The IUCN Urban Nature Indexes

Methodological framework and key indicators

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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 (NGOs) 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.

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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.

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About Urban Biodiversity Hub

Founded in 2016, the Urban Biodiversity Hub (UBHub) enables cities around the world to plan with nature. This non-profit organisation 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. The UBHub team is honoured to contribute to the creation of the Urban Nature Indexes 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 the urban dimensions of nature conservation, has unveiled a new knowledge product for measuring the ecological performance of cities: the IUCN Urban Nature Indexes (UNI).

Comprising six themes with five indicator topics nested within each theme, the UNI is intended to help policymakers, stakeholders and local communities understand their impacts on nature, set science-based targets for improvement, and monitor progress using 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 IUCN Urban Alliance developed the UNI over a two-year period with the help of surveys, workshops, and webinars. Technical support was provided by a team of consultants at the 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. Reflecting 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 cities to select the indicator topics most appropriate for their targets and capacities. The flexibility of the Indexes ensures each city can adjust the framework to meet local needs.

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 (www.iucnurbannatureindexes.org) 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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A global consultation elicited detailed survey responses from Ajanta Dey (Kolkata, India), Alessandra Andreazzi Péres (Brasilia, Brazil), Allan Kwanjana (Lilongwe, Malawi), Bernd-Ulrich Netz (Hamburg, Germany), Bikash Ranjan Rautray (Bhubaneswar, India), Cameron McLean (Durban, South Africa), Daniela Biaggio (Wellington, New Zealand), Dave Barlow (Manchester, England), Etienne Aulotte (Brussels, Belgium), 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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Glossary

Developed area - any area that has been built up or altered significantly such that ecosystem functions are disrupted. Developed areas include places that are too damaged for natural functioning to occur such as dead zones, areas majorly damaged by salt, pollutants, or fertiliser build-up, trawled areas, areas stripped bare of topsoil or vegetation, and/or with infill that has not resulted in regrowth. They may feature some limited natural elements or permeable surfaces. Examples of developed areas include streets, sidewalks, buildings, parking lots, mowed lawns, golf courses, sports fields, ports, hardscape coastlines, channelised streams, artificial pools, underground parking, plazas, landfills, mining quarries, and monoculture fields. See the definition of "natural area" to understand what is not considered a developed area.

Endemic species - a species, subspecies, or lower taxon, occurring within its natural range (past or present) and dispersal potential (i.e. within the range it occupies naturally or could occupy without direct or indirect introduction or care by humans).

Green-collar - relating to workers, jobs, volunteers, institutions, or businesses that are involved directly or indirectly in protecting the environment. Examples of green-collar jobs include conservation officers, researchers focused on sustainability, environmental educators, sustainability officers within an organisation, organic or traditional farmers and grocers, hazardous cleanup technicians, environmental restoration labourers, workers in the repair/reuse economy, and sustainable landscape maintenance workers. Indirect impacts of green-collar jobs include innovation and education for transforming processes, structures, products or behaviour to be more environmentally positive.

Natural area - any area that is not built up or is sustainably used and therefore still largely functions as an ecosystem. Uses with limited negative impact such as low-impact harvesting or sustainable agricultural activities, trails, small access roads, signage, campsites, cultural sites, gardening, or similar may be included within natural areas. They include areas that may have been previously developed but have since been restored or rewilded. Some brownfields may be considered natural areas if ecosystem functions have returned. Structures with vegetated roofs (including underground structures) may only be included if they provide ecosystem functions appropriate to the local context such as water filtration and habitat for key species. See the definition of "developed area" to understand what is not considered a natural area.

Natural elements - biota and abiota that are not human-generated, introduced, or controlled, featuring a wildness stemming from the activities of lifeforms and geological processes outside of human domestication or control and that function as part of an ecosystem. Livestock, companion animals, lab-derived substances, invasive species, and artificial structures are not natural elements. Lifeforms with some human influence (e.g. pruned and/or planted trees) and structures designed by humans to integrate functionally with nature (e.g. nature-based solutions) may be considered natural elements.

Sacred natural sites - places that are recognised by a local community and/or an indigenous community as a meaningful place of cultural, historical, or religious significance and that is either located within a natural area or has an existing natural element that is significant to its meaning. Sacred natural sites may include burial sites, traditional village sites, traditional harvesting grounds, traditional boat launching or fishing sites, heritage trees, ceremonial locations, sacred water bodies or springs, areas of mourning, meditation/prayer sites, or historically significant places. For additional information on sacred natural sites, see WWF's publication *Beyond Belief* (available at https://wwfeu.awsassets.panda.org/downloads/beyondbelief.pdf).

Urban - relating to a conglomeration of ongoing human use represented by development of the area. Government boundaries of urbanised areas may incorporate both developed and natural areas. Examples include more rural villages and towns as well as industrial- or agricultural-based communities, cities of any size, and metro areas that consist of combinations of the aforementioned examples.

Urban nature - includes natural areas in and around a city as well as natural elements within developed areas of a city. The scale of urban nature can vary widely, from mountains to microbiota.

Parkroyal Collection Pickering, Singapore. Photo by Danist Soh on Unsplash. Used under the Unsplash License.

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 Kunming-Montreal 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, IUCN launched the IUCN 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 Indexes (UNI), a series of indices aiming 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 and involved scores of experts from local governments and IUCN constituencies. From this process emerged a comprehensive system organised around 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 (available at www.iucnurbannatureindexes.org) to present the indicator topics and options to complete them, provide implementation guidance, and share the results of participating cities.

Methodology

To develop the UNI, the IUCN Urban Alliance established a Technical Expert Group made up of 16 members drawn from IUCN, city governments and urban conservation organisations. The expert group was tasked with creating a framework for the new tool that built on best practices and insights derived from experience with other similar indices. In particular, the expert group sought to devise indexes that could overcome difficulties posed by existing approaches, where a lack of harmonisation and standardisation in tools and indicators made it difficult to draw meaningful comparisons (Elmqvist et al., 2013; Houvila et al., 2019).

The idea behind the new set of indexes was to bring together a wide range of themes and variables, including several not included in other indices, such as consumption patterns and access to nature, while at the same time ensuring that cities could report flexibly against each theme according to their capacities. Thanks to IUCN's membership and constituents, this new tool could be promoted and applied in a vast array of cities, reinforcing its global scope and yielding results that enable more meaningful comparisons.

In a first step, the expert group undertook a scoping exercise to identify existing tools, standards and frameworks of relevance to urban ecological performance.

These included, but were not limited to:

- Sustainable Development Goals
- Convention on Biological Diversity
- New Urban Agenda and City Prosperity Index
- World Bank Urban Sustainability Framework
- Singapore Index on Cities' Biodiversity
- European Urban Biodiversity Index
- European Green Capital Award
- Making Nature's City
- Various standards of the International Organization for Standardization
- Living Cities: Towards Ecological Urbanism
- International Ecocity Framework and Standards
- IUCN Global Standard for Nature-based Solutions
- Kunming-Montreal Global Biodiversity Framework
- Global Assessment Report on Biodiversity and Ecosystem Services

The evaluation included a close look at the Singapore Index, which has constituted a global benchmark for urban biodiversity monitoring since 2010. The Singapore Index has proven a useful tool for cities to evaluate and monitor the progress of their nature-related efforts against their own individual baselines. The experts suggested three ways in which the UNI could go beyond the Singapore Index:

- While the Singapore Index only considers within-boundary impacts, the UNI could also account for peri-urban and rural ecosystems
- The UNI could be designed to be adaptable according to the capacity and data available
- The UNI could be supported by a web platform for monitoring and knowledge exchange

The UNI is based on two pre-existing frameworks: the Driver-Pressure-State-Impact-Response (DPSIR) model (Bradley & Yee, 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 relationships between 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.

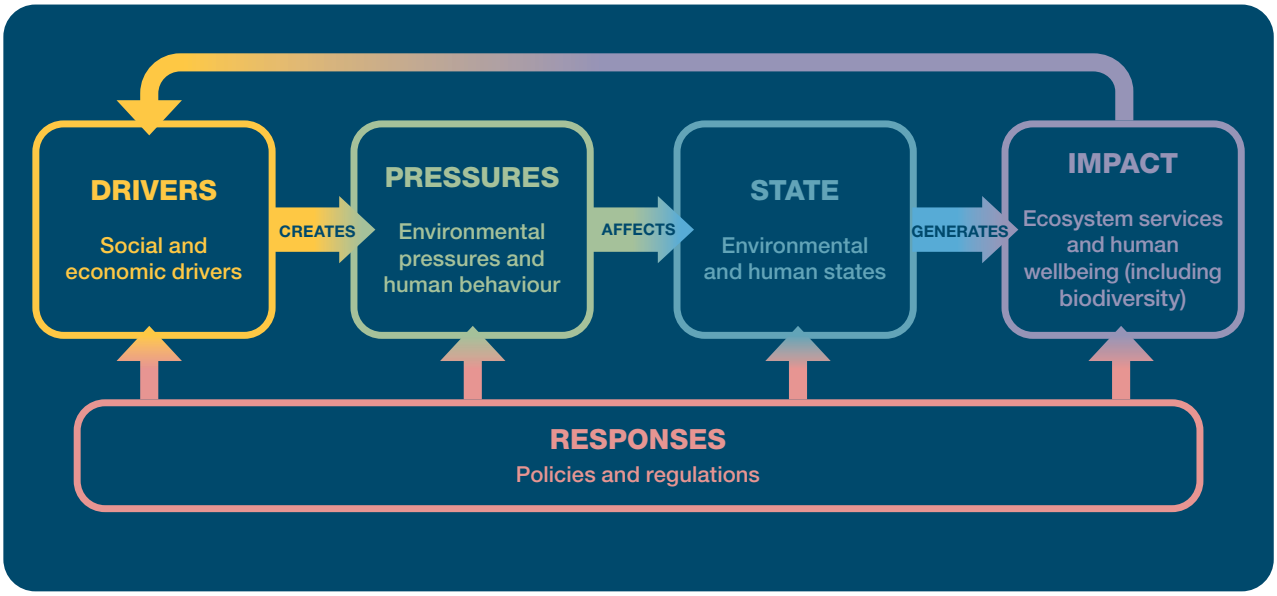

Figure 1. DPSIR model for environmental impacts (Source: adapted from Bradley & Yee (2015)).

