

A Model For Assessing Biodiversity Conservation in Cities: The Singapore Index on Cities' Biodiversity

Text by Lena Chan and Muslim Anshari
Photography as credited

Cities and Biodiversity Conservation

Despite occupying only two percent of the earth's surface, cities consume about 75 percent of the planet's natural resources (UNEP and UN-HABITAT 2005). The ecological footprint of cities impacts an area vastly beyond their boundaries, contributing significantly to biodiversity loss at the local and global levels. This issue is made more pressing by the fact that the majority of the world population will reside in cities and urban areas. By 2050, the world population is expected to increase to 9.2 billion, of which 6.4 billion will be living in urban areas (UN 2008). As urban populations burgeon, the role that cities play in biodiversity conservation becomes increasingly relevant. Effective land use and management of natural ecosystems in urban areas can be beneficial to both residents and biodiversity that exists within and around the city. Cities can be part of the solution.

With the increasing recognition of biodiversity's importance to their survival, cities today undertake many initiatives to manage ecosystems effectively. There is also a growing

trend of cities forming alliances to share best practices, notably the Global Partnership on Local and Sub-National Action for Biodiversity. However, there is no single index that measures biodiversity conservation at the city level—existing environmental indices for cities and local authorities cover mainly brown issues. At the city level, the Asian Green City Index ranks 20 Asian cities based on assessment in eight environmental categories: energy and carbon dioxide emissions; land use and buildings; transport; water; waste; sanitation; air quality; and environmental governance (EIU 2010). The 2005 Environmental Sustainability Index is a widely accepted index that benchmarks a country's performance on a key set of environmental indicators, of which biodiversity is a component (Esty et al. 2005). None of these indices reviewed focused on biodiversity in cities.

The Ninth Meeting of the Conference of Parties to the Convention on Biological Diversity (COP-9), held from 19 to 30 May 2008, opened an opportunity for urban biodiver-

sity conservation. For the first time ever, the Parties recognised the role of cities and local authorities in national strategies for biodiversity conservation through Decision IX/28, where national governments were encouraged to engage cities in the national implementation of the CBD. During the High-Level Segment, Mr. Mah Bow Tan, former Minister for National Development, proposed the development of a biodiversity index for cities to benchmark conservation efforts and evaluate progress in reducing the rate of biodiversity loss, led by the Secretariat of the Convention on Biological Diversity (SCBD). Mr. Mah also called upon Parties to contribute to the development of the index and offered to host the first technical expert meeting in Singapore.

The Tenth Meeting of the Conference of Parties to the CBD (COP-10), held from 18 to 29 October 2010, was a major step forward in the global movement on urban biodiversity conservation. Parties endorsed the Plan of Action on Subnational Governments, Cities, and Other Local Authorities for Biodiversity



ABOVE A picturesque scene of a family of Little Terns set against a backdrop of a residential town in Punggol, Singapore. The Singapore Index includes an indicator that measures bird species in built-up areas (Photo: Lee Tiahk Khee).

“The future of human societies is intricately linked to that of biodiversity. The collaborative efforts of cities and local authorities are critical to ensure the continued diversity of species. As decision makers, policy formulators, and technical experts, we share a responsibility to work together to conserve ecosystems and biodiversity so that future generations can enjoy and benefit from the rich natural heritage of our planet.”

—former Minister Mah Bow Tan (Tan, 2008)



TOP At the High-level Segment of CBD COP-10, former Minister Mah Bow Tan provided updates on the development of the Singapore Index. At COP-10, Parties endorsed the Plan of Action on Subnational Governments, Cities and Other Local Authorities for Biodiversity, which includes the Singapore Index as a monitoring tool for cities to apply (Photo: Muslim Anshari).

BOTTOM Singapore hosted three expert workshops in 2009, 2010, and 2011 to develop the index. Participants comprised city officials, international governmental organisations, experts, and academics (Photo: Muslim Anshari).

(Decision X/22), which encourages Parties to actively engage local authorities and cities in implementing the CBD. This includes Parties involving cities and local authorities in post-2010 revisions of national biodiversity strategies and action plans (NBSAP), and including their conservation efforts in future national reporting. The Plan of Action highlights the City Biodiversity Index (CBI), also known as the Singapore Index on Cities' Biodiversity, as a monitoring tool to assist local authorities to evaluate their progress in urban biodiversity conservation.

Development of the Index

Following CBD's Decision IX/28 and Mr. Mah's proposal for the development of the CBI at COP-9 in 2008, Singapore partnered the SCBD and the Global Partnership on Local and Sub-National Action for Biodiversity to develop an index as a self-assessment tool to assist national governments and local authorities in benchmarking conservation efforts in the urban context. Singapore hosted three expert workshops in 2009, 2010, and 2011, which were attended by technical experts and resource persons on urban biodiversity, city officials responsible for the management of biodiversity, and representatives from international organisations.

A Technical Task Force was also established at the First Expert Workshop, comprising Dr. Nancy Holman (London School of Economics), Mr. Peter Werner (Institute of Housing and Environment, Darmstadt, Germany), Professor Thomas Elmqvist (Stockholm Resilience Centre), Mr. Andre Mader (ICLEI-Local Governments for Sustainability LAB Initiative), