The IUCN Urban Nature Index

A Methodological Framework

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INTERNATIONAL UNION FOR CONSERVATION OF NATURE

URBAN BIODIVERSITY HUB
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About IUCN

The International Union for Conservation of Nature (IUCN) is a membership Union uniquely composed of both government and civil society organisations. It provides public, private and non-governmental organisations with the knowledge and tools that enable human progress, economic development and nature conservation to take place together.

Created in 1948, IUCN is now the world's largest and most diverse environmental network, harnessing the knowledge, resources and reach of more than 1,400 Member organisations and some 15,000 experts. It is a leading provider of conservation data, assessments and analysis. Its broad membership enables IUCN to fill the role of incubator and trusted repository of best practices, tools, and international standards.

IUCN provides a neutral space in which diverse stakeholders including governments, NGOs, scientists, businesses, local communities, indigenous peoples' organisations and others can work together to forge and implement solutions to environmental challenges and achieve sustainable development.

www.iucn.org

About Arcadia, a charitable fund of Lisbet Rausing and Peter Baldwin

Arcadia supports work to preserve endangered cultural heritage, protect endangered ecosystems, and promote access to knowledge. The fund aims to defend the complexity of human culture and the natural world, so that coming generations can build a vibrant, resilient and green future.

www.arcadiafund.org.uk

About Urban Biodiversity Hub

Founded in 2016, the Urban Biodiversity Hub (UBHub) enables cities around the world to plan with nature. This non-profit organization connects the latest science with current practice and political visions to identify best practices for local governments to assess and implement their biodiversity strategy. UBHub works with municipal and other local governments and their partners to improve the efficiency and effectiveness of their biodiversity planning, according to the goals they set for themselves and in pursuit of justice for all beings. They also host the most comprehensive database and guide on urban biodiversity planning activities and frameworks in a one-stop-shop at www.ubhub.org. The UBHub team is honoured to contribute to the creation of the UNI and is dedicated to supporting its implementation as a part of the suite of tools that are vital to creating a nature-positive future.

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Executive summary

The IUCN Urban Alliance, a broad coalition of IUCN constituents concerned with urban dimensions of nature conservation, has unveiled a new knowledge product for measuring the ecological performance of cities: the IUCN Urban Nature Index (UNI).

Comprising a set of six themes with five indicator topics nested within each theme, the UNI is intended to help cities understand their impacts on nature, set science-based targets for improvement, and monitor progress on science-based measures. By enhancing environmental transparency and accountability, and by focusing on improvement rather than fixed targets the UNI aims to catalyse local action for nature in all cities.

Financed by Arcadia – a charitable fund of Lisbet Rausing and Peter Baldwin, the UNI was developed over a two-year period entailing surveys, workshops, and webinars. Technical support was provided by a team of consultants at Urban Biodiversity Hub, some 30 experts drawn from IUCN Members and Commissions, and representatives of 26 local governments. Six cities volunteered their time to conduct an early testing of the UNI and provide feedback prior to its release: Curridabat (Costa Rica), Lagos (Nigeria), Mexico City (Mexico), Paris (France), Saanich (Canada) and Singapore.

The UNI can be differentiated from other urban sustainability indices by its unique scope, framing, and flexibility. Recognising that the ecological impacts of cities extend far beyond their boundaries, the scope of UNI is intentionally broad, encompassing local, bioregional, and global scales of impact. Recognising the dynamism and complexity of urban systems, the UNI uses the Driver-Pressure-State-Impact-Response framework to identify and address root causes of ecological problems. Furthermore, the UNI allows for cities to select from the range of indicator topics, with alternative options available to fulfil each one. The flexibility of the Index is a core component that ensures each city can adjust the framework to meet local needs and capacities.

IUCN Members have expressed political support for the UNI by way of the Marseille Manifesto—the key outcome document of the 2021 IUCN World Conservation Congress. The Manifesto comprises a bold commitment “to expand universal access to high-quality green spaces and to enhance urban biodiversity in 100 cities, representing around 100 million citizens by 2025, and assessing their impact according to the IUCN Urban Nature Index.”

IUCN has developed an interactive digital platform to present the indicator topics, provide implementation guidance, and share the results of participating cities. While the UNI is primarily intended for use by local governments, the results generated will be of interest to anyone concerned with the relationship between cities and nature, and its implications for human health and wellbeing.

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The early, voluntary testing of the UNI, together with a first feedback, was performed by representatives of six local governments, namely, Adeniran Akanni (Lagos State, Nigeria), Esteban Benítez and Michelle Montijo (Mexico City, Mexico), Eva Riccius (Saanich District Municipality, Canada), Huberth Méndez Hernández (Curridabat Municipality, Costa Rica), Jeanne Fouquoire (City of Paris, France), Lena Chan and Wendy Yap (Singapore National Parks Board, Singapore).

A global consultation elicited detailed survey responses from Ajanta Dey (Kolkata, India), Alessandra Andreazzi Péres (Brasilia, Brazil), Allan Kwanjana (Lilongwe, Malawi), Aulotte Etienne (Brussels, Belgium), Bernd-Ulrich Netz (Hamburg, Germany), Bikash Ranjan Rautray (Bhubaneswar, India), Cameron McLean (Durban, South Africa), Daniela Biaggio (Wellington, New Zealand), Dave Barlow (Manchester, England), Hasna Jasimuddin Moudud (Dhaka, Bangladesh), Julie Dewar (Edinburgh, Scotland), Laura Alicia Guerrero (Posadas, Argentina), Martin Luther Shikongo (Windhoek, Namibia), Michelle Barton (Los Angeles, United States of America), Michelle Montijo Arreguín (Mexico City, Mexico), Nilima Thapa Shrestha (Kathmandu, Nepal), Philippe Jacob (Paris, France), Rajan Chedambath (Kochi, India), Rebecca Kiernan (Pittsburgh, United States of America), Samantha Davenport (London, England), Satish Awate (Pune, India), Sebastian Dunnett (Hammersmith and Fulham, England), and Zhang Daqian (Beijing, China).

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Introduction

Measuring and monitoring are essential to the effective management of natural capital by cities. Qualitative and quantitative indicators can convey valuable information on the status and trends of natural capital stocks, the flows of services they generate, the efficacy of conservation measures, and the impacts of urban consumption on nature globally. In recent years, a plethora of monitoring systems have been developed with different methodologies and approaches. This has resulted in a 'paradox of choice' and limited meaningful comparison of measurements over space and time.

To understand collective urban impacts, streamline data aggregation and optimise resources such as staff time, urban indicators of ecological impacts need to be harmonised and standardised. There is a need for a comprehensive system of indicators, flexible enough to cater to a wide range of users, but firm enough to facilitate comparative measurement. The need is urgent given the accelerated loss of biodiversity worldwide, the extraordinary potential for cities to ameliorate or exacerbate the crisis, the imperative to strengthen urban resilience in the face of climate change, and the necessity for all institutions to make measurable contributions to targets in the Post-2020 Global Biodiversity Framework. As a standard-setting organisation with a broad membership base, the International Union for Conservation of Nature (IUCN) is well placed to lead such a process.

In September 2018, the International Union for Conservation of Nature (IUCN) launched the Urban Alliance – a broad coalition of IUCN constituents working towards "a world in which nature thrives in cities, delivering solutions to multiple environmental, social and economic challenges." With the financial support of Arcadia – a charitable fund of Lisbet Rausing and Peter Baldwin, the IUCN Urban Alliance committed to developing the IUCN Urban Nature Index (UNI) to measure the ecological performance of cities. The UNI was intended to bring together existing indicators and data sources to create a single coherent yet flexible tool valuable to both local governments and larger scale governance institutions.

A two-year development process ensued. It entailed multiple workshops, webinars, and consultations. It involved scores of experts from local governments and IUCN constituencies. From this process emerged a comprehensive system organized into six themes, each containing five indicator topics, constituting the first public version of the UNI and the subject of this report.

While local governments are the primary intended users, the results generated will be of interest to anyone concerned with the relationship between cities and nature, and its implications for human health and wellbeing.

To expedite the rollout of the UNI, IUCN has built an interactive digital platform to present the indicator topics and options to complete them, provide implementation guidance, and share the results of participating cities.

Methodology

The UNI was developed using a mix of deductive and inductive methods, resulting from the initial framework established by the Technical Expert Group, which provided guidance on the general methodology of the Index and recommended indicators. Firstly, a scoping exercise was undertaken to identify existing tools, standards and frameworks of relevance to urban ecological performance. These included, but were not limited to, the Singapore Index on Cities' Biodiversity (Chan *et al.*, 2021), the World Bank Urban Sustainability Framework (GPSC, 2018), the Sustainable Development Goals, the New Urban Agenda, the City Prosperity Index, the International Ecocity Framework and Standards, the Science-based Framework for Building Urban Biodiversity, the 'zero draft' of the post-2020 Global Biodiversity Framework, and various standards prescribed by the International Organisation for Standardisations. From these, a long list of over 450 indicators was compiled. Secondly, a review of the academic literature on conceptual frameworks and indicators for measuring urban drivers, pressures, status, and impacts of ecological health was conducted to identify the latest approaches and best practices.