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 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. The global scale refers to the impacts that a city has in distant locations, connected by transportation lines, cultural influence, or other forces of globalisation. 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.

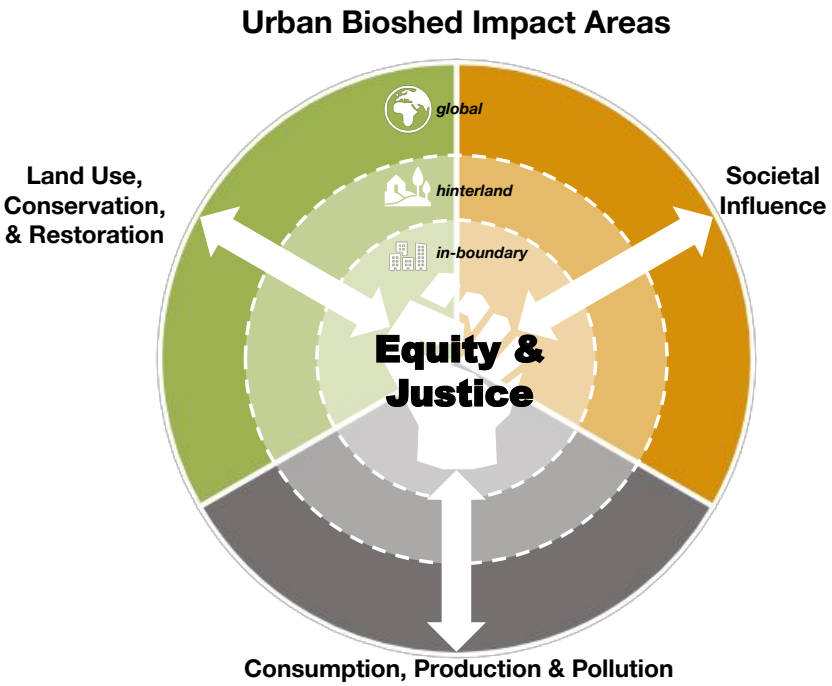

Figure 2. Urban Bioshed Impact Areas Model reprinted with slight modifications with permission from the Routledge Handbook for Sustainable Cities and Landscapes in the Pacific Rim (Pierce, 2022). Creative Commons Attribution-Non Commercial-No Derivatives 4.0 license.

Considering past experiences with other indices such as the Living Planet Index, the Multidimensional Biodiversity Index, or the Red List Index (Butchart et al., 2007), the diversity of metrics and units that cities may select for a given indicator topic, and the progressive dimension of assessments which may see the number of indicators increase, it was recommended to keep indicators disaggregated.

Scope and structure

The expert panel reviewed more than 450 existing indicators for measuring drivers, pressures, status, and impacts related to urban ecological health. Following recommended methods for index creation, the list of indicators was substantially reduced by applying a set of recognised criteria: salience, legitimacy, credibility, and feasibility (van Oudenhoven et al., 2018; Füssel, 2010). The resulting shortlist 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 in six cities.

The UNI is structured around 30 indicator topics nested across six themes. The indicator topics allow for the analysis and monitoring of different aspects of urban nature. Thanks to the flexible nature of the UNI, and given potential capacity constraints, cities are recommended to implement at least one indicator topic per theme.

The six themes are:

- **Consumption drivers.** This theme reflects the impacts of cities that result from the resources (e.g. food, energy, water, goods) used by its inhabitants and businesses and often have global reach.
- **Human pressures.** This theme refers to human-induced disturbances (e.g. noise, light and water pollution) of natural habitat within cities' jurisdiction.
- **Habitat status.** This theme captures the extent to which natural habitats are protected, restored and/or connected at city level.
- **Species status.** This theme includes indicators of species diversity and extinction risk and services provided by nature.
- **Nature's contributions to people.** This theme provides insight into the multiple benefits (e.g. health, employment, culture) provided by nature.
- **Governance responses.** This theme help understand how local government and legal frameworks promote development that supports biodiversity conservation.

As depicted in Table 1, the indicator topics span local (in-boundary), regional (hinterland), and global spheres of influence, and include strong equity dimensions. Collectively, the indicator topics are relevant to all of the Sustainable Development Goals (SDGs) as well as to goals under the IUCN Nature 2030 Programme and the Kunming-Montreal Global Biodiversity Framework (GBF), agreed by the Conference of the Parties to the Convention on Biological Diversity in December 2022. Cities may use the indicator topics of the present indexes to report their performance against the SDGs and the GBF as part of their public annual report and national monitoring efforts. A plethora of other platforms can be used to showcase cities' commitments to urban biodiversity through the application of the UNI, such as CitiesWithNature.

Table 1. Scope and structure of the UNI (Source: Prepared by the report authors).

Theme	ID	Indicator topics	Equity	Local	Hinterland	Global	SDGs	IUCN Nature 2030 Programme	GBF
1 Consumption drivers	1.1	Material consumption			✓	✓	8.4, 11.6, 12.2		16
	1.2	Harmful harvest and trade			✓	✓	12, 15.7, 15.c	P.3.1, L.1.1, W.1.1, O.1.1	5, 9
	1.3	Greenhouse gas emissions from energy				✓	7.2, 13	P.3.1, C.2.1, C.2.2	8
	1.4	Unsustainable diets	✓		✓	✓	2.4, 12.3	L.2.2	10
	1.5	Water withdrawal		✓	✓		6.4	W.2.1, W.2.2, W.3.1	11

2 Human pressures	2.1	Urban sprawl			✓		11.3, 15	L.2.3, L.3.1	10, 12
	2.2	Water pollution		✓	✓	✓	6, 12.4, 14.1	W.1.1, W.1.2, W.2.1, W.2.2, O.1.1, O.1.2	7, 8
	2.3	Noise pollution		✓			14, 15		7
	2.4	Light pollution		✓	✓		15		7
	2.5	Invasive species		✓	✓		15.8	L.1.1, W.1.1, O.1.1	6
3 Habitat status	3.1	Land use/protection		✓	✓		15.1	P.1.1, P.2.1, P.2.2, P.3.1, L.1.1, L.1.2, L.2.2, L.2.3, L.3.1	3
	3.2	Ecosystem restoration (terrestrial)		✓	✓		15.5	L.2.1, L.2.3	2
	3.3	Shorelines and riverbanks		✓	✓	✓	14	W.1.1, W.1.2, O.1.1	2
	3.4	Vegetation cover		✓			13, 15.2		8, 11
	3.5	Connectivity		✓	✓		14, 15		2, 12
4 Species status	4.1	Animal species		✓	✓		14, 15	L.1.1, W.1.1, O.1.1	4
	4.2	Plant species		✓			14, 15	L.1.1, W.1.1, O.1.1	4
	4.3	Functional diversity		✓			14, 15		11
	4.4	Microbiota and fungi		✓	✓		14, 15		11
	4.5	Endemic species		✓	✓	✓	14, 15	L.1.1, W.1.1, O.1.1	4, 12
5 Nature's contributions to people	5.1	Exposure to nature		✓			11.7	P.2.1, P.2.2	12
	5.2	Access to nature	✓	✓			10, 11.7	P.2.1, P.2.2	12
	5.3	Human health	✓	✓	✓	✓	3.3, 3.9, 11.6	P.2.2, L.3.1	11
	5.4	Livelihoods	✓	✓	✓		1, 4.5, 4.7, 5, 8, 9, 10, 12.b, 15.c	P.1.1, P.1.2, P.2.2	9, 19, 20
	5.5	Sacred natural sites	✓	✓	✓	✓	11.4	P.1.1, P.2.1, L.1.2, W.1.2, O.1.	22
6 Governance responses	6.1	Planning		✓	✓	✓	11, 12.1, 15.9	P.2.1, P.2.2, L.2.3, L.3.1, W.2.2	12, 14
	6.2	Legislation and regulation	✓	✓	✓	✓	12.c, 14.c, 16.b	P.1.1, P.1.2, P.1.3, P.2.1, P.2.2, P.3.1, L.2.3, L.3.1, W.3.1, O.3.2, C.1.2, C.2.2, C.3.1	14, 16, 18
	6.3	Education	✓	✓	✓	✓	4, 5, 12.8, 13.3	P.1.1, P.1.2, P.1.3	16, 21
	6.4	Management	✓	✓	✓		2.3, 11	P.1.1, P.2.1, P.2.2, L.1.2, L.2.2, L.3.1, W.2.1, O.2.1	1, 3, 10, 19
	6.5	Incentives and participation	✓	✓	✓	✓	5, 8, 9.5, 11.3, 12.1, 16.6, 16.7, 17.17	P.1.1, P.1.2, P.1.3	15, 16, 19, 20, 22, 23

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 indexes 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 three years. The reporting period can be adjusted depending on cities' resources for data collection, as long as the subsequent assessments present the same indicator topics in order to ensure consistency. 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 indicator topics based on capacity level (Source: Prepared by the report authors).

