10.19.1 City Biodiversity Index

Project Name: UNaLab (Grant Agreement no. 730052)

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City Biodiversity Index	Biodiversity
Description and justification	The definition of biodiversity is the presence of different species of different taxonomic groups. The net change in the number of species in a municipality is an indication of biological diversity loss or gain. A more comprehensive sample of the biodiversity in an area can be obtained through a census of species in different groups. Vascular plants, birds, and butterflies have been defined in the City Biodiversity Index as core taxonomic groups to be followed in all cities. On top of these, cities are encouraged to select two supplementary taxonomical groups chosen to best reflect local biodiversity. The supplementary taxonomical groups can include, e.g., bryophytes, fungi, amphibians, reptiles, fish, beetles, spiders, seagrasses or others.
Definition	The number of native species detected in the urban area, compared to a baseline number of species
Strengths and weaknesses	+ Encourage reintroduction of lost native species to urban areas through active development or protection - The data can be difficult to obtain, it has high variability and requires long timescales to show significant trends
Measurement procedure and tool	Counts of animal and plant species found on the whole urban area of interest are used. As focus in this metric is increasing biodiversity and reintroducing broader array of natural species, it can be sufficient to select a certain biotypes or areas and a selection of species for monitoring. The indicator value is the number of new native species detected in the urban area, compared to a baseline species number. The first part of the framework involves a profile of the city, then 23 indicators are proposed that comprise 3 core components: 1) native biodiversity, 2) ES provided by biodiversity, and 3) governance and management of biodiversity. This framework could be used to undertake a full CBI self-assessment. Alternatively, those indicators that directly measure biodiversity could be used, for example Indicator 3: native biodiversity in built-up areas (bird

	species), or Indicators 4-8 which include three 'core indicator' groups that are most surveyed worldwide – plants, birds and butterflies. Cities can select two additional taxonomic groups (for instance those where data is already held or target groups of local importance/conservation interest). The data from the first year of implementing the Index provides the baseline for future monitoring. It is recommended that application of the Index take place every 3 years to allow sufficient time for the results of biodiversity conservation efforts (e.g., NBS implementation) to materialise. Example units of calculation are: number/abundance of native bird species per hectare. The net change in number of native species from the previous survey to the most recent survey is calculated as: total increase in number of species (as a result of re-introduction or restoration efforts, new species found, etc.) minus number of species that have gone extinct. Possible sources of data include agencies in charge of nature conservation/biodiversity (Wildlife Trusts, etc), city municipalities and urban planning agencies, biological records centres, nature groups, universities, etc.
Scale of measurement	District to region scale
Data source	
Required data	Data on counts of animal and plant species found on the whole urban area of interest. These can be available through municipalities, government agencies, environmental organizations, bird watch organizations or universities.
Data input type	Quantitative or semi-quantitative
Data collection frequency	Annually
Level of expertise required	Low to Moderate – for the identification of the taxonomic groups
Synergies with other indicators	Related to *Reclamation of contaminated land* and *Ratio of open spaces to built form* indicators
Connection with SDGs	SDG 11 Sustainable cities and communities, SDG 13 Climate action, SDG 15 Life on land
Opportunities for participatory data collection	Participatory data collection is feasible via citizen science with appropriate training of the volunteers
Additional information	
References	Chan, L., Hillel, O., Elmqvist, T., Werner, P., Holman, N., Mader, A., & Calcaterra, E. (2014). User's Manual on the Singapore

	Index on Cities' Biodiversity (also known as the City Biodiversity Index). Singapore: National Parks Board, Singapore.

10.20 Bird species richness

Project Name: CONNECTING Nature (Grant Agreement no. 730222)

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Bird Species Richness	Biodiversity
Description and justification	Based on the European Urban Biodiversity Index (EUBI) metric, this indicator uses bird species richness as a proxy for habitat quality in urban areas. Species richness is a crucial component of biodiversity and species density describes how many bird species are encountered within the Formal Urban Area. The concept is based on the idea of umbrella species, whereby bird species richness is considered to be indirectly linked to the conservation and protection of other species within their ecosystem.
Definition	Count of bird species per hexagonal grid cell, derived from modified Article12 datasets from the EU Birds Directive (Number of species per hexagonal grid cell).
Strengths and weaknesses	+ can be aligned with Birds Directive reporting - can represent a substantial amount of survey work, if such a survey protocol is not already established. - the value of the outcomes are proportional to the effort of the survey - whilst birds can represent a good indication of habitat quality, they are not an accurate proxy for all biodiversity.
Measurement procedure and tool	Based on the EUBI metric: C06 Art. 12 Bird species richness The process involves several steps to obtain the Article 12 species count per hexagonal cell. At first a hexagonal grid with a unique identifier for each grid cell is created. This grid is merged with Urban Area polygons which have been assigned towards specific MAES habitats with a crosswalk using the GIS Tool "Union". In a second step, the Article 12 GIS- data is clipped to the Formal Urban Area Boundary and also merged with the grid. Through this process the created datasets obtain a