Then, in accordance with recommended methods for index creation, the long list was substantially reduced by applying a set of recognised criteria: salience, legitimacy, credibility, and feasibility (van Oudenhoven *et al*., 2018; Füssel, 2010; OECD, 2009). A tentative short list of indicators emerged. This was further refined based on feedback received from IUCN scientific advisors, a survey of 24 cities, deliberations at a series of international workshops, and pilot testing within six cities.

Conceptual frameworks

The UNI is informed by two pre-existing frameworks: the Driver-Pressure-State-Impact-Response (DPSIR) model (US Environmental Protection Agency (USEPA), 2015) (see Figure 1) and the Urban Bioshed Impact Areas model (Pierce, 2022) (see Figure 2).

According to Bradley and Yee (2015), the DPSIR model is useful for conveying complex environmental issues. As a systems-thinking framework, it considers the component parts of a system and how they relate to and interact with one another and other systems. The DPSIR model is commonly used in environmental management contexts to demonstrate the cause-and-effect relationship between the interacting components of social, economic and environmental systems. Bradley and Yee (2015) describe the five distinct components of the DPSIR model as follows:

- ***Drivers*** are the social and economic imperatives that seek to fulfil human needs by creating the necessary conditions and, through material consumption, support wellbeing, health, security, and freedom. The provisions for supporting life include food and raw materials, water, shelter, health, culture, security, and infrastructure.

- ***Pressures*** are human activities that induce changes to the environment, for instance, the discharge of chemical, physical or biological agents, or land use changes. The intensity of the pressures depends on the technology and extent of activities that vary across geographic regions and spatial scales.

- ***State*** refers to the physical, chemical, and biological components of the natural environment (i.e., the living and non-living components).

- ***Impacts*** are the resulting changes in the quality and functioning of the ecosystem that influence living things including the production of ecosystem goods and services.

- ***Responses*** are actions taken through policies and regulations to prevent, compensate, ameliorate, or adapt to changes in the state of the environment.

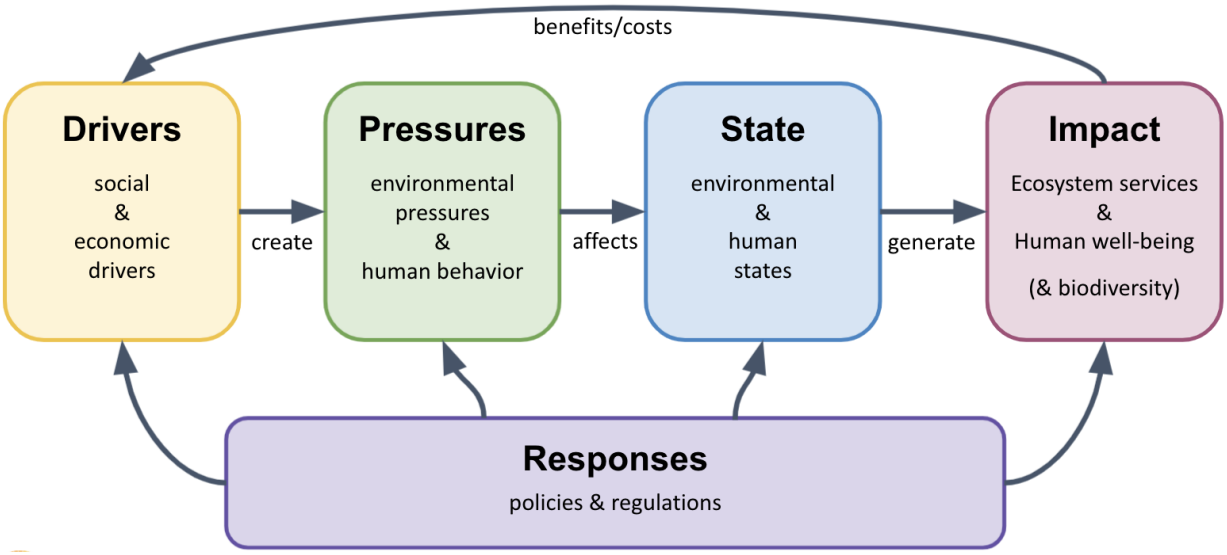

Figure 1. DPSIR model for environmental impacts adapted from the USEPA.

The Urban Bioshed Impact Areas model (Figure 2) helps to conceptualise the wide and varied impacts by scale and sector that cities have on ecosystems, whether they are ultimately harmful or protective. Harmful activities include permitting ecologically destructive urban sprawl or fostering excessive consumption of products obtained via destructive mining practices. Protective activities include the restoration of watersheds via payments for ecosystem services (PES) schemes, or the procurement of certified sustainably harvested products.

Such activities can directly or indirectly impact ecosystems over areas hundreds of times larger than the city itself. As such, the three scales shown in the diagram—in-boundary, hinterland, and global—encourage cities to consider impact areas outside their borders that result from regional resource flows and cycles (e.g., watersheds, airsheds, and nitrogen) and trade (e.g., industrial activities, resource extraction, and the forces of supply and demand that generate them).

The in-boundary scale is defined as the political boundary of the urban area, which can be problematic as these boundaries rarely align with ecological or other functional borders. The hinterland scale is the nearby territory adjacent to the urban political boundary that has a direct economic or other functional link to the city such as farmlands that deliver food products or watersheds that provide drinking water to the city. The global scale refers to the impacts that a city has in distant locations, connected by transportation lines, cultural influence, or other forces of globalization. The three impact areas serve to remind cities of the indirect drivers they can influence, such as market forces, supply chains, and societal norms of consumption.

Lastly, at the centre of the Urban Bioshed Impact Areas model is the notion of equity and justice, underscoring the need for transformational systems that actively oppose the oppression of both human and non-human beings.

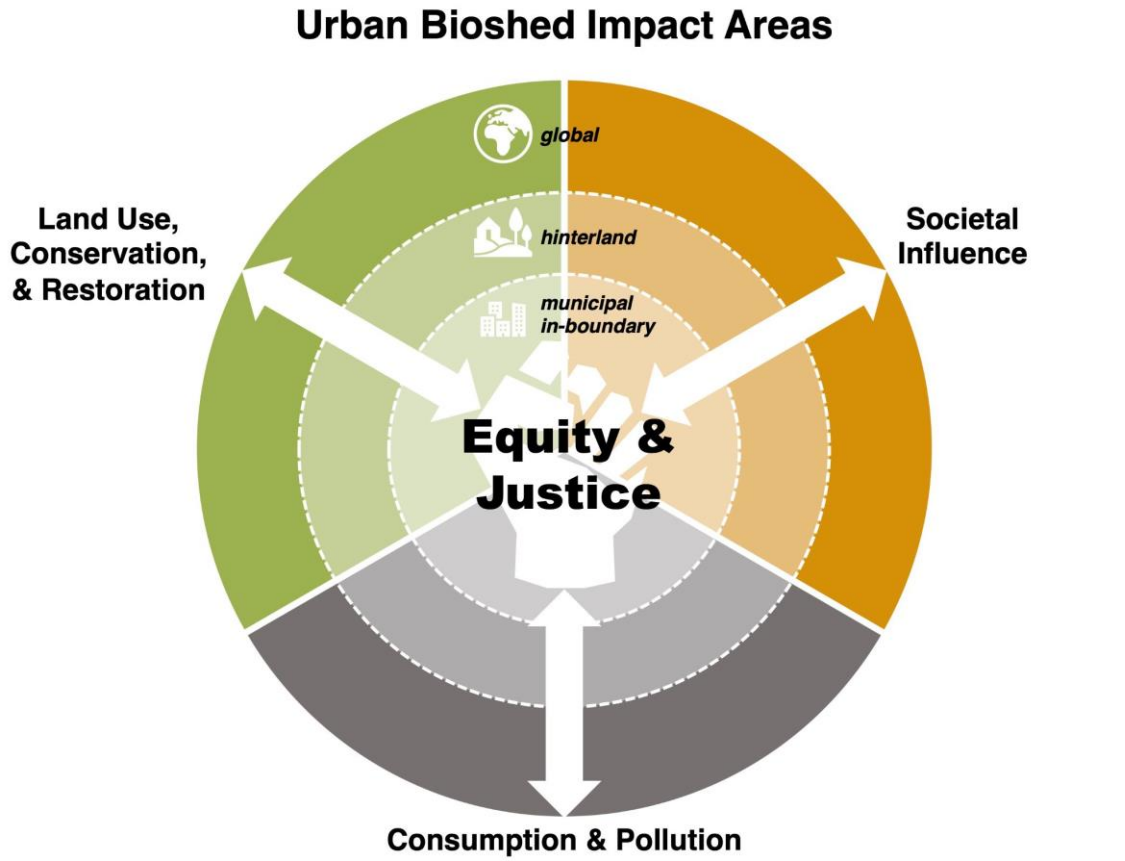

Figure 2. Urban Bioshed Impact Area Model reprinted with permission from the Routledge Handbook for Sustainable Cities and Landscapes in the Pacific Rim (Pierce, 2022). Creative Commons Attribution-Non Commercial-No Derivatives 4.0 license.

Scope and structure

The UNI has been organized into six themes: consumption drivers, human pressures, habitat status, species status, nature's contributions to people, and governance responses. Each theme contains five indicator topics that cities can choose from. As depicted in Table 1 below, collectively, these indicator topics link to all the Sustainable Development Goals, span local (in-boundary), regional (hinterland), and global spheres of influence, and comprise strong equity dimensions.

Table 1. Scope and structure of the UNI.

Theme	ID	Indicator Topics	Equity	Local	Hinterland	Global	SDG
1 Consumption Drivers	**1.1**	Material Consumption			x	x	12, 11.6
	1.2	Harmful Harvest & Trade			x	x	12
	1.3	GHG Emissions from Energy				x	7, 13
	1.4	Unsustainable Diets	x			x	2
	1.5	Water Withdrawal		x	x		6
2 Human Pressures	**2.1**	Sprawl			x		15
	2.2	Water Pollution		x	x	x	6, 12.4
	2.3	Noise Pollution		x			14, 15
	2.4	Light Pollution		x	x		15
	2.5	Invasive Species		x	x		14, 15
3 Habitat Status	**3.1**	Land Use/Protection		x	x		15
	3.2	Ecosystem Restoration		x	x		15
	3.3	Shorelines & River Banks		x	x	x	14
	3.4	Vegetation Cover		x			13, 11.6
	3.5	Connectivity		x	x		14, 15
4 Species Status	**4.1**	Animal Species		x	x	x	14, 15
	4.2	Plant Species		x	x	x	14, 15
	4.3	Functional Diversity		x			14, 15
	4.4	Microbiota		x	x		14, 15
	4.5	Endemic Species		x	x	x	14, 15
5 Nature's Contributions to People	**5.1**	Exposure to Nature		x			11.7
	5.2	Access to Nature	x	x			10, 11.7
	5.3	Human Health	x	x		x	3
	5.4	Livelihoods	x	x	x		1, 5, 8, 9
	5.5	Sacred Natural Sites	x	x	x	x	11.4
6 Governance Responses	**6.1**	Planning		x	x	x	11
	6.2	Law & Policy		x	x	x	16
	6.3	Education		x	x	x	4, 12.8
	6.4	Management	x	x			11
	6.5	Incentives & Participation		x	x	x	5, 17

Recommended implementation

The UNI is designed for use by local governments operating in an urban context, broadly defined as landscapes that prioritise human use for living and wellbeing. The index may be completed by staff representing a city, town, metro area, or other local government, or by an outside entity on behalf of a local government.

Participating cities are asked to complete the UNI approximately every 3 years. For each period, the cities will select indicator topics from the UNI within each of the six themes. Within each of the indicator topics, a range of indicators may be accepted. The recommended number of indicator topics for a participating city to complete is determined by the city's capacity level as per Table 2.

Table 2. Recommended number of indicators to adopt based on capacity level.

Capacity	Required Indicators	Indicator Level	Quantity of Indicators
Low	Fulfil at least 1 indicator topic from each theme.	Basic	**6**
Medium	Fulfil at least 2 indicator topics from each theme.	Basic	**12**
High	Fulfil at least 3 indicator topics from each theme.	Advanced	**18**
Mega	Fulfil at least 4 indicator topics from each theme.	Advanced	**24**
Champion	Fulfil all indicators	Advanced	**30**

Cities may choose to complete indicators at a more advanced level and may exceed the minimum indicated for their category by either completing additional indicators and/or by completing indicators at a higher level. Note that the Champion level is not determined by capacity, but is rather an option for cities who wish to achieve the highest level of completion. Cities are strongly advised to select and track the same set of indicators over time so that trends can be established for the selected indicators.

Under some indicator topics, there will be a 'basic' option that is easier to implement and an 'advanced' option that requires additional effort but is more accurate and/or comprehensive.

It is recommended for cities to start the application of the UNI through an assessment of data and capacities, in order to frame the scope of the tool, tailor it to available resources, and select the indicators that meet local needs. In order to do so, a Capacity Assessment Questionnaire has been developed to support cities in this process and provide a recommendation on the number of indicators to implement according to cities' capacities. This questionnaire is based on a review of city typologies and capacity for sustainable action (Chubarov, 2015; Sluka, 2019; Uchiyama, 2019), as well as feedback from the UNI early testing performed in six cities.

1. *What is the population size of your city or town?*
    a. Less than 1 million people
    b. Between 1 and 3 million people
    c. Above 3 million people

2. *What is the GDP per capita in your city or town?*
    a. €21,000 or less
    b. Between €21,000 and €31,000

c. €31,000 or higher

3. *Have you completed an assessment of ecological characteristics in your city before, such as in a biodiversity report?*
    a. Never
    b. Once
    c. More than once

4. *How many full-time equivalent staff work on biodiversity-related initiatives (including planning, management, outreach, and implementation) and who are also trained in a related field (such as ecology or urban forestry)?*
    a. Up to 2 full-time staff persons
    b. 2-6 staff persons
    c. more than 6 staff persons

5. *What is the municipal funding status for biodiversity-related initiatives (other than staff salaries)?*
    a. None - reliant on external funding
    b. Variable annual funding is provided
    c. Dedicated regular funding is budgeted (such as annually)

6. *How would you rate the political priority of biodiversity and/or nature in your city?*
    a. *Not a priority*
    b. Medium priority
    c. Top priority

7. *How long ago was your local biodiversity office/unit established?*
    a. Less than 2 years ago
    b. 2-5 years ago
    c. More than 5 years ago

After attributing 1 point for “a” answers, 2 points for “b” answers, and 3 points for “c” answers, a tally can be calculated to determine the capacity level using Table 3 below.

Table 3. Capacity level as determined by answers to the Capacity Assessment Questionnaire.

Points	Capacity	Completion Requirements	Indicator Level
7-9	**Low**	At least one indicator topic per theme.	basic
10-13	**Medium**	At least two indicator topics per theme.	basic
14-17	**High**	At least three indicator topics per theme.	advanced
18-21	**Mega**	At least four indicator topics per theme.	advanced
Any	**Champion**	Complete all indicator topics.	advanced

How are the indicators assessed?

Once a user has determined which indicators to adopt, with a minimum of one per theme, an initial baseline assessment can be undertaken. The assessment is based on indicator trends (target achieved, improving, static, or worsening) and, depending on the indicator topic, measures quantitative information or more qualitative considerations such as efforts made (efforts being made or no efforts currently underway). In the absence of historical data, it will not be possible to discern trends during the initial year of measurement. However, over successive rounds of implementation—recommended at a frequency of once every three years—trends would emerge. The precise scoring system is automated within the digital platform.

The indicators

This section presents each of the five indicator topics that may be selected within the six themes, their intent, calculation instructions, suggested resources and tentative scoring system. Note that the UNI is designed to accommodate alternatives suggested by the cities and accepted by IUCN reviewers that would still fulfil the intent of each indicator topic.

1.1 Material Consumption

Intent	Estimate consumption of goods per person by measuring waste produced.
Instructions	Calculate the average daily volume of solid waste produced by household, commercial, and industrial sectors, divided by total population. Include estimates for any solid waste that is not collected by government services. This calculation should include all solid waste, regardless of its processing (recycling, composting, etc.) as it is being used as a proxy measurement for consumption.
Alternatives	A consumption-based ecological footprint calculation per capita may be used instead of the above option. If the city tracks waste by weight rather than volume, this measure may be substituted.
Resources	The ecological footprint is used to measure the impacts of consumption which include solid waste, but also activities such as transportation. Ecocity Footprint offers a tool for cities to calculate consumption-based ecological footprint and carbon footprint. www.ecocityfootprint.org www.footprintnetwork.org
Scoring	Score this indicator as follows: **++ Multi-year decreasing trend established** **+ Decreasing trend observed** **= Unchanged trend** **• Baseline measured** **- Increasing trend observed** **-- Data deficient**

1.2 Harmful Harvest & Trade

Intent	Assess trade that directly harms species or ecosystems, whether legal or illegal.
Instructions	1. Identify at least 1 endangered species (plant or animal) or unsustainably harvested resource that is particularly harmful to biodiversity or ecosystems and that is connected to trade originating in, flowing through, or terminating in, the boundary of your local government. Examples may include: • Old growth wood • Pangolins and pangolin-derived products • Fish farmed using harmful practices 2. Measure the amount of harvest or trade occurring (imports, exports, or both) to determine the trend over time.
Alternatives	None yet identified
Resources	WILDLEX provides access to case-law, legislation, literature and training materials on illegal wildlife trade. The Cities4Forests Forest Footprint Tool can help cities to understand and reduce tropical deforestation for which they are responsible.