Capacity	Required indicator topics	Indicator topic level	Minimum number of indicator topics
Low	At least 1 indicator topic per theme	Basic	**6**
Medium	At least 2 indicator topics per theme	Basic	**12**
High	At least 3 indicator topics per theme	Advanced	**18**
Mega	At least 4 indicator topics per theme	Advanced	**24**
Champion	All indicator topics	Advanced	**30**

Cities may choose to complete indicators at a more advanced level and/or exceed the minimum indicated for their category (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). 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.

Before beginning the application of the UNI, it is essential that cities assess data availability and capacities to frame the scope of the tool, tailor it to available resources, and select the indicator topics that meet local needs. To support cities in this process, a 'capacity assessment questionnaire' has been developed to help users identify the appropriate number of indicator topics to implement. The 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 early testing of the UNI.

The questionnaire comprises seven questions:

1. What is the population of your city or town?

a. Less than 1 million people

b. Between 1 and 3 million people

c. More than 3 million people

2. What is the GDP per capita in your city or town?

a. Less than €21,000

b. Between €21,000 and €31,000

c. More than €31,000

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. 1–2 staff members

b. 3–6 staff members

c. More than 6 staff members

5. What is the municipal funding status for biodiversity-related initiatives (other than staff salaries)?

a. No funding, reliant on external support

b. Variable annual funding is provided

c. Dedicated regular funding is budgeted (e.g. annually)

6. How would you rate the political priority of biodiversity and/or nature in your city?

a. Low priority

b. Medium priority

c. High 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 score can be calculated to determine the capacity level using Table 3.

Table 3. Capacity level as determined by answers to the capacity assessment questionnaire.

Score	Capacity	Completion requirements	Indicator level
7–9	**Low**	At least 1 indicator topic per theme	Basic
10–13	**Medium**	At least 2 indicator topics per theme	Basic
14–17	**High**	At least 3 indicator topics per theme	Advanced
18–21	**Mega**	At least 4 indicator topics per theme	Advanced
Any	**Champion**	All indicator topics	Advanced

Through the UNI web platform (www.iucnurbannatureindexes.org), cities will be able to proceed with all implementation steps: the assessment of capacity, selection of indicators (basic or advanced) and reporting of performance, including the upload of supporting documentation. Visual representations of trends will be automatically generated based on reported performance.

How are the indicator topics assessed?

Once a user has determined which indicator topics to adopt, with a minimum of one per theme, a baseline assessment can be undertaken. The assessment is based on indicator levels and trends (targets achieved/missed, improving, unchanged, or worsening) and, depending on the indicator topic, looks at quantitative data or more or qualitative considerations such as presence/absence of effort. 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 will emerge.

The flexibility of the UNI allows for a range of methodologies and data sets to be employed to meet the requirements of each indicator topic. However, this feature might pose limitations on data confidence, as resources and capacity vary from municipality to municipality. Cities are therefore asked to provide an assessment of the robustness of results reached.

Data confidence estimation is based on three factors:

- Spatial resolution
- Temporal characteristics
- Sampling and representativeness of the dataset

Confidence levels will be high when indicator topics are completed in line with the instructions provided; moderate when the instructions are largely adhered to; and low when only one of the three dimensions is satisfactorily addressed.

Themes and indicator topics

This section presents each of the indicator topics that may be selected within the six themes, including their intent, calculation instructions, suggested resources and tentative scoring system. Note that the UNI is designed to accommodate alternatives suggested by 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.
Indicator	Average daily volume of solid waste produced per person.
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	Ecological footprint measures the impacts of consumption including 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 Citizen science and volunteer monitoring can contribute data. https://www.dopastoaoprato.com.br/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**

1.2 Harmful harvest and trade

Intent	Assess trade that directly harms species or ecosystems, whether legal or illegal.
Indicator	Amount of harvest or trade of an endangered species or unsustainably harvested resource.
Instructions	1. Identify at least 1 endangered species of plant/animal or 1 type of natural resource subject to unsustainable harvesting that is particularly harmful to biodiversity or ecosystems and that is connected to trade originating in, flowing through, or terminating in the boundaries of your local government. Examples may include: • Unsustainably harvested timber • Products derived from illegal wildlife trade • Fish farmed using harmful practices 2. Measure the harvest or trade (imports and/or exports) 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. https://wildlex.org/ *Wildlife trafficking in Metropole Sao Paulo – Brazil: an analysis of the legal, cultural and characteristics of this (un)sustainable activity.* Available in English and Spanish at: http://revista.domhelder.edu.br/index.php/veredas/article/view/2175/25320 *Can citizen reporting apps plug the data gap in the Himalayan wildlife trade?*, case study on citizen science and youth empowerment in efforts to combat wildlife trafficking. Available at: https://www.sciencedirect.com/science/article/pii/S2666719321000893
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 emissions from energy

Intent	Estimate greenhouse gas (GHG) emissions per person that result from energy use.
Indicator	Total city-wide GHG emissions from energy source.
Instructions	1. Calculate total city-wide energy use for each energy source, including both industrial and household use. 2. Convert energy use from each source to GHG emissions using emission factors for your location by energy source as provided by the Intergovernmental Panel on Climate Change (IPCC). For simplicity, sources 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 GHG emissions per capita using the method indicated in the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories.
Resources	IPCC Emission Factor Database: https://www.ipcc-nggip.iges.or.jp/EFDB/main.php Global Protocol for Community-Scale Greenhouse Gas Emission Inventories: 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 the sustainability of diets according to land use and overharvesting concerns.
Indicator	Animal protein consumed per year per person, or percentage of food that has travelled over 320 km (200 miles).
Instructions	Select one of the approaches listed below: 1. Calculate the total annual amount (weight) of red meat and seafood consumed by local, nonindigenous populations (where applicable), and divide by total nonindigenous population. Red meat is defined as any non-poultry meat. 2. Measure the proportion of locally consumed food that has travelled more than 320 kilometres from where it was produced.
Alternatives	Calculate the share of per capita ecological footprint attributable to food consumption. Indigenous communities are invited to suggest their own approach to measuring the sustainability of diets under this topic.
Resources	https://attra.ncat.org/product/food-miles-background-and-marketing/ www.ecocityfootprint.org https://coolfood.org/ The Indigenous Food Systems Network provides information on indigenous approaches to food systems and food sovereignty: https://www.indigenousfoodsystems.org/ Forest Footprint for Cities Dashboard: https://forestfootprint.org/cities/model-city/ Citizen science platforms such as Do Pasto Ao Prato, available in Brazil, can be used in the context of this indicator topic: https://www.dopastoaoprato.com.br/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**

1.5 Water withdrawal

Intent	Measure freshwater consumption against locally sustainable levels.
Indicator	Ratio comparing current total water withdrawal with sustainable water withdrawal rates.
Instructions	1. Determine sustainable freshwater withdrawal rates* for your local government area including any protected watersheds managed by or on behalf of the local government. 2. Calculate current freshwater withdrawal rates for your local government area. Include water withdrawn for any purpose (residential, agricultural, industrial, recreational, etc.) that is consumptive.** Exclude desalinated seawater. 3. Compare the sustainable and current withdrawal rates. * Sustainable water withdrawal ensures the current and future availability of sufficient freshwater (groundwater, aquifers, lakes, wetlands and streams) to meet basic human needs and support healthy ecosystems. The sustainable rate may vary based on precipitation rates or other factors. ** 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, excluding recycled water, harvested rainwater and desalinated seawater.
Resources	Consumptive water definition: 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 Urban sprawl

Intent	Assess level of urban sprawl.
Indicator	Average population density of developed land within the boundaries of the local government.
Instructions	Calculate the average population density of developed land (i.e. excluding undeveloped and restored/naturalised land) within the boundaries of the local government area.
Alternatives	Calculate the ratio of the annual land consumption rate to the annual population growth rate (as per SDG Indicator 11.3.1), where land consumption is a measure of the urbanised land area. With this alternative, decreasing scores indicate a positive trend (the inverse of the base option). A metro-area-scale measurement may be used, if applicable.
Resources	SDG Indicator 11.3.1 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 UN-Habitat: "Cities and Nature: Planning for the Future". https://unhabitat.org/sites/default/files/2022/12/white_paper_cities_and_nature_rev2.pdf
Scoring	Score this indicator as follows: **++ Multi-year decreasing trend established** **+ Decreasing trend observed** **= Unchanged trend** **• Baseline measured** **- Increasing trend observed** **-- Data deficient**

2.2 Water pollution

Intent	Assess the level of pollutants in aquatic ecosystems.
Indicator	Nutrient retention of streams (including rivers) from raw water samples and/or the area of eutrophication along coasts/in lakes.
Instructions	Cities should select the most appropriate measures according to the nature of local water bodies (streams, lakes or coastal areas). Artificial and/or channelised 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 ha 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 the largest streams in the city. For coastal areas and lakes: Measure the total area of eutrophication. When there are no large aquatic systems within their boundaries, cities may consider smaller streams and lakes or measure pollution in 3 systems within 10 km of the city boundaries (again sampling at both upstream and downstream sites).

