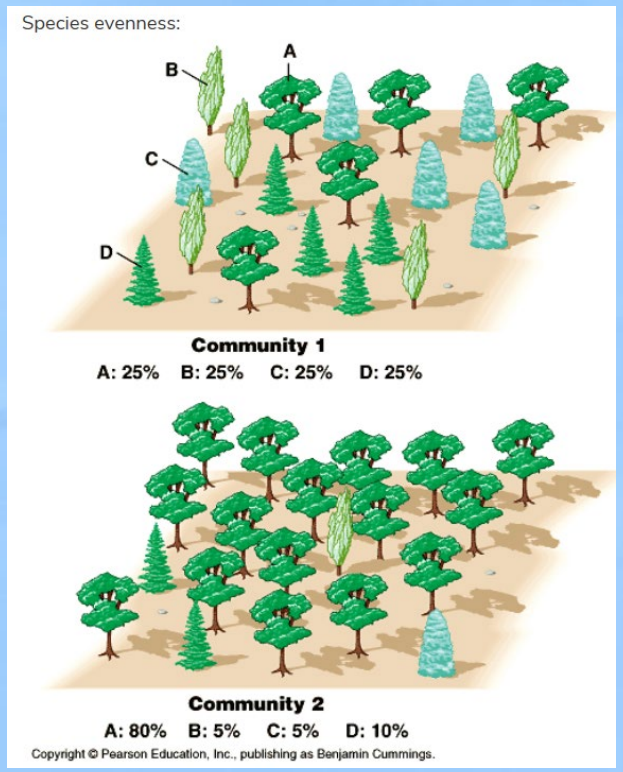
$D = \sum (n / N)^2$	$D = \frac{\sum n(n-1)}{N(N-1)}$
n = the total number of organisms of a particular species N = the total number of organisms of all species	

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.



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)

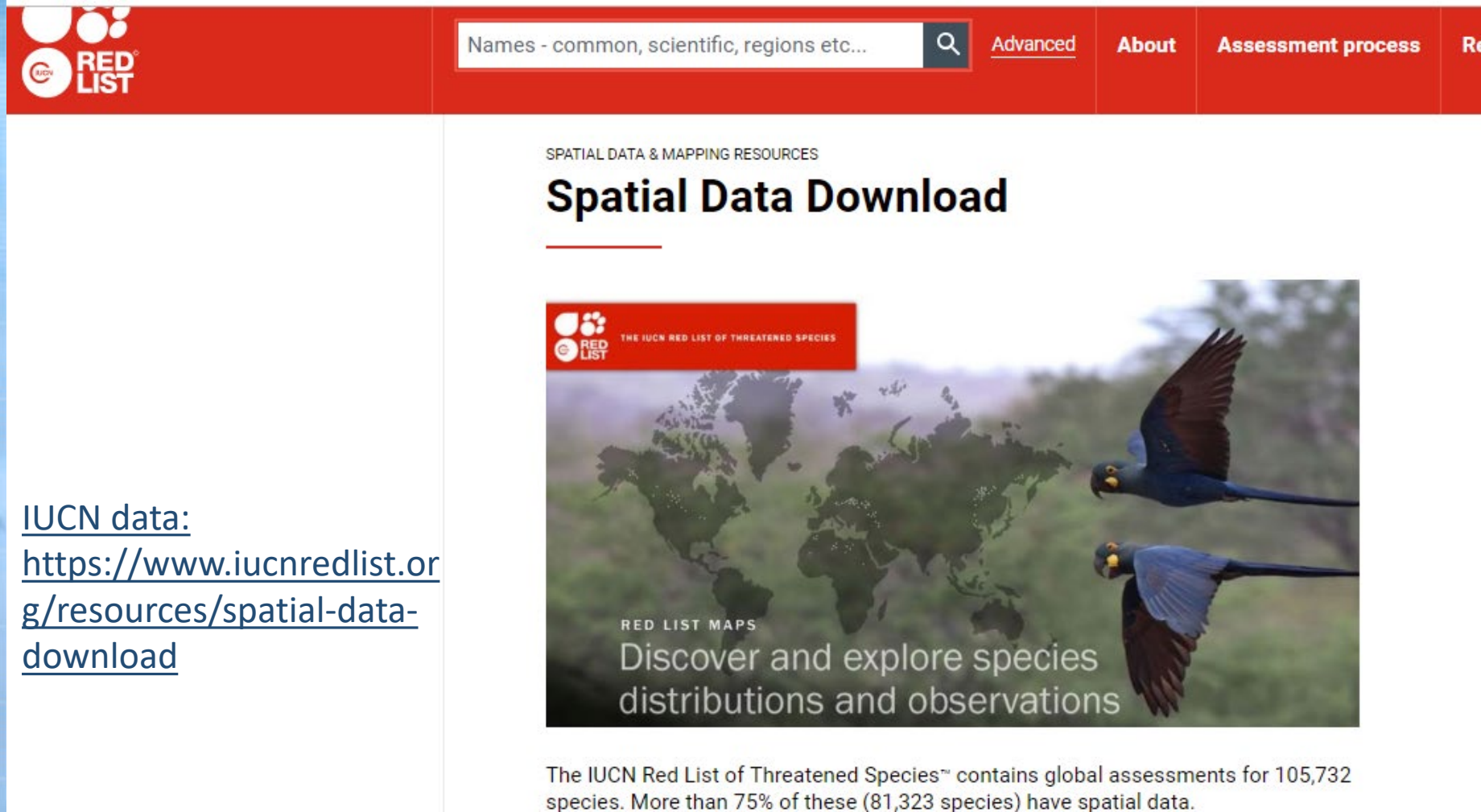
Total possible threat score

Sources: SDGs metadata -https://unstats.un.org/sdgs/metadata/

RLI formula: https://www.nationalredlist.org/support-information/red-list-indices/how-to-create-a-national-red-list-index/calculating-the-rli/

International data

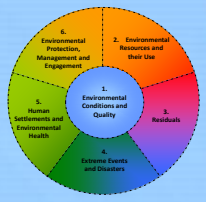
[IUCN data: https://www.iucnredlist.org/resources/spatial-data-download](https://www.iucnredlist.org/resources/spatial-data-download)



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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