Scoring

Score this indicator as follows:

- ++ **Harmful trade eradicated or at sustainable levels**
- \+ **Harmful trade in decline**
- = **Unchanged trend**
- • **Baseline measured**
- \- **Harmful trade unmanaged or growing**
- -- **Data deficient**

1.3 Greenhouse Gas (GHG) Emissions from Energy

Intent	Estimate greenhouse gas emissions per person that result from energy use.
Instructions	1. Calculate total energy use city-wide by energy source, including fuel, for industrial and household use. 2. Convert energy use from each source to greenhouse gas emissions according to emission factors for your location by energy source as provided by the IPCC Emission Factor Database (EFDB). For simplicity, any sources that are responsible for less than 5% of total energy use can optionally be converted using the average of the emission factors for the other sources.
Alternatives	Report total greenhouse gas emissions per capita following the calculation method indicated in the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC).
Resources	IPCC Emission Factor Database https://www.ipcc-nggip.iges.or.jp/EFDB/main.php Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities
Scoring	Score this indicator as follows: **++ Multi-year decreasing trend established** **+ Decreasing trend observed** **= Unchanged trend** **• Baseline measured** **- Increasing trend observed** **-- Data deficient**

1.4 Unsustainable Diets

Intent	Measure of diet sustainability according to land use and overharvesting concerns.
Instructions	Select one of the approaches listed below: 1. Calculate the total amount (weight) of red meat and seafood consumed by local, nonindigenous populations (where applicable), and divide by total nonindigenous population per year. Red meat is defined as any non-poultry meat source. 2. Measure the proportion of food that has travelled more than 320 kilometres (200 miles) from where it was produced.
Alternatives	Apportion out the consumption-based ecological footprint calculation due to food consumed per capita. We welcome Indigenous communities completing this indicator topic to suggest their own approach to measuring local unsustainable diets.
Resources	https://attra.ncat.org/product/food-miles-background-and-marketing/ www.ecocityfootprint.org https://coolfood.org/ For information on indigenous approaches to food systems and food sovereignty, one source is the Indigenous Food Systems Network. https://www.indigenousfoodsystems.org/
Scoring	Score this indicator as follows:

++ Multi-year decreasing trend established
+ Decreasing trend observed
= Unchanged trend
• Baseline measured
- Increasing trend observed
-- Data deficient

1.5 Water Withdrawal

Intent	Measure of freshwater consumption as compared to locally sustainable levels.
Instructions	1. Determine sustainable freshwater withdrawal rates* for your local government area plus any protected watersheds managed by or on behalf of the local government. Include water withdrawn for any purpose (residential, agricultural, industrial, recreational, etc.) that is consumptive. ** 2. Compare this sustainable rate with current total water withdrawal, minus desalinated seawater. * Sustainable water withdrawal would be identified by the availability of sufficient water for ecosystems and basic human needs while also ensuring consistent freshwater availability (groundwater, aquifers, lakes, wetlands and streams) that support healthy ecosystems. Note that this rate may vary based on precipitation rates or other factors in a given year. ** This measure is intended to capture consumptive water use, meaning water that is withdrawn and no longer made immediately available within the same watershed at the same level of quality or higher than when it was withdrawn.
Alternatives	Calculate total water use (household, industrial, and agricultural) per capita, other than intentionally recycled water, harvested rainwater, and desalinated seawater.
Resources	Consumptive water definition provided by https://www.pnas.org/doi/10.1073/pnas.1004812107
Scoring	Score this indicator as follows:

++ Multi-year decreasing trend established
+ Decreasing trend observed
= Unchanged trend
• Baseline measured
- Increasing trend observed
-- Data deficient

2.1 Sprawl

Intent	Assess level of ongoing sprawl.
Instructions	Calculate the average population density of developed land (i.e. excluding undeveloped and restored/naturalized land) within the boundaries of the local government.
Alternatives	Calculate the ratio of the annual land consumption rate to the annual population growth rate (as per SDG Indicator 11.3.1). Land consumption is a measure of the urbanized land area. In the case of selecting this alternative, the scoring would be based on decreasing trends (the inverse of the base option such that a decreasing trend is desirable). A metro area scale measurement may alternatively be used, if applicable.
Resources	https://unhabitat.org/sites/default/files/2020/07/metadata_on_sdg_indicator_11.3.1.pdf Ending Global Sprawl: Urban Standards for Sustainable and Resilient Development https://www.thegpsc.org/knowledge-products/cities-4-biodiversity/ending-global-sprawl-urban-standards-sustainable-and
Scoring	Score this indicator as follows: **++ Multi-year positive trend established** **+ Positive trend observed** **= Unchanged trend** **• Baseline measured** **- Negative trend observed** **-- Data deficient**

2.2 Water Pollution

Intent	Assess the level of pollutants in aquatic ecosystems.

Instructions	Cities should select the most appropriate measure from the options below, based on whether the most significant local water bodies are streams, lakes or coastal areas. Artificial and/or channelized water bodies may be considered as appropriate. For basic completion, select at least one major stream, at least three large lakes, or the coastal area. For advanced completion, include all major local water bodies (streams of at least fourth order in size and any lakes of at least 4 hectares in area) and coastal areas. For streams: Measure the difference in nutrient retention from raw water samples taken at predetermined upstream and downstream sampling locations of primary* streams in the city. For coastal areas and lakes: Measure the total area of eutrophication for coastal areas and large lakes. When there are no large aquatic systems within the cities' boundaries, cities may consider smaller streams and lakes in boundary, or may measure quality in 3 systems within 10 km from the city boundaries, in an area upstream (control site) and downstream. Sampling should take into account the expected temporal and seasonal changes in the environment. Sampling protocol (i.e. frequency of measurement, sampling during baseflow or during flood event condition) shall be specified. *primary streams are the largest streams in the city.
Alternatives	Nutrient retention measures would commonly be captured by nitrogen, but may alternatively use sediment levels or phosphorous as appropriate. Measures of solid waste particles, such as plastics, may alternately be considered as appropriate.
Resources	USEPA Technical Guidance Manual for nutrient retention measurement in streams Methods for satellite imagery analysis of water colour as a measure of eutrophication rates as described in http://www.cearac-project.org/cearac-project/integrated-report/Annex_A5_Peter.pdf DES. 2018. Monitoring and Sampling Manual: Environmental Protection (Water) Policy. Brisbane: Department of Environment and Science Government. Page 6: *When* and *where* to sample. https://environment.des.qld.gov.au/__data/assets/pdf_file/0031/89914/monitoring-sampling-manual-2018.pdf Map of wetland types for reference of locally significant aquatic ecosystems. Global Wetlands.
Scoring	Score this indicator as follows: **++ Multi-year decreasing trend established across all water bodies measured** **+ Decreasing trend observed across more than half of water bodies measured** **= Unchanged trend** **• Baseline measured or less than half are decreasing.** **- Increasing trend observed** **-- Data deficient**

2.3 Noise Pollution

Intent	Assess the level of noise pollution that may adversely impact wildlife.
Instructions	Identify areas of concern where sources of noise (ports, underwater acoustic deterrents, pile driving, busy streets, airports, railways, industry, etc.) are near to natural habitats, including marine habitats. Count occurrences of noise above a 55 decibel threshold on land (or a 170 decibel threshold underwater) in at least 5 outdoor locations within the areas of concern in the city for at least 30 minutes each during the most noisy time period of a typical day (Benliay et al., 2019).
Alternatives	A noise map of the areas of concern can be used in lieu of these measurements to report on extent of natural habitats adjacent to sources of noise above 55 decibels on land or 170 decibels underwater.
Resources	https://www.eea.europa.eu/airs/2018/environment-and-health/environmental-noise ISO standard 37120:2018:8.8 https://www.researchgate.net/publication/262047792_Marine_noise_pollution_-_increasing_recognition_but_need_for_more_practical_action NOAA Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing https://media.fisheries.noaa.gov/dam-migration/tech_memo_acoustic_guidance_(20)_(pdf)_508.pdf
Scoring	Score this indicator as follows: **++ Multi-year decreasing trend established** **+ Decreasing trend observed** **= Unchanged trend** **• Baseline measured** **- Increasing trend observed** **-- Data deficient**

2.4 Light Pollution

Intent	Assess the level of light pollution that may adversely impact wildlife.
Instructions	Calculate Average Night Sky light pollution levels on the Sky Quality Meter (SQM) Scale, based on at least 1 measurement point per square kilometre and no less than 20 measurements.
Alternatives	The Bortle scale may alternatively be used.
Resources	For more information, see https://www.globeatnight.org/maps.php Guidelines on how to conduct a Sky Quality Survey by the International Dark-Sky Association.
Scoring	Score this indicator as follows:

++ **Multi-year decreasing trend established**
+ **Decreasing trend observed**
= **Unchanged trend**
• **Baseline measured**
- **Increasing trend observed**
-- **Data deficient**

2.5 Invasive Species

Intent	Assess threat level of invasive species that may adversely impact other wildlife.	
Instructions	According to the local context, select invasive species of interest based on their potential negative impact to local ecosystems or human activities. Determine the status of each invasive species in the city by measuring their range, total population, or impact as appropriate. Cities can use the methodology of the Horizon Scanning to forecast future trends and impacts related to invasive species within the municipality. In addition, the Environmental Impact Classification for Alien Taxa (EICAT) is a global standard on alien species impact assessment, mitigation measures and management actions.	
	Basic: At least 1 species	Advanced: At least 3 species
Alternatives	None	
Resources	Code of Conduct for Invasive Alien Trees Code of Conduct on horticulture and invasive alien plants Free Horizon Scanning tool for invasive species using CABI Compendium. https://www.cabi.org/horizonscanningtool Environmental Impact Classification for Alien Taxa (EICAT)	
Scoring		

++ **All invasive species eradicated or in decline**
+ **Majority of invasive species eradicated or in decline**
= **Unchanged trend**
• **Baseline measured**
- **Majority of invasive species unmanaged or growing**
-- **Data deficient**

Scoring system for the Advanced option:

- When 2 species are assessed and they present opposite trends: **Trend uncertain**
- When 3 species are assessed and among these 2 present positive trends and 1 presents a negative trend: **Majority of invasive species eradicated or in decline**
- When 3 species are assessed and among these 2 present negative trends and 1 presents a positive trend: **Majority of invasive species unmanaged or growing**

3.1 Land Use/Protection

Intent	Assess land use and regulatory protections against harmful development patterns.
Instructions	1. Classify land into the categories below as a percentage of total land area. Categories should not overlap. 2. Calculate the protected land factor by summing all but the last category using the following calculation: $L_F + 0.75\ L_N + 0.5\ L_P + 0.25\ L_I$ = protected land factor

Category	Examples
L_F = % of land that is undeveloped and protected primarily for nature conservation or indigenous and local traditional use.	Green belts, protected watershed areas, local co-managed forests, botanical gardens, and protected ecological parks. Includes IUCN protected area categories Ia, Ib. May also include land outside of the local government boundary that is connected to the city via agreements such as "Payment for Ecosystem Services" (PES).
L_N = % of land that is natural and protected or conserved but allows for sustainable use and/or access.	Natural areas within public parks (vegetated and unmowed), protected riparian zones in a residential zone, or sustainably managed and protected forests. Includes IUCN protected area categories II, III, IV, V, VI. May also include land outside of the local government boundary that is connected to the city via agreements.
L_P = % of land that requires conservation development approaches.	Conservation development zones, clustered development areas, or areas that have existing requirements for natural restoration or protection when development occurs.
L_I = % of land with incentives encouraging conservation-friendly development.	Same as L_P above, except with a non-mandatory approach. May also include disincentives such as requiring an environmental assessment or riparian permit.

Alternatives	None
Resources	Trzyna, T. (2014). Urban Protected Areas: Profiles and best practice guidelines. Best Practice Protected Area Guidelines Series No. 22, Gland, Switzerland: IUCN. xiv + 110pp. Part 3, page 51. Best practice guidelines. https://portals.iucn.org/library/sites/library/files/documents/PAG-022.pdf
Scoring	Score this indicator as follows:

++ **Multi-year positive trend established**
+ **Positive trend observed**
= **Unchanged trend**
• **Baseline measured**
- **Negative trend observed**
-- **Data deficient**

3.2 Ecosystem Restoration (Terrestrial)

Intent	Measure restoration of terrestrial and wetland habitats.
Instructions	1. Establish targets for ecosystem restoration in terms of land area. Targets may be set in a participatory manner, using the Restoration Opportunity Assessment Methodology (Laestadius et al., 2014) and, when applicable, consider the results of ecosystem risk assessment (Valderrábano et al., 2021). Collaborative regional restoration efforts may be included if the local government is at least a supporting partner. 2. Sum up the land area of terrestrial and/or wetland habitats that have undergone restoration efforts in the last year. The types of restoration include:* ● Conversion of grey infrastructure to green ● Creation of blue and green spaces ● Restoration of catchment zones ● Creation and enhancement of habitats for native species ● Rehabilitation of extractive areas
Alternatives	Report using the Restoration Intervention Typology for Terrestrial Ecosystem, aligned with the Restoration Barometer, Bonn Challenge, and UN Decade for Ecosystem restoration Complete Singapore Index indicator 7 (based on 2021 version).
Resources	* IUCN Restoration Intervention Typology for Terrestrial Ecosystem guiding principles for ad hoc restoration activities on Urban areas. Restoration in other types of terrestrial ecosystems such as forests, grasslands or farmlands may also be reported. The Society for Ecological Restoration International (SER) defines restoration, its principles and implementation, including how ecological restoration and livelihoods can be maintained. Bonn Challenge for restoring degraded and deforested lands. Massive Open Online Course (MOOC) on Ecosystem Restoration 2022. United Nations Development Programme (UNDP) and the Convention on Biological Diversity (CBD), with the support of the European Union and the Korea Forest Service of the Government of the Republic of Korea through the Forest Ecosystem Restoration Initiative (FERI). This course compiles research from leading institutions engaged in ecosystem restoration and experts in the field to raise awareness and build ecosystem restoration capacity. https://www.learningfornature.org/en/courses/ecosystem-restoration-2022/ Gann GD, McDonald T, Walder B, Aronson J, Nelson CR, Jonson J, Hallett JG, Eisenberg C, Guariguata MR, Liu J, Hua F, Echeverría C, Gonzales E, Shaw N, Decleer K, Dixon KW (2019) International principles and standards for the practice of ecological restoration. Second edition. Restoration Ecology DOI:10.1111/rec.13035
Scoring	Score this indicator as follows:

++ Targets fully met and new targets established
+ Targets partially met
= No change in targets
• Targets established
- Targets not met
-- Data deficient

3.3 Shorelines & Riverbanks

Intent	Proxy measure for the health and restoration of aquatic ecosystems.

Instructions	Calculate the ratio of nearby shoreline areas and water beds that are naturalized compared to engineered for freshwater streams, lakes, wetlands, and marine areas in the city. All streams of at least fourth order in size and wetlands or lakes of at least 4 hectares in area should be included. **Naturalized shorelines** include natural vegetated porous surfaces such as soil/sandy/rocky shores, beds, and tidal pools and includes restored or artificial shorelines with the same characteristics. Include the area from the bank at the high water mark as well as the underwater bed or subsurface. **Engineered shorelines** include hardscape such as concrete or riprap edge, mowed lawn, channelized, or culverted. Stream or lake beds and underwater sub-surfaces that have been hardened, dredged, filled, dammed, drilled, mined, tunnelled, undergone bottom trawling, or otherwise altered without restoration are also considered to be engineered. In the case of streams, calculate both sides of the stream bank including the condition of the stream bed between the banks as one-unit equivalent in length to a single marine or other type of shoreline. In the case of lakes, calculate naturalized shorelines that are also adjacent to naturalized lake beds as natural. In the case of coastal areas, calculate the shoreline from high tide as well as adjacent associated ecosystems (mangrove forests, tidal pools, beaches) and the condition of the associated subsurface bed extending until the shelf break. Naturalized coastal shorelines must feature a substantially natural tidal area and bed to be included as naturalized. Substantially natural means that natural ecosystems cover the majority of the area and any human interventions such as pedestrian pathways have minimal impact (for example, vehicular roadways running along the shoreline are not substantially natural, but a public pedestrian beachfront with raised platforms to protect dunes and nesting areas could be substantially natural).
Alternatives	None

Resources	Gann GD, McDonald T, Walder B, Aronson J, Nelson CR, Jonson J, Hallett JG, Eisenberg C, Guariguata MR, Liu J, Hua F, Echeverría C, Gonzales E, Shaw N, Decleer K, Dixon KW (2019) International principles and standards for the practice of ecological restoration. Second edition. Restoration Ecology DOI:10.1111/rec.13035 For naturalized shorelines, see Principle 6: ECOLOGICAL RESTORATION SEEKS THE HIGHEST LEVEL OF RECOVERY ATTAINABLE, page 40. How to compute stream order in GIS Gleyzer, A.; Denisyuk, M.; Rimmer, A.; Salingar, Y. (2004), "A fast recursive GIS algorithm for computing Strahler stream order in braided and non-braided networks", *Journal of the American Water Resources Association*, **40** (4): 937–946, Bibcode:2004JAWRA..40..937G, doi:10.1111/j.1752-1688.2004.tb01057.x, S2CID 128399321 Trzyna, T. (2014). Urban Protected Areas: Profiles and best practice guidelines. Best Practice Protected Area Guidelines Series No. 22, Gland, Switzerland: IUCN. xiv + 110pp. See Degrees of naturalness, Box 3, page 4. https://portals.iucn.org/library/sites/library/files/documents/PAG-022.pdf Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM) Adopted by Resolution VIII.4 (2002) of the Ramsar Convention https://www.ramsar.org/sites/default/files/documents/pdf/guide-iczm.pdf Guidelines for integrating wetland conservation and wise use into river basin management. Adopted by Resolution VII.18 (1999) of the Ramsar Convention, page 4. https://www.ramsar.org/sites/default/files/documents/library/key_res_vii.18e_0.pdf
Scoring	Score this indicator as follows:

++ **Multi-year positive trend established**
+ **Positive trend observed**
= **Unchanged trend**
• **Baseline measured**
- **Negative trend observed**
-- **Data deficient**

3.4 Vegetation Cover

Intent	Assess extent of vegetation cover throughout the local government land area.
Instructions	Measure the percent of land area city-wide that is covered in vegetation. Depending on your local context, this may consider tree cover only, or may also include shrubs for areas such as shrublands. Lawns are not to be counted. Complete the advanced or basic indicator as follows:

	Basic: Use the free iTree online tool to estimate the percentage of land area that is vegetated, based on canopy cover. Continue to assess points until the accuracy of tree canopy coverage is calculated to be +/- 3% percent cover or less (this number updates automatically as you assess each point). iTree guidelines recommend 500-1000 points that will need to be assessed for an average city. Note that this process can take a few hours, but volunteer groups may be able to assist. A canopy change assessment for 3-10 years in the past may be used to generate a trend if satellite imagery is of sufficient quality. Once complete, save the data, and upload the csv file and the iTree report to this platform.	Advanced: 1. Determine Normalized Difference Vegetation Index (NDVI) in GIS using Landsat 8 remote sensing imagery. 2. Determine which NDVI threshold is most appropriate for your native ecosystem: 0.2 to 0.5 = partial vegetation (shrubland, desert, alpine ecosystems, etc.) 0.5 to 1.0 = vegetated (forested, jungle ecosystems, etc.) 3. Calculate the % land area of the city meeting the appropriate NDVI threshold.
Alternatives	Additional wall area or planted area of vertical green walls, green roofs featuring the same level of vegetation (e.g. trees and/or shrubs) or vertical forests may be added if preferred to the % as appropriate. As an alternative to iTree, applicants may use Collect Earth Online by the World Resources Institute (WRI).	
Resources	NDVI corresponds to the annual net primary productivity of vegetation and is sensitive to temperature and water availability (Tucker 1979). A comprehensive review of NDVI applications is available by Kerr and Ostrovsky (2003) and Pettorelli et al. (2005). This can be done in QGIS (free and open source) or ESRI's ArcGIS Image Analysis toolbar. A QGIS tutorial for this analysis is available here: https://towardsdatascience.com/remote-sensing-with-qgis-calculate-ndvi-c2095f0de21b Worldwide Landsat 8 satellite data is available for free at earthexplorer.usgs.gov The Better Forests, Better Cities report by WRI Cities4Forests program provides guidelines for urban forests and trees and outlines the benefits of urban forests.	
Scoring	Score this indicator as follows:	

++ **Multi-year positive trend established**
+ **Positive trend observed**
= **Unchanged trend**
• **Baseline measured**
- **Negative trend observed**
-- **Data deficient**

3.5 Connectivity

Intent	Assess habitat connectivity throughout the local government's land area.	
Instructions	Measure habitat connectivity according to an accepted tool according to capacity. Complete the advanced or basic indicator as follows:	
	Basic: Calculate the effective mesh size or refer to the explanation in the Singapore Index indicator 2 (based on 2021 version).	Advanced: Calculate the connectivity metric for your city following the "graph theory" framework. You may import spatial data into the free, open source Graphab tool to calculate this. Include nearby regional habitat areas if feasible.
Alternatives	Alternative approaches with similar robustness may alternatively be used or combined, such as the Biodispersal plug-in for qGIS, the landscapemetrics R package, or a fragmentation index. Take care that the approach differentiates between habitat amount and connectivity.	
Resources	For more information on effective mesh size, see Deslauriers et al., "Corrigendum to: Implementing the connectivity of natural areas in cities as an indicator in the City Biodiversity Index (CBI)" *Ecological Indicators.* 2018, vol. 19 part 2. https://doi.org/10.1016/j.ecolind.2017.09.037 Other resources for alternative methods include: Wang, Blanchett, and Koper, "Measuring habitat fragmentation: An evaluation of landscape pattern metrics," *Methods in Ecology and Evolution*. 2014. https://doi.org/10.1111/2041-210X.12198 Hesselbarth et al., "Landscapemetrics: an open-source R tool to calculate landscape metrics," *Ecography*. 2019. https://doi.org/10.1111/ecog.04617	
Scoring	Score this indicator as follows:	

++ **Multi-year positive trend established**
+ **Positive trend observed**
= **Unchanged trend**
• **Baseline measured**
- **Negative trend observed**
-- **Data deficient**

4.1 Animal Species

Intent	Proxy measure of citywide animal species diversity through careful selection of indicator species.
Instructions	1. Select at least 3 of the following taxonomic categories: • Birds • Mammals • Aquatic animals and molluscs (cnidaria, porifera, fish, molluscs) • Invertebrates • Herpetofauna (reptiles and amphibians) • Fungi 2. Identify at least 3 native species (or more if advanced) from each category, using endangered* species as appropriate, referred to as indicator species. Species affected by urban-related threats such as Residential and Commercial development, Transportation and Service corridors; Pollution should be prioritized (see IUCN Red List Threat Classification Scheme). On the contrary, introduced species threatened in their original distribution range shall not be considered.
	Basic: Determine presence/absence of at least 3 indicator species in at least 5 representative locations each, distributed throughout the city (total minimum of 45 data points). Count 1 point for the presence of each species in each location, then divide by the maximum possible points for the time period of interest (at least one year) resulting in a %.
	Advanced: Map observed distribution of at least 5 indicator species throughout the city. Calculate the total distribution area of each species (by adding up all distribution areas), then divide by the number of species mapped over the time period of interest (at least one year). For example, species A is found in two locations, a 500 m^2 area and a 1km^2 area. Species B is found in one 2.5 km^2 area. The area for species A is therefore 1.5 km^2 and for B is 2.5 km^2. The total area is therefore 4km^2 which is divided by 2 (for 2 species) for a result of 2. Note that overlapping areas may be counted multiple times, once for each species.
Alternatives	Complete either the UBIF programme or Singapore Index indicators 3, 5, and 6 (based on 2021 version).
Resources	Endangered species are classified as endangered or critically endangered on the IUCN Red List, listed in CITES appendix I, listed in the Convention of Migratory Species appendix I, and/or equivalent local/national species lists. Data on Red List species can be downloaded from the Integrated Biodiversity Assessment Tool (IBAT).

	Data sources for species observations and distribution estimates: Databases such as GBIF or national data repositories Verified citizen science observations such as such as iNaturalist or eBird Original data gathered by local organizations, staff, or trained volunteers using, for example: Traps, Transect walks/dives, Automatic trail cameras, DNA assessments (soil, water, invertebrates), and Systematic surveys/observations
Scoring	Score this indicator as follows: **++ Multi-year positive trend established** **+ Positive trend observed** **= Unchanged trend** **• Baseline measured** **- Negative trend observed** **-- Data deficient**

4.2 Plant Species

Intent	Proxy measure of citywide plant species diversity through careful selection of survey locations.
Instructions	1. Select at least 5 areas* that together represent plant diversity in your city. 2. Assay an area totalling at least 100 square meters per location by designating transects or plots. 3. Record the presence of native vascular plants in each location. 4. Count the total number of vascular plant species across all locations. 5. Repeat this count to establish a trend, every 1-5 years. *Criteria for selection may include: availability and representativeness of data and ease of access to the location. Examples include a park, green street edge, or undeveloped area.
Alternatives	Complete Singapore Index indicator 4 (based on 2021 version).
Resources	None
Scoring	Score this indicator as follows: **++ Multi-year positive trend established** **+ Positive trend observed** **= Unchanged trend** **• Baseline measured** **- Negative trend observed** **-- Data deficient**

4.3 Functional Diversity

Intent	Measure functional diversity of interest, depending on local context.

Instructions	1. Identify a species group (may be a mix of taxa) according to an ecological function of interest such as: • pollinators • predators • fungi • ecosystem engineers • in situ bioremediation • water or air biofiltration 2. Select from the example choices below or determine your own local measure of this function. 3. Measure this function across at least 5 representative locations across the city.