	Sampling should take into account temporal and seasonal factors that affect water quality. Sampling protocols (i.e. frequency of measurement, sampling during baseflow or flood conditions) shall be specified.
Alternatives	Analysis of water samples for nutrient retention commonly measure nitrogen levels but may alternatively measure sediment or phosphorous levels as appropriate. Measures of solid waste particles such as plastics may be considered.
Resources	USEPA Technical Guidance Manual for nutrient retention measurement in streams: https://www.epa.gov/sites/default/files/2018-10/documents/nutrient-criteria-manual-rivers-streams.pdf Methods for the analysis of satellite imagery of water colour as a measure for eutrophication rates are described in: http://www.cearac-project.org/cearac-project/integrated-report/Annex_A5_Peter.pdf Guidance on water sampling prepared by the State of Queensland, Australia: https://environment.des.qld.gov.au/__data/assets/pdf_file/0031/89914/monitoring-sampling-manual-2018.pdf A global map showing wetland types for reference of locally significant aquatic ecosystems: https://www2.cifor.org/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.
Indicator	Number of instances of noise >55dB in outdoor areas of concern for at least 30 minutes during the peak noise period.
Instructions	Identify areas of concern within the city 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 55 dB on land (or 170 dB underwater) in at least 5 outdoor locations within the areas of concern for at least 30 minutes each during the noisiest 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 the extent of natural habitats adjacent to sources of noise above 55 dB on land or 170 dB underwater.

Resources	European Environment Agency: Environmental Noise: https://www.eea.europa.eu/airs/2018/environment-and-health/environmental-noise ISO standard 37120:2018:8.8 Marine noise pollution - increasing recognition but need for more practical action: 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 Relevant citizen science platforms and apps include NoiseTube and SPLnFFT. https://scistarter.org/noisetube https://apps.apple.com/us/app/splnfft-noise-meter/id355396114
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.
Indicator	Average night sky light pollution levels on the Sky Quality Meter (SQM) scale.
Instructions	Calculate average night sky light pollution levels on the Sky Quality Meter (SQM) scale, based on at least 1 measurement point per km2 and no less than 20 measurements.
Alternatives	The Bortle scale may be used.
Resources	Guidelines on how to conduct a Sky Quality Survey https://darksky.org/resources/guides-and-how-tos/how-to-conduct-a-night-sky-quality-survey/ Light pollution map https://www.lightpollutionmap.info Citizen science platforms: Globe at Night and Loss of the Night. https://www.globeatnight.org/ https://play.google.com/store/apps/details?id=com.cosalux.welovestars&hl=en_US&gl=US
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.	
Indicator	Status of each invasive species of interest based on range, total population or impact.	
Instructions	Select invasive species of interest based on their potential negative impact on local ecosystems or human activities. Determine the status of each selected invasive species by measuring their range, total population or impact, as appropriate. Cities can use the Horizon Scanning methodology to forecast future trends and impacts related to invasive species. Also useful is the Environmental Impact Classification for Alien Taxa (EICAT), 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: https://rm.coe.int/european-code-of-conduct-for-invasive-alien-trees-adopted-version/168076e86e Code of Conduct on horticulture and invasive alien plants: https://rm.coe.int/1680746a50 Free Horizon Scanning tool for invasive species using CABI Compendium: https://www.cabi.org/horizonscanningtool Environmental Impact Classification for Alien Taxa (EICAT): https://www.iucn.org/resources/conservation-tool/environmental-impact-classification-alien-taxa Citizen science resources for invasive species mapping and monitoring: • Citizen Scientists' Role in Invasive Species Mapping and Management https://onlinelibrary.wiley.com/doi/abs/10.1002/9781119607045.ch50 • A review of invasive species reporting apps for citizen science and opportunities for innovation https://neobiota.pensoft.net/article/79597/list/1/ • EASIN – European Alien Species Information Network https://easin.jrc.ec.europa.eu/easin/CitizenScience/BecomeACitizen	
Scoring	Score this indicator as follows: **++ All invasive species eradicated or in decline** **+ Majority of invasive species eradicated or in decline** **= Unchanged trend (including where equal numbers of species show opposite trends)** **• Baseline measured** **- Majority of invasive species unmanaged or growing** **-- Data deficient**	

3.1 Land use/protection

Intent	Assess land use and regulatory protections against harmful development patterns.
Indicator	Total protected land factor as the sum of protected areas weighted by level of protection.
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 using the following formula: $L_F + 0.75\ L_N + 0.5\ L_P + 0.25\ L_I$ = 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 the local government boundary that is connected to the city via agreements such as payment for ecosystem services (PES) schemes.
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 unmown), protected riparian zones in a residential area, 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 under 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 include disincentives such as requiring an environmental assessment or riparian permit.

Alternatives	None
Resources	Best practice guidelines for protected areas: 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.
Indicator	Average area of ecosystems brought under restoration in a given timeframe (1–5 years).
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, considering 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 the area of terrestrial and/or wetland habitats that have undergone restoration in the given timeframe. 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	Complete Singapore Index indicator 7. https://www.nparks.gov.sg/biodiversity/urban-biodiversity/the-singapore-index-on-cities-biodiversity
Resources	IUCN's "Restoration Intervention Typology for Terrestrial Ecosystems" provides guiding principles for restoration activities. Restoration in other types of terrestrial ecosystems such as forests, grasslands or farmlands may also be reported: https://restorationbarometer.org/wp-content/uploads/2022/02/iucn_restoration_intervention_typology.pdf The Society for Ecological Restoration has developed definitions, principles and other tools to advance restoration, such as the "International Principles and Standards for the Practice of Ecological Restoration": https://www.ser.org/page/SERStandards/International-Standards-for-the-Practice-of-Ecological-Restoration.htm Bonn Challenge for restoring degraded and deforested lands: https://www.bonnchallenge.org/ Massive Open Online Course (MOOC) on ecosystem restoration: https://www.learningfornature.org/en/courses/ecosystem-restoration-2022/
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 and riverbanks

Intent	Measure the health and restoration of aquatic ecosystems.
Indicator	Ratio of naturalised to engineered shoreline for streams, lakes and marine areas.
Instructions	Calculate the ratio of naturalised to engineered shoreline areas 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 ha in area should be included. Naturalised shorelines include naturally vegetated porous surfaces such as soil/sandy/rocky shores, beds, and tidal pools and include 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, channelised, 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, count 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, count naturalised shorelines that are also adjacent to naturalised lake beds as naturalised shoreline area. In the case of coastal areas, consider 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. Naturalised coastal shorelines must feature a substantially natural tidal area and bed to be included as naturalised. Substantially natural means that natural ecosystems cover the majority of the area and any human interventions such as pedestrian pathways have minimal impact (e.g. 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	For guidance on computing stream order, see Gleyzer et al. (2004): https://onlinelibrary.wiley.com/doi/10.1111/j.1752-1688.2004.tb01057.x Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management: https://www.ramsar.org/sites/default/files/documents/pdf/guide-iczm.pdf Guidelines for integrating wetland conservation and wise use into river basin management: https://www.ramsar.org/sites/default/files/documents/library/key_res_vii.18e_0.pdf See also the resources for indicator topics 3.1 and 3.2.
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.
Indicator	Percentage of local government area land that is vegetated.
Instructions	Measure the percentage of land across the local government area that is covered in vegetation. Depending on your local context, this may consider tree cover only or include shrubs. Lawns are not to be counted. Complete the advanced or basic indicator as follows:

Basic:	**Advanced:**
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% cover or less (this number updates automatically as you assess each point). iTree guidelines recommend 500–1000 points will need to be assessed for an average city. A canopy change assessment for 3-10 years in the past may be used to generate a trend if satellite imagery of sufficient quality is available. Once complete, save the data, and upload the csv file and the iTree report to this platform.	1. Generate Normalised Difference Vegetation Index (NDVI) values 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	Area of vertical green walls, green roofs featuring the same level of vegetation (e.g. trees and/or shrubs) or vertical forests may be included as appropriate. An alternative to iTree is the Collect Earth Online tool from the World Resources Institute. https://www.collect.earth/
Resources	The iTree tool and guidance on how to use it is available at: https://canopy.itreetools.org/ Citizen science is encouraged when using iTree as part of the basic methodology. NDVI corresponds to the annual net primary productivity of vegetation and is sensitive to temperature and water availability. A comprehensive review of NDVI applications is available by Kerr and Ostrovsky (2003) and Pettorelli (2006). NDVI can be calculated in QGIS (free and open source) or ESRI's ArcGIS Image Analysis toolbar. A QGIS tutorial is available here: https://towardsdatascience.com/remote-sensing-with-qgis-calculate-ndvi-c2095f0de21b Worldwide Landsat 8 satellite data is available for free at: https://earthexplorer.usgs.gov/
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 land area.	
Indicator	Connectivity via basic effective mesh size or connectivity metric following the 'graph theory' framework.	
Instructions	Measure habitat connectivity using an accepted tool, according to capacity. Complete the advanced or basic indicator as follows:	
	Basic:	**Advanced:**
	Calculate effective mesh size, an established measure of fragmentation of natural habitats (see resources below).	Calculate the connectivity metric using the "graph theory" framework. Spatial data can be imported into the free Graphab tool to calculate this. Include nearby regional habitat areas if feasible.
Alternatives	Alternative approaches with similar robustness include the Biodispersal plug-in for QGIS, the landscapemetrics R package, or a fragmentation index.	
Resources	For guidance on calculating effective mesh size, see Indicator 2 in the Handbook on the Singapore Index on Cities' Biodiversity at: https://www.nparks.gov.sg/biodiversity/urban-biodiversity/the-singapore-index-on-cities-biodiversity Graphab https://sourcesup.renater.fr/www/graphab/en/home.html QGIS Biodispersal plug-in https://plugins.qgis.org/plugins/BioDispersal/ landscapemetrics R package https://r-spatialecology.github.io/landscapemetrics/ Conefor http://www.conefor.org/ For more information on effective mesh size, see Deslauriers et al. (2018) "Corrigendum to: Implementing the connectivity of natural areas in cities as an indicator in the City Biodiversity Index (CBI)", *Ecological Indicators* at https://doi.org/10.1016/j.ecolind.2017.09.037 For information on alternative methods see: Wang et al. (2014). Measuring habitat fragmentation: An evaluation of landscape pattern metrics. *Methods in Ecology and Evolution*, 7(5), 634–646. https://doi.org/10.1111/2041-210X.12198 Hesselbarth et al. (2019). Landscapemetrics: an open-source R tool to calculate landscape metrics. *Ecography*, 10(42), 1623–1801. 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	Measure citywide animal species diversity.
Indicator	Presence/absence of selected native species in representative areas or extent of their habitat.
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) 2. Identify at least 3 native species (at least 5 for the advanced option) from each category to act as indicator species, including endangered species as appropriate. Species affected by urban-related threats such as residential and commercial development, transportation and service corridors, and pollution should be prioritised (see IUCN Red List). Introduced species threatened in their original distribution range should not be considered. 3. Implement the basic or advanced options below.

Basic:	**Advanced:**
Determine presence/absence of at least 3 indicator species in at least 5 representative locations per species across the city (minimum of 45 data points) during the time period of interest (at least one year). Count 1 point for the presence of each species in each location, then divide the total by the maximum possible score to produce a percentage.	Map the observed distribution of at least 5 indicator species throughout the city. Calculate the total distribution area of each species and sum the results. Divide the sum by the number of species mapped over the time period of interest (at least one year) to produce an average distribution area. For example, species A is found in two locations, a 0.5 km^2 area and a 1 km^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 4 km^2 which is divided by 2 (for 2 species) for a result of 2 km^2. Note that overlapping areas may be counted multiple times, once for each species.

Alternatives	Complete either the Urban Biodiversity Inventory Framework programme or Singapore Index indicators 3, 5, and 6.
Resources	National or local "Red Lists" provide information on endangered species (information on species on the global IUCN Red List is available at www.iucnredlist.org/). Urban Biodiversity Inventory Framework: https://drive.google.com/file/d/1d0dT7cX5eNsRuTIfFaztz68g3wr2Hzdf/view Singapore Index: https://www.nparks.gov.sg/biodiversity/urban-biodiversity/the-singapore-index-on-cities-biodiversity The IUCN Red List Threat Classification Scheme can be used to identify threats to nature in urban areas. https://www.iucnredlist.org/resources/threat-classification-scheme

	National/local data repositories are a key source of species observations and distribution estimates. Local conservation organisations and citizen science initiatives are potential partners for the gathering of original data. Useful online platforms include iNaturalist and eBird. https://www.inaturalist.org/ https://ebird.org/home
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	Measure of citywide plant species diversity.
Indicator	Presence and diversity of native vascular plants in at least 5 locations representative of plant species.
Instructions	1. Select at least 5 locations that provide different conditions for native plants across the city and for which data is available/can be gathered (e.g. park, green street edge, undeveloped area). 2. Survey an area totalling at least 100 m2 per location by designating transects or plots. 3. Record the presence of native vascular plant species in each location. 4. Count the total number of vascular plant species across all locations. 5. Repeat this count every 1–5 years to establish a trend.
Alternatives	Complete Singapore Index indicator 4.
Resources	Singapore Index https://www.nparks.gov.sg/biodiversity/urban-biodiversity/the-singapore-index-on-cities-biodiversity Citizen science platforms include Flora Capture, iNaturalist or Pl@ntNet. https://bmcbioinformatics.biomedcentral.com/articles/10.1186/s12859-020-03920-9 https://www.inaturalist.org/ https://plantnet.org/en/
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	Assess ecosystem health and resilience by measuring functional diversity.
Indicator	Species group or ecological function of interest across representative locations.
Instructions	1. Identify a group of species (may be a mix of taxa) according to an ecological function of interest such as: • pollination • predation • ecosystem engineering • in situ bioremediation • water or air biofiltration 2. Select at least five representative locations across the city. 3. Follow the examples below or determine another measure of the selected function. 4. Measure the function at the representative locations.

Example 1:	**Example 2:**
Pollination services can be estimated by counting the visitation rate of flowers in each location over a given period of time (Fijen and Kleijin, 2017), 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).

Alternatives	None
Resources	Schmitz, O. J., Hawlena, D., & 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 FAO (2008), Rapid assessment of pollinators' status. https://www.fao.org/publications/card/en/c/3e786cf8-ae00-593c-8b13-d96ab8a90d71/ FAO (2014), Principios y avances sobre polinización como servicio ambiental para la agricultura sostenible en países de Latinoamérica y El Caribe. https://www.fao.org/family-farming/detail/es/c/340161/ Citizen science platforms include Flora Capture, UMAPIT, and iNaturalist. https://bmcbioinformatics.biomedcentral.com/articles/10.1186/s12859-020-03920-9 www.umapit.org/ https://www.inaturalist.org/
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 and fungi

Intent	Measure the health of soils, fungi and microbiotic systems in aquatic and terrestrial areas.	
Indicator	Average decomposition rates across representative sites, or other chemical, physical or biological indicators.	
Instructions	1. Select at least 5 representative sites across the 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**, decomposition rates can be estimated by placing leaf litter or cotton strips in bags affixed to a location and measuring decomposition of the material over time.
Alternatives	Chemical (soil organic matter), physical (erosion rate) or biological (microbial biomass) properties of urban soils can be assessed through the analysis of soil samples.	
Resources	Karberg et al. (2008). Methods for Estimating Litter Decomposition. In C. M. Hoover (Ed.) *Field Measurements for Forest Carbon Monitoring* (pp. 103-111). https://doi.org/10.1007/978-1-4020-8506-2 Citizen science initiatives such as TeaComposition (https://www.teacomposition.org/) or volunteer monitoring can be used as part of this indicator topic.	
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 and conservation status of endemic species (where endemicity may be regional or local).
Indicator	Endemic species index based on diversity and conservation status.
Instructions	1. Select a taxonomic group* that is well represented in the local government area (and surrounding region) and assessed in a national/local/IUCN Red List**. 2. Measure richness by recording the number of endemic species from the selected taxonomic group that are present within a given timeframe and that have been assessed in national/local/global Red Lists of endangered species or another spatially explicit database. 3. Calculate the percentage of the total number of assessed endemic species that are considered threatened (e.g. species listed as "vulnerable", "endangered" or "critically endangered" as per IUCN Red List conservation status, or equivalent local/national lists). * According to IUCN Red List species, amphibians conifers, crustaceans, birds, mammals, reptiles are taxonomic groups most commonly assessed and threatened with extinction. ** Authors recommend considering species assessed within the last five years, to allow for comparability between reporting periods. When new endemic species are added to species count from one assessment to another, this shall be stated in the limitation as it will limit comparability over time (Butchart et al., 2007).
	Basic: Assess only one taxonomic group. / **Advanced:** Repeat steps 1–3 for at least two additional taxonomic groups.
Alternatives	None
Resources	Local, national or global spatially explicit databases can provide data on the presence of endemic species in a given area, while local conservation groups can help with survey activities. Information from the IUCN Red List of Threatened Species is available at https://www.iucnredlist.org/. Lists of assessed species in a given location can be downloaded at: https://www.iucnredlist.org/resources/spatial-data-download Other biodiversity indexes, such as the Living Planet Index, may be consulted. https://www.livingplanetindex.org/data_portal Local experts for a given taxonomic group may be identified through IUCN Species Survival Commission Groups, which gather a total of 10,500 volunteer experts: https://www.iucn.org/our-union/commissions/group/1445 See also the resources listed for indicator topics 4.1 and 4.2.
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 exposure to nature of urban residents and visitors.
Indicator	Total annual number of visitors to vegetated and/or natural open areas.
Instructions	Calculate the total annual number of visitors to vegetated and/or natural open areas (including parks and botanical gardens) in the local government area during a given time period. Counts and/or estimates are acceptable.
Alternatives	Cities are encouraged to disaggregate the data by neighbourhood, demographic, or other criteria to address equity concerns or other goals.
Resources	UNESCO (2021). Visitors count! Guidance for protected areas on the economic analysis of visitation: https://unesdoc.unesco.org/ark:/48223/pf0000378568.locale=en Citizen science and phone traffic analysis can be used in this indicator topic.
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 access to natural areas for members of vulnerable urban communities.	
Indicator	Percentage of all residents living within 300 m of a public, open access natural area (advanced option measures access for lowest income quintile).	
Instructions	Complete the advanced or basic indicator as follows:	
	Basic:	**Advanced:**
	Calculate the percentage of residents living within a walkable distance (300 m) of a public, open access natural area.	Calculate the percentage of residents in the lowest income quintile (lowest 20%) living within a walkable distance (300 m) of a public, open access natural area.
Alternatives	Calculate the average share of a city's built-up area considered as green/blue* space for public use. * Blue spaces are defined as "outdoor environments – either natural or manmade – that prominently feature water and are accessible to humans either proximally (being in, on or near water) or distally/virtually (being able to see, hear or otherwise sense water)" (Grellier et al., 2017, p. 3).	
Resources		
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 an environmental variable directly related to human health.
Indicator	A measure of air quality. The advanced option requires the measurement of one additional relevant environmental variable or of a health condition related to environmental factors.
Instructions	Measure local air quality via an air quality index or a variable such as PM 2.5 concentration or local asthma rates. For advanced completion, include an additional measure appropriate to the local context (see the list below). For the purpose of this indicator topic, air quality is considered as a proxy for respiratory health.
Alternatives	Air quality can be measured using, for example: • Air quality index • Childhood asthma rates • Nitrogen dioxide concentration • Household solid fuels combustion • Ambient ozone pollution • PM 2.5 concentration • Distribution of bioindicators such as lichens or bryophytes Alternative/additional measures include: 1. Rates of disorders and diseases linked to exposure to dangerous substances such as lead poisoning, birth defects, cancer and obesity as well as neurological, endocrinological, thyroid 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, and inflammatory bowel diseases. 4. The contribution of vegetation to urban cooling (as modelled with, for instance, the Urban InVEST tool) may also be reported as a measure of heat mitigation.
Resources	IUCN's policy scoping brief on biodiversity and human health and well-being (2018): https://portals.iucn.org/library/sites/library/files/resrecrepattach/DRAFT%20IUCN%20Policy%20Briefing%20Paper%20on%20Biodiversity%20and%20Human%20Health%20CBD%20COP14%20051118.docx WHO and CBD (2015). Connecting Global Priorities: Biodiversity and Human Health: https://www.cbd.int/health/SOK-biodiversity-en.pdf Zhang, XX., Liu, JS., Han, LF. et al. (2022). Towards a global One Health index: a potential assessment tool for One Health performance. *Infectious Diseases of Poverty* 11, 57. https://doi.org/10.1186/s40249-022-00979-9 National and local health authorities in many countries monitor major air pollutants and maintain air quality indexes. Index values from around the world can be seen at: https://aqicn.org/city/all/ WHO global air quality guidelines are available at: https://www.who.int/publications/i/item/9789240034228 Relevant citizen science and information platforms include the ESA Air Quality Platform, Urban Air Action Platform and hackAIR. https://aqp.eo.esa.int/aqstation/