Example 1:	Example 2:
Pollination services can be estimated by counting the visitation rate of flowers in each location over a fixed set of time (Fijen and Kleijin, 2017, https://doi.org/10.1016/j.baae.2017.01.004), or the rate of pollinated fruit/seed set in each location.	Mosquito predation services can be estimated by placing artificial oviposition habitats for mosquitos in each location and then removing and counting daily egg clutches in the habitat (Reiskind and Wund, 2009, doi: 10.1603/033.046.0510)

Alternatives	A custom option can be determined, as appropriate.
Resources	Schmitz, O. J., Hawlena, D., y Trussell, G. C. 2010. Predator control of ecosystem nutrient dynamics. Ecology Letters, 13(10): 1199-1209). https://doi.org/10.1111/j.1461-0248.2010.01511.x Reports by the UN Food and Agricultural Organization: Rapid assessment of pollinators' status (2008, English) and Principios y avances sobre polinización como servicio ambiental para la agricultura sostenible en países de Latinoamérica y El Caribe (2014, Spanish).
Scoring	Score this indicator as follows: **++ Multi-year positive trend established** **+ Positive trend observed** **= Unchanged trend** **• Baseline measured** **- Negative trend observed** **-- Data deficient**

4.4 Microbiota

Intent	Proxy measure for the health of soils and microbiotic systems in aquatic and terrestrial areas.	
Instructions	1. Select at least 5 representative sites across your city, including both terrestrial and aquatic ecosystems. 2. Measure decomposition rates in each location. 3. Calculate an average rate of decomposition across all 5 sites.	
	In **terrestrial locations**, decomposition rates can be estimated by measuring the loss in mass of leaf litter decomposition in terrestrial locations (Karberg et al., 2008).	In **aquatic locations**, they can be estimated by placing leaf litter or cotton strips in bags affixed to a location and measuring the decomposition rates of the material over time.
Alternatives	None	
Resources	Karberg et al. 2008 "Methods for Estimating Litter Decomposition" In Field Measurements for Forest Carbon Monitoring. https://www.nrs.fs.usda.gov/pubs/jrnl/2008/nrs_2008_karberg_002.pdf	
Scoring	Score this indicator as follows: **++ Multi-year positive trend established** **+ Positive trend observed** **= Unchanged trend** **• Baseline measured** **- Negative trend observed** **-- Data deficient**	

4.5 Endemic Species

Intent	Assess the richness of endemic species (endemicity is based on context, and may be regional or local).
Instructions	Complete the advanced or basic indicator as follows:

Basic:

Measure richness by counting the total number of endemic species present and their conservation status.

Calculate your score based on species counts (S) with a multiplier according to conservation status:

$0*S_{EX} + .2*S_{EW} + .4*S_{CR} + .6*S_{EN} + .8*S_{VU} + .9*S_{NT} + S_{LC}$

Status per the IUCN Red List (EX = extinct, EW = extinct in the wild, CR = critically endangered, EN = endangered, VU = vulnerable, NT = near threatened, LC = least concern) or equivalent local/national lists.

Advanced:

1. Measure abundance by estimating the total local population of at least 3 species endemic to your area (local or regional).

2. Calculate the growth rate for each species, then average this growth rate across all measured endemic species.

Alternatives	None
Resources	None
Scoring	Score this indicator as follows:

- **++ Multi-year positive trend established**
- **+ Positive trend observed**
- **= Unchanged trend**
- **• Baseline measured**
- **- Negative trend observed**
- **-- Data deficient**

5.1 Exposure to Nature

Intent	Measure overall exposure to nature by urban residents and visitors.
Instructions	Calculate the total annual number of visitors to vegetated and/or natural open areas (including vegetated parks and botanical gardens). Counts or estimates are accepted.
Alternatives	Cities are encouraged to disaggregate the data by neighbourhood, demographic, or other measure in order to address equity concerns or related goals specific to the local context.
Resources	None
Scoring	Score this indicator as follows:

++ Multi-year positive trend established
+ Positive trend observed
= Unchanged trend
• Baseline measured
- Negative trend observed
-- Data deficient

5.2 Access to Nature

Intent	Measure increasing access to natural areas for all members of vulnerable urban communities.	
Instructions	Complete the advanced or basic indicator as follows:	
	Basic: Calculate the percentage of residents living within a walkable distance (300 metres) of a public, open access natural area.	Advanced: Calculate the percentage of residents in the lowest income quintile (lowest 20%) living within a walkable distance (300 metres) of a public, open access natural area.
Alternatives	Complete Singapore Index indicator 13 (based on the 2021 version) may be used for basic completion.	
Resources	None	
Scoring	Score this indicator as follows:	

++ **Multi-year positive trend established**
+ **Positive trend observed**
= **Unchanged trend**
• **Baseline measured**
- **Negative trend observed**
-- **Data deficient**

5.3 Human Health

Intent	Measure human health that is directly related to ecosystem services and/or biodiversity.
Instructions	Select from the measures listed below that link human health with environmental conditions, as appropriate to your local context: For basic completion, select a measure of local air quality that is appropriate for your local context, such as PM 2.5 concentration or local asthma rates. For advanced completion, also include an additional linked measure from the alternatives listed below or suggest an alternative measure appropriate to your context.

Basic:	Advanced:
Select 1 measure of air quality.	Select 2 measures, one of which is an indicator of air quality and one that measures a different aspect.

Alternatives	Air quality measures could include: ● Childhood asthma rates ● Nitrogen dioxide concentration ● Ambient particulate matter pollution ● Household solid fuels combustion ● Ambient ozone pollution ● PM 2.5 concentration (such as SEEA air emissions accounts) ● The European Green Capital Award section 2.6 Air Quality indicators ● The North American Air Quality Index for PM 2.5. ● Distribution of bioindicators such as lichens or bryophytes Additional measures that could be selected include: 1. Rates of disorders and diseases linked to exposure to dangerous substances such as lead poisoning, birth defects, cancer, neurological, endocrinological, thyroid, obesity, and cardiovascular problems 2. Rates of zoonotic communicable disease outbreaks and/or presence of resistant bacterial strains 3. Rates of human microbiome diversity-related conditions such as autoimmune diseases, type 1 diabetes, multiple sclerosis, allergic disorders, eczema, inflammatory bowel diseases, and Crohn's disease
Resources	IUCN policy scoping brief on Biodiversity and Human Health, 2018. Report: Connecting Global Priorities: Biodiversity and Human Health by WHO and CBD, 2015. One Health definition: Tripartite and UNEP support One Health High Level Expert Panel (OHHLEP's) definition of "One Health". Joint Tripartite (FAO, OIE, WHO) and UNEP Statement, 1 December 2021 Generalizable One Health Framework (GOHF), a five-step framework that provides structure for using a One Health approach in zoonotic disease programs being implemented at the local, sub-national, national, regional, or international level. Ghai, R.R., Wallace, R.M., Kile, J.C. et al. A generalizable one health framework for the control of zoonotic diseases. Sci Rep 12, 8588 (2022). https://doi.org/10.1038/s41598-022-12619-1 Zhang, XX., Liu, JS., Han, LF. et al. 2022 Towards a global One Health index: a potential assessment tool for One Health performance. Infect Dis Poverty 11, 57. https://doi.org/10.1186/s40249-022-00979-9 Online course (EN & FR): ONE HEALTH: Basics of multisectoral collaboration at the Human - Animal - Environment interface. WHO, 2022 One Health Basics. Centers for Disease Control and Prevention. https://www.cdc.gov/onehealth/basics/index.html.
Scoring	Score this indicator as follows:

++ **Multi-year decreasing trend established**
+ **Decreasing trend observed**
= **Unchanged trend**
• **Baseline measured**
- **Increasing trend observed**
-- **Data deficient**

5.4 Livelihoods

Intent	Measure support for livelihoods stemming from conservation and sustainable management.	
Instructions	1. Select from the categories below (see advanced and basic options for more information): • Vocational training intended to transition or otherwise funnel workers into green-collar jobs • Green-collar work (full-time equivalent receiving at least an effective hourly compensation that is equal to or above the local median wage rate, based on equity and gender equality) • Payment for ecosystem services (PES) or other direct monetary incentives for the stewardship or sustainable management of natural resources. Ecosystem services are not limited to those within the city boundary • Women-led conservation initiatives or other initiatives established by underrepresented community members 2. Calculate the total number of individuals, disaggregated by gender, who received one or more of the items you selected.	
	Basic: Select one of the categories listed. Choose at least one industry or sector from which to gather data, if applicable.	Advanced: Select at least two of the categories listed. Choose at least two industries or sectors from which to gather data, if applicable.
Alternatives	None	

Resources	Green collar jobs are within a green industry, for a green institution, or in a position responsible for increasing the sustainability of goods or services (define this for yourself as appropriate in the local context). Green Jobs Assessment Reports by country by the International Labour Organization Measuring Green Jobs? Report by Norden
Scoring	Score this indicator as follows: **++ Multi-year positive trend established** **+ Positive trend observed** **= Unchanged trend** **• Baseline measured** **- Negative trend observed** **-- Data deficient**

5.5 Sacred Natural Sites

Intent	Measure the recognition and shared custodianship of local sacred natural sites.
Instructions	Complete the advanced or basic indications as follows: Basic: Calculate the total number of Sacred Natural Sites that are: ● Actively in the process of being legally recognised and/or protected for sacred use, or ● Recognised and/or protected for sacred use, or ● Managed to suit spiritual purposes in partnership with appropriate local communities or indigenous leaders. Advanced: Monitor local practices and initiatives related to natural places of religious interest. The indicator can be expressed by means of: • The number of practices and initiatives • The progress in mapping such practices (%) • The number of community members actively participating in these initiatives
Alternatives	Calculate the number of recognised and protected urban heritage trees located within the municipality, preferably through community participation.