	https://www.unep.org/explore-topics/air/what-we-do/monitoring-air-quality/urban-air-action-platform https://www.hackair.eu/about-hackair/ Urban cooling model of Urban InVEST: https://naturalcapitalproject.stanford.edu/software/invest-models/urban-cooling https://www2.purpleair.com/
Scoring	Score this indicator as follows: **++ Multi-year positive trend established** **+ Positive trend observed** **= Unchanged trend** **• Baseline measured** **- Negative trend observed** **-- Data deficient**

5.4 Livelihoods

Intent	Measure support for livelihoods stemming from conservation and sustainable management.
Indicator	Number of people classed as green-collar workers, who received green-collar vocational training, or receive payment for ecosystem services (PES).
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 effective hourly compensation equal to or above the local median wage rate, based on equity and gender equality) • PES schemes or other direct monetary incentives for the stewardship or sustainable management of natural resources • Women-led conservation initiatives or other initiatives established by underrepresented community members • Bio-businesses • Urban design projects incorporating materials inspired by nature 2. Calculate the total number of individuals, disaggregated by gender and race, who were employed by or otherwise benefitted directly from one or more of the items selected. Ensure that training is diverse and equitable. It should be inclusive and safe for all, particularly for members of vulnerable groups of society, including women and girls, racialised people, religious minorities, and other groups.

Basic:	**Advanced:**
Select one of the categories listed. Choose at least one industry or sector from which to gather data, as applicable.	Select at least two of the categories listed. Choose at least two industries or sectors from which to gather data, as applicable.

Alternatives	None
Resources	Green-collar jobs may be within a green industry, for a green institution, or in a position responsible for increasing the sustainability of goods or services. The category can be defined as appropriate in the local context. Green Jobs Assessment Reports published by the International Labour Organization: https://www.ilo.org/global/topics/green-jobs/publications/assessments/lang--en/index.htm

	The Measuring Green Jobs? report provides guidance on defining and assessing green jobs: https://norden.diva-portal.org/smash/get/diva2:702024/FULLTEXT01.pdf
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.	
Indicator	Number of recognised and/or protected sacred natural sites managed for sacred use in partnership with appropriate local leaders and the number of people involved in sacred natural site management.	
Instructions	Complete the basic or advanced indicators as follows:	
	Basic:	**Advanced:**
	Calculate the total number of Sacred Natural Sites that are: • actively in the process of being legally recognised and/or protected for sacred use; • recognised and/or protected for sacred use; or • managed to suit spiritual purposes in partnership with appropriate local communities or indigenous leaders.	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 (%); or • 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 (Wild and McLeod, 2008). They may be recognized by the 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 programme. 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 Aird, P. L. (1994). Heritage, natural heritage, cultural heritage and heritage tree defined. *The Forestry Chronicle*, 81(4). https://doi.org/10.5558/tfc81593-4	
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 for biodiversity and ecosystem services in the UNI themes.
Indicator	Active local government documents such as plans or strategies that address at least 4 of the UNI themes.
Instructions	Identify current local government plans, policies or other strategic documents that address the themes of the UNI. Relevant public documents generally include a goal or objective statement, and are linked to verifiable measures of success, such as particular outputs (an event, a project, a governance structure) or one or more timebound targets. Documents passing through an approvals process anticipated to be completed within an assessment period as well as those under which measures are in implementation or which have already been implemented and are currently being monitored and revised for the next assessment period are eligible. 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). Describe how each of these goals are currently on track according to local targets or outputs Score the basic or advanced indicator as follows:

Basic:	**Advanced:**
Assess whether current qualifying documents address at least 4 of the 6 UNI themes.	Assess whether current qualifying documents address all of the 6 UNI themes.

Alternatives	Complete Singapore Index indicators 17 and 18 earning up to 8 points in total. https://www.nparks.gov.sg/biodiversity/urban-biodiversity/the-singapore-index-on-cities-biodiversity
Resources	Urban Biodiversity Hub database of biodiversity plans. http://www.ubhub.org/ 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 ICLEI Canada (2015). BiodiverCities: A Handbook for Municipal Biodiversity Planning and Management: 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 Legislation and regulation

Intent	Assess government regulatory efforts related to biodiversity and ecosystem services.
Indicator	Regulations that support improving indicators across the themes of the UNI.
Instructions	Identify bylaws and regulations adopted by local government and in force during the assessment period that provide the enforcement, implementation, or direct support needed to improve indicators for each of the themes of the UNI. Regulations should be equitable, non-discriminatory, and promote justice for all people. Bylaws that are not actively enforced shall not be considered as supporting improvement. Score the advanced or basic indicator as follows:

Basic:	**Advanced:**
Supporting regulations are in place for at least one indicator each for a minimum of two themes.	Supporting regulations are in place for at least one indicator each for a minimum of four themes.

Alternatives	None
Resources	For guidance on identifying relevant laws for this indicator topic, see: IUCN World Commission on Environmental Law (WCEL) https://www.iucn.org/search?type%5B%5D=resource&f%5B0%5D=commissions%3A1446 World Declaration on the Environmental Rule of Law https://www.iucn.org/our-union/commissions/world-commission-environmental-law/our-work/history/foundational-documents-4 Framework for Assessing and Improving Law for Sustainability https://www.iucn.org/our-work/governance-law-and-rights ECOLEX https://www.ecolex.org/
Scoring	Score this indicator as follows: **++ Local bylaws for each theme actively enforced** **+ Progress made on adoption of local bylaws for all themes** **= No changes detected** **• Overarching policy commitment only** **- No current commitment** **-- Data deficient**

6.3 Education

Intent	Assess depth of educational programmes for biodiversity and ecosystem services.
Indicator	Number of citizens participating in educational programmes covering the themes of the UNI.
Instructions	Tally the number of citizens that participated in educational programmes covering any of the UNI themes in the assessment period. Relevant educational programmes include: • Guided nature walks • Student research • Internships, training, volunteer programmes

	• Lectures, seminars, conferences • Activities organised with schools and research institutions Ensure that educational outreach is diverse and equitable. It should be inclusive and safe for all, particularly for more vulnerable members of society, including women and girls, racialised people, religious minorities, and other groups. We encourage submittal of gender- and race-disaggregated data.
Alternatives	None
Resources	Public education programmes Universities, schools and research institutions Civil society organisations involved in environmental education or ecotourism IUCN Commission on Education and Communication https://www.iucn.org/our-union/commissions/commission-education-and-communication CBD Communication, Education and Public Awareness (CEPA) programme, including biodiversity education resources https://www.cbd.int/cepa/
Scoring	Score this indicator as follows: **++ Multi-year positive trend established** **+ Positive trend observed** **= Unchanged trend** **• Baseline measured** **- Negative trend observed** **-- Data deficient**

6.4 Management

Intent	Assess government-supported management of natural spaces and resources.
Indicator	Total extent of natural areas with a sustainable management plan, community co-management, and/or local indigenous stewardship.
Instructions	Measure the total extent 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: – fertilisers – pesticides (including rodenticides) – motorised mowing and other motorised tool use • An active co-management programme with local community groups • Stewardship by local indigenous group(s)
Alternatives	Complete Singapore Index indicator 19. https://www.nparks.gov.sg/biodiversity/urban-biodiversity/the-singapore-index-on-cities-biodiversity Protected Area Management Effectiveness (PAME) methodologies may alternately be used. https://www.protectedplanet.net/en/thematic-areas/protected-areas-management-effectiveness-pame?tab=Methodologies

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 and participation

Intent	Assess government-supported incentives and initiatives for sustainable lifestyles.
Indicator	Number of participants in or municipal expenditure on local government-supported programmes designed to contribute positively to the UNI themes.
Instructions	1. Identify local government-supported programmes and initiatives (other than education) whose primary purpose is to contribute positively to any of the UNI themes. These activities should enable the active involvement of vulnerable members of society. Incentives and initiatives should be inclusive and support diverse participation that is safe for all. Such activities include: • Awards organised by municipalities • Calls for tenders, funding and state support to projects and local organisations • Support for citizen science initiatives • Activities organised in the framework of corporate social responsibility projects with local businesses 2. Score the advanced or basic indicator as follows:

Basic:	**Advanced:**
Calculate either total local government expenditure or the total number of direct participants related to eligible activities, providing gender-disaggregated data.	Use both methodologies.

Alternatives	For the budgetary approach, complete Singapore Index indicator 16. https://www.nparks.gov.sg/biodiversity/urban-biodiversity/the-singapore-index-on-cities-biodiversity
Resources	
Scoring	Score this indicator as follows: **++ Multi-year positive trend established** **+ Positive trend(s) observed** **= Unchanged trend(s)** **• Baseline measured** **- Negative trend(s) observed** **-- Data deficient**

Bibliography

Aird, P. L. (1994). Heritage, natural heritage, cultural heritage and heritage tree defined. *The Forestry Chronicle*, 81(4). https://doi.org/10.5558/tfc81593-4

Almeida, P., & Calandrini, V. (2021). Wildlife Trafficking in Metropole Sao Paulo – Brazil: an Analysis of the legal, cultural and characteristics of this (un)sustainable activity. *Veredas do Direito* (18) 42.

Auvray, A., & Poyer, L. (2021). *Biodiversity in Cities*. Paris, France : Agence Française de Développement.

Avlonitis, G., Doll, C., Galt, R., Mader, A., Moreno-Peñaranda, R., Patrickson, S., Puppim de Oliveira, J., & Shih, W. (2012). *Local Biodiversity Strategy and Action Plan Guidelines: an aid to municipal planning and biodiversity conservation*. http://doi.org/10.13140/RG.2.2.28707.45607

Benliay, A., Özyavuz, M., Çabuk, S. & Gunes, M. (2019). *Use of noise mapping techniques in urban landscape design. Journal of Environmental Protection and Ecology.* 20, 113-122.

Bradley, P., & Yee, S. (2015). U*sing the DPSIR Framework to Develop a Conceptual Model: Technical Support Document.* US Environmental Protection Agency, Office of Research and Development, Atlantic Ecology Division, Narragansett, RI. EPA/600/R-15/154.

Brundu, G., & Richardson, D. M. (2017). *Code of Conduct for Invasive Alien Trees*. Strasbourg, France: Convention on the Conservation of European Wildlife and Natural Habitats.

Bruvoll, A., Ibenholt, K., Ahvenharju, S., & Bröckl, M. (2012), *Measuring green jobs? An evaluation of definitions and statistics for green activities.* TemaNord; 2012:534. Copenhagen, Denmark: Nordic Council of Ministers.

Butchart, S.H.M., Akçakaya, H.R., Chanson, J., Baillie, J.E.M., Collen, B., Quader, S., Turner, W.R., Amin, R., Stuart, S.N., & Hilton-Taylor, C. (2007). Improvements to the Red List Index. *PLoS ONE* 2(1), e140. https://doi.org/10.1371/journal.pone.0000140

Calthorpe, P. (2022). *Ending Global Sprawl: Urban Standards for Sustainable and Resilient Development*. Washington, DC, USA: World Bank.

Chan, L., Hillel, O., Werner, P., Holman, N., Coetzee, I., Galt, R., & Elmqvist, T. (2021) *Handbook on the Singapore Index on Cities' Biodiversity (also known as the City Biodiversity Index).* Montreal, Canada: Secretariat of the Convention on Biological Diversity and Singapore: National Parks Board.

Chubarov, I. (2015). Spatial hierarchy and emerging typologies inside world city network. *Bulletin of Geography*, 30, 23-30. http://doi.org/10.1515/bog-2015-0032

Conference of the Contracting Parties to the Convention on Wetlands (1999). *Guidelines for integrating wetland conservation and wise use into river basin management*, Resolution VII.18. https://www.ramsar.org/sites/default/files/documents/library/key_res_vii.18e_0.pdf

__ (2002). *Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management* (ICZM), Resolution VIII.4. https://www.ramsar.org/sites/default/files/documents/pdf/guide-iczm.pdf

Convention on Migratory Species (CMS) (2020). *Appendices I and II of the Convention on the Conservation of Migratory Species of Wild Animals*. https://www.cms.int/sites/default/files/basic_page_documents/appendices_cop13_e_0.pdf

Department of Environment and Science Government (DES) (2018). *Monitoring and Sampling Manual: Environmental Protection (Water) Policy.* Brisbane, Australia: Department of Environment and Science Government.

Deslauriers, M. R., Asgary, A., Nazarnia N., & Jaeger, J. A. G. (2018). Corrigendum to: Implementing the connectivity of natural areas in cities as an indicator in the City Biodiversity Index (CBI), *Ecological Indicators*, Volume 94, Part 2, pp. 114-115, https://doi.org/10.1016/j.ecolind.2017.09.037

DiNapoli, T. P. (2002). *Local Government Management Guide: Strategic Planning*. New York, USA: Office of the New York State Controller, Division of Local Government and School Accountability. https://www.osc.state.ny.us/localgov/pubs/lgmg/strategic_planning.pdf

Elmqvist, T., Fragkias, M., Goodness, J., Goodness, J., Güneralp, B., Marcotullio, P. J., McDonald, R. I., Parnell, S., Schewenius, M., Sendstad, M., Seto, K. C., & Wilkinson, C. (Eds.) (2013). *Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities. A Global Assessment.* Dordrecht, the Netherlands: Springer. https://doi.org/10.1007/978-94-007-7088-1

European Environmental Agency (2019). *Environmental Noise.* European Environment Agency. Retrieved 14 March 2023 from *https://www.eea.europa.eu/airs/2018/environment-and-health/environmental-noise*

Food and Agriculture Organization of the United Nations (FAO) (2008). *Rapid assessment of pollinators' status. A contribution to the international initiative for the conservation and sustainable use of pollinators.* Rome, Italy: FAO.

Fijen, T. P. M., & Kleijn, D., (2017). How to efficiently obtain accurate estimates of flower visitation rates by pollinators, *Basic and Applied Ecology*, 19, 11-18, ISSN 1439-1791, https://doi.org/10.1016/j.baae.2017.01.004

Füssel, H. (2010). *Review and Quantitative Analysis of Indices of Climate Change Exposure, Adaptive Capacity, Sensitivity, and Impacts.* Washington, DC, USA: World Bank. https://openknowledge.worldbank.org/handle/10986/9193 License: CC BY 3.0 IGO.

Gann, G.D., McDonald, T., Walder, B., Aronson, J., Nelson, C.R., Jonson, J., Hallett J.G., Eisenberg C., Guariguata M.R., Liu J., Hua F., Echeverría C., Gonzales E., Shaw N., Decleer K., Dixon K.W. (2019). International principles and standards for the practice of ecological restoration. *Restoration Ecology*. http://doi.org/10.1111/rec.13035

Ghai, R.R., Wallace, R.M., Kile, J.C., Shoemaker, T. R., Vieira, A. R., Negron, M. E., Shadomy, S. V., Sinclair, J. R., Goryoka, G. W., Salyer, S. J., & Barton Behravesh, C. (2022) A generalizable one health framework for the control of zoonotic diseases. *Scientific Reports* 12, 8588. https://doi.org/10.1038/s41598-022-12619-1

Gleick, P. H., & Palaniappan, M. (2010). Peak water limits to freshwater withdrawal and use. *Proceedings of the National Academy of Sciences*, 107, 11155-11162. https://doi.org/10.1073/pnas.1004812107

Gleyzer, A., Denisyuk, M., Rimmer, A., & Salingar, Y. (2004). A fast recursive GIS algorithm for computing Strahler stream order in braided and nonbraided networks, *Journal of the American Water Resources Association,* 40 (4), 937–946, https://doi.org/10.1111/j.1752-1688.2004.tb01057.x

Grellier J., White M.P., Albin M., Bell, S., Elliott, L. R., Gascón, M., Gualdi, S., Mancini, L., Nieuwenhuijsen, M. J., Sarigiannis, D. A., van den Bosch, M., Wolf, T., Wuijts, S., & Fleming, L. E. (2017). BlueHealth: a study programme protocol for mapping and quantifying the potential benefits to public health and well-being from Europe's blue spaces. *BMJ Open* 7(6), e016188. https://doi.org/10.1136/bmjopen-2017-016188

Hesselbarth, M. H. K., Sciaini, M., With, K. A., Wiegand, K., & Nowosad, J. (2019), landscapemetrics: an open-source R tool to calculate landscape metrics, *Ecography* 42:1648-1657. https://doi.org/10.1111/ecog.04617

Heywood, V., Brunel, S. (2008). *Code of conduct on horticulture and invasive alien plants.* Strasbourg, France: Convention on the Conservation of European Wildlife and Natural Habitats.

Holmes, P. M., Rebelo, A. G., Dorse, C., & Wood, J. (2012). Can Cape Town's unique biodiversity be saved? Balancing conservation imperatives and development needs. *Ecology and Society* 17(2): 28. http://dx.doi.org/10.5751/ES-04552-170228

Huovila, A., Bosch, P., & Airaksinen, M. (2019). Comparative analysis of standardized indicators for Smart sustainable cities: What indicators and standards to use and when? *Cities*, 89, 141-153. https://doi.org/10.1016/j.cities.2019.01.029

ICLEI - Local Governments for Sustainability (2015). *biodiverCITIES: A Handbook for Municipal Biodiversity Planning and Management.* Toronto, Canada: ICLEI-Local Government for Sustainability (Management) Inc.