Resources	Sacred Natural Sites are areas of land or water having special spiritual significance to peoples and communities (IUCN, 2008). They may be recognized by Man and the Biosphere Programme, the Convention on Wetlands, the World Heritage Convention, the Convention on Biological Diversity, the Convention for the Safeguarding of Intangible Cultural Heritage, the Declaration on the Rights of Indigenous Peoples, or a comparable community-led local recognition program. Wild, R. and McLeod, C. (Editors) (2008). *Sacred Natural Sites: Guidelines for Protected Area Managers*. Gland, Switzerland: IUCN. Definition of Sacred Natural Site, page 7. https://portals.iucn.org/library/sites/library/files/documents/PAG-016.pdf Verschuuren B., Mallarach J-M., Bernbaum, E., Spoon J., Brown S., Borde R., Brown J., Calamia M., Mitchell N., Infield M and Lee E. (2021). *Cultural and spiritual significance of nature. Guidance for protected and conserved area governance and management*. Best Practice Protected Area Guidelines Series No. 32, Gland, Switzerland: IUCN. XVI + 88pp. Principles, Guidelines and Examples. Chapter 4, page 27. https://portals.iucn.org/library/sites/library/files/documents/PAG-032-En.pdf Mundoli, S., Nagendra, H. (2020). *Heritage Trees of Urban India: Importance and their Protection*. 2020-09-09_Report-on-Heritage-trees.pdf (bngenvtrust.org) Aird, P. L. (1994). Heritage, natural heritage, cultural heritage and heritage tree defined. *The Forestry Chronicle,* 81(4). Heritage, natural heritage, cultural heritage and heritage tree defined (cif-ifc.org)
Scoring	Score this indicator as follows: **++ Multi-year positive trend established** **+ Positive trend observed** **= Unchanged trend** **• Baseline measured** **- Negative trend observed** **-- Data deficient**

6.1 Planning

Intent	Assess local government planning progress for biodiversity and ecosystem services in the UNI themes.
Instructions	Provide publicly available excerpts of statements from one or more local government plans, policies, strategies, or other strategic documents that address the themes in this index, with specific indicators, actions and goals. Statements are generally either a goal or objective statement, and must be linked to verifiable measures of success, such as particular outputs (an event, a project, a governance structure) or one or more targets that are tied to a year or date. Indicate the relevant statements in the adopted document and provide an explanation of the current progress along the stated measure of success. Examples of statements that would be considered “on track” could include an excerpted goal statement from a recently drafted document that is currently going through the approvals process, anticipated to be completed within the current UNI assessment time period, an excerpted objective from an already adopted document that is to be implemented during the current time period, or a strategy with a measure that has been successfully achieved and is now being monitored and revised for the next time period. Score the advanced or basic indicator as follows:
	Basic: Indicate either a goal or objective statement from one or more of your institution’s current plans, policies, strategies, or other strategic documents that addresses at least 4 of the 6 UNI themes. Current documents are those that have been adopted by government and that have not expired or been superseded/replaced. Text for each theme should be clearly indicated, with the active dates of the document (year adopted, and time frame of document, if applicable).
	Advanced: Indicate either a goal or objective statement from one or more of your institution’s current plans, policies, strategies, or other strategic documents that addresses each of the 6 UNI themes. Current documents are those that have been adopted by government and that have not expired or been superseded/replaced. Text for each theme should be clearly indicated, with the active dates of the document (year adopted, and time frame of document, if applicable). Explain how each of these goals are currently on track according to local targets or outputs.
Alternatives	Complete Singapore Index indicator 17 and 18 (based on 2021 version), earning up to 8 points in total.

Resources	Urban Biodiversity Hub database of biodiversity plans. Guide to the contents of a strategic plan for local government: https://www.osc.state.ny.us/files/local-government/publications/pdf/strategic_planning.pdf Agence Francaise de Développement (AFD) Guide to Biodiversity Planning https://www.afd.fr/en/ressources/biodiversity-cities-technical-guide ICLEI Local Action for Biodiversity Guidelines https://cbc.iclei.org/wp-content/uploads/2016/06/LBSAP-Guidelines.pdf BiodiverCities: A Handbook for Municipal Biodiversity Planning and Management by ICLEI Canada https://icleicanada.org/wp-content/uploads/2019/05/BiodiverCITIES-Handbook_Final.pdf The Biodiversity Action Guide by The Nature Conservancy https://www.nature.org/en-us/what-we-do/our-insights/perspectives/biodiversity-action-guide/
Scoring	Score this indicator as follows: **++ Statements currently on track according to local goals (Alternative: cumulatively earn 8 points on SI indicators 17 and 18)** **+ Some statements (at least 2 if Basic, at least 4 if Advanced) currently on track (Alternative: cumulatively earn 5 points on SI indicators 17 and 18)** **= No change in Statements** **• Statements identified, but insufficiently on track (Alternative: cumulatively earn 3 points on SI indicators 17 and 18)** **- Statements not identified for the minimum number of UNI themes (4 if basic, 6 if advanced)** **-- Data deficient**

6.2 Law & Policy

Intent	Assess government regulatory efforts for biodiversity and ecosystem services.	
Instructions	Government adoption of local policies and bylaws (together referred to as regulations) that commit to the enforcement, implementation, or direct support needed to improve the indicators measured in each of the themes of this index. Note that plans are not covered here, but are rather in the previous indicator topic. Score the advanced or basic indicator as follows:	
	Basic: Supporting regulations for at least one indicator under a minimum of two themes are required.	Advanced: Supporting regulations for at least one indicator under a minimum of four themes are required.
Alternatives	None	
Resources	IUCN's World Commission on Environmental Law (WCEL), World Declaration on the Environmental Rule of Law and Framework for Assessing and Improving Law for Sustainability, ECOLEX environmental law database.	
Scoring	Score this indicator as follows:	

++ **Local bylaws for each theme actively enforced**
+ **Progress made on adoption of local bylaws**
= **No changes detected**
• **Overarching policy commitment only**
- **No current commitment**
-- **Data deficient**

6.3 Education

Intent	Assess depth of educational programs for biodiversity and ecosystem services.
Instructions	Total number of hours members of the public have spent participating as leaders, or learners in educational programs (formal or informal) covering any of the themes listed in this index including citizen science, guided nature walks, student research, formal classes, or primary/secondary education.
Alternatives	None
Resources	IUCN Commission on Education and Communication CBD Communication, Education and Public Awareness (CEPA) programme, including Biodiversity Education resources
Scoring	Score this indicator as follows: ++ **Multi-year positive trend established** + **Positive trend observed** = **Unchanged trend** • **Baseline measured, trend undetermined** - **Negative trend observed** -- **Data deficient**

6.4 Management

Intent	Assess government-supported management of natural spaces and resources.
Instructions	Measure the total hectares of natural areas in the city with at least one of the following: ● An officially adopted sustainable management plan that encourages integrated pest management while reducing or eliminating: ○ Fertilizers ○ pesticide application (including rodenticides), and ○ Motorized mowing and other motorized tool use ● An active co-management program with local community groups ● Stewardship by local indigenous group(s)
Alternatives	Complete Singapore Index indicator 19 (based on 2021 version). Protected Area Management Effectiveness (PAME) methodologies may alternately be used.
Resources	None

Scoring	Score this indicator as follows:

++ **Multi-year positive trend established**
+ **Positive trend observed**
= **Unchanged trend**
• **Baseline measured**
- **Negative trend observed**
-- **Data deficient**

6.5 Incentives & Participation

Intent	Assess government-supported incentives and initiatives for visionary and sustainable lifestyles.
Instructions	Calculate the total number of direct participants, providing gender-disaggregated data, in local government-supported programs (other than education) with their primary purpose being to contribute to any of the themes listed in this index, including: Events Awards or funding Volunteer work, including restoration Collaborative programs
Alternatives	None
Resources	None
Scoring	Score this indicator as follows:

++ **Multi-year positive trend established**
+ **Positive trend observed**
= **Unchanged trend**
• **Baseline measured**
- **Negative trend observed**
-- **Data deficient**

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