International Union for Conservation of Nature (IUCN) World Environmental Law Congress (2016). *World Declaration on the Environmental Rule of Law*. Rio de Janeiro, Brazil. http://www2.ecolex.org/server2neu.php/libcat/docs/LI/MON-091064.pdf

IUCN (2018). *IUCN's policy scoping brief on biodiversity and human health and well-being.* Sharm-el-Sheik, Egypt: Convention on Biological Diversity.

IUCN (2020). I*UCN EICAT Categories and Criteria. The Environmental Impact Classification for Alien Taxa First edition.* Gland, Switzerland and Cambridge, UK: IUCN. https://doi.org/10.2305/IUCN.CH.2020.05.en

IUCN (2021). *IUCN Restoration Intervention Typology for Terrestrial Ecosystems.* Gland, Switzerland: IUCN.

Karberg, N. J., Scott, N. A. & Giardina, C. P. (2008) Methods for Estimating Litter Decomposition, *Field Measurements for Forest Carbon Monitoring*. https://www.nrs.fs.usda.gov/pubs/jrnl/2008/nrs_2008_karberg_002.pdf

Kerr, J. T., & Ostrovsky, M. (2003) From space to species: ecological applications for remote sensing. *Trends in Ecology & Evolution* 18(6), 299-305. https://doi.org/10.1016/S0169-5347(03)00071-5

Laestadius, L., Maginnis, S., Rietbergen-McCracken, J., Saint-Laurent, C., Shaw, D., & Verdone, M. (2014). *A guide to the Restoration Opportunities Assessment Methodology (ROAM)*. Gland, Switzerland: IUCN. https://portals.iucn.org/library/node/44852

Laituri, M., Davis, D., Sternlieb, F., & Galvin, K. (2021). SDG Indicator 11.3.1 and Secondary Cities: An Analysis and Assessment. *ISPRS International Journal of Geo-Information*, 10, 713. http://doi.org/10.3390/ijgi10110713

Li, E., Parker, S. S., Pauly, G. B., Randall, J. M., Brown, B. V.,& Cohen, B. S. (2019). An Urban Biodiversity Assessment Framework That Combines an Urban Habitat Classification Scheme and Citizen Science Data. *Frontiers in Ecolology and Evolution*, 7, 277. https://doi.org/10.3389/fevo.2019.00277

Marselle, M. R., Lindley, S. J., Cook, P. A. & Bonn, A. (2021). Biodiversity and Health in the Urban Environment. *Current Environmental Health Reports* 8, 146–156. https://doi.org/10.1007/s40572-021-00313-9

Mundoli, S., & Nagendra, H. (2020). *Heritage Trees of Urban India: Importance and their Protection*. https://bngenvtrust.org/wp-content/uploads/2020/09/2020-09-09_Report-on-Heritage-trees.pdf

National Marine Fisheries Service (2018). *Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts*. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-59.

Organisation for Economic Co-operation and Development (OECD), (2008). *Handbook on Constructing Composite Indicators: Methodology and User Guide.* Paris, France: OECD. https://www.oecd.org/sdd/42495745.pdf

Pantoja, A., Smith-Pardo, A., García, A., Sáenz, A., & Rojas, F. (2014). *Principios y avances sobre polinización como servicio ambiental para la agricultura sostenible en países de Latinoamérica y El Caribe (1st ed.)*. FAO.

Pettorelli, N. (2006). Erratum: Using the satellite-derived NDVI to assess ecological responses to environmental change (vol 20, pg 503, 2005). *Trends in Ecology & Evolution.* 1(21), 11. https://doi.org/10.1016/j.tree.2005.11.006

Pierce, J. R. (2022). Cities and Biodiversity. In A. Taufen & Y. Yan (Eds.) *The Routledge Handbook of Sustainable Cities and Landscapes in the Pacific Rim* (pp. 211–218). London, UK: Routledge. https://doi.org/10.4324/9781003033530

Reiskind, M. H., & Wund, M. A., (2009) Experimental Assessment of the Impacts of Northern Long-Eared Bats on Ovipositing Culex (Diptera: Culicidae) Mosquitoes. *Journal of Medical Entomology*, 5, 1(46), 1037–1044, https://doi.org/10.1603/033.046.0510

Schmitz, O. J., Hawlena, D., & 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

Simmonds, M., Dolman, S., Jasny, M., Parsons, E.C.M., Weilgart, L., Wright, A., & Leaper, R. (2014). Marine noise pollution - increasing recognition but need for more practical action. *Journal of Ocean Technology*, 9, 71-90.

Sluka, N. A., Tikunov, V. S., & Chereshnia, O. Y. (2019). The Geographical Size Index for Ranking and Typology of Cities. *Social Indicators Research*, 144(2), 981-997. http://doi.org/10.1007/s11205-019-02069-0

The Nature Conservancy (2021). *The Biodiversity Action Guide.* https://www.nature.org/content/dam/tnc/nature/en/documents/TNC_BiodiversityActionGuide.pdf

Trzyna, T. (2014). *Urban Protected Areas: Profiles and best practice guidelines*. Best Practice Protected Area Guidelines Series No. 22, Gland, Switzerland: IUCN. https://portals.iucn.org/library/node/44644

Tucker, C. J. (1979) Red and Photographic Infrared Linear Combinations for Monitoring Vegetation. *Remote Sensing of Environment*, 8, 127-150. http://dx.doi.org/10.1016/0034-4257(79)90013-0

Uchiyama, Y., & Kohsaka, R. (2019). Application of the City Biodiversity Index to populated cities in Japan: Influence of the social and ecological characteristics on indicator-based management. *Ecological Indicators*, 106, 105420. http://doi.org/10.1016/j.ecolind.2019.05.051

United Nations (UN)-Habitat (2022). *Cities and Nature: Planning for the Future.* https://unhabitat.org/sites/default/files/2022/12/white_paper_cities_and_nature_rev2.pdf

United States Environmental Protection Agency (USEPA) (2000). *Nutrient Criteria Technical Guidance Manual: Rivers and Streams.* Washington DC, USA: USEPA.

Valderrábano, M., Nelson, C., Nicholson, E., Etter, A., Carwardine, J., Hallett, J.G., McBreen, J., & Botts, E., (2021). *Using ecosystem risk assessment science in ecosystem restoration: A guide to applying the Red List of Ecosystems to ecosystem restoration.* Gland, Switzerland: IUCN. https://doi.org/10.2305/IUCN.CH.2021.19.en

van Oudenhoven, A. P. E., Schroter, M., Drakou, E. G., Geijzendorffer, I. R., Jacobs, S., van Bodegom, P. M., Chazee, L., Czucz, B., Grunewald, K., Lillebo, A. I., Mononen, L., Nogueira, A. J. A., Pacheco-Romero, M., Perennou, C., Remme, R. P., Rova, S., Syrbe, R., Tratalos, J. A., & Albert, C. (2018). Key criteria for developing ecosystem service indicators to inform decision making. *Ecological Indicators*, 95(1), 417-426. https://doi.org/10.1016/j.ecolind.2018.06.020

Verschuuren, B., Mallarach, J-M., Bernbaum, E., Spoon, J., Brown, S., Borde, R., Brown, J., Calamia, M., Mitchell, N., Infield, M., & 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. https://doi.org/10.2305/IUCN.CH.2021.PAG.32.en

V.I. Il'ichev Pacific Oceanological Institute (2011). *A Case Study Report on Assessment of Eutrophication Status in Peter the Great Bay.* Russia: V.I. Il'ichev Pacific Oceanological Institute, Far Eastern, Branch of the Russian Academy of Sciences. http://www.cearac-project.org/cearac-project/integrated-report/Annex_A5_Peter.pdf

Wang, B., Blanchet, F. G., & Koper, N. (2014). Measuring habitat fragmentation: An evaluation of landscape pattern metrics. *Methods in Ecology and Evolution* 5(7), 634-646. https://doi.org/10.1111/2041-210X.12198

World Bank (2018). *Urban Sustainability Framework* (1st ed.). Washington, DC, USA: World Bank. http://documents.worldbank.org/curated/en/339851517836894370/Urban-Sustainability-Framework-1st-ed

Wild, R., & McLeod, C. (Eds) (2008). *Sacred Natural Sites: Guidelines for Protected Area Managers.* Best Practice Protected Area Guidelines Series, No. 16. Gland, Switzerland: IUCN. https://portals.iucn.org/library/node/9201

Wilson, S. J., Juno, E., Pool, J. R., Ray, S., Phillips, M., Francisco, S., & McCallum, S. (2022). *Better Forests, Better Cities*. Washington, DC, USA: World Resources Institute. http://doi.org/10.46830/wrirpt.19.00013

World Health Organization (WHO), Convention on Biological Diversity (CBD), United Nations Environment Programme (UNEP) (2015). *Connecting Global Priorities: Biodiversity and Human Health. A State of Knowledge Review.* World Health Organization and Convention on Biological Diversity

World Resources Institute (WRI), ICLEI, and C40 (2021). *Global Protocol for Community-Scale Greenhouse Gas Inventories: An Accounting and Reporting Standard for Cities. Version 1.1.* Washington, DC, USA: Greenhouse Gas Protocol. http://www.ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

Zhang, X. X., Liu, J. S., Han, L. F., Xia, S., Li, S. Z., Li, O. Y., Kassegne, K., Li, M., Yin, K., Hu, Q. Q., Xiu, L. S., Zhu, Y. Z., Huang, L. Y., Wang, X. C., Zhang, Y., Zhao, H. Q., Yin, J. X., Jiang, T. G., Li, Q., … & Zhou, X. N. (2022) Towards a global One Health index: a potential assessment tool for One Health performance. *Infectious Diseases of Poverty*, 11 (57). https://doi.org/10.1186/s40249-022-00979-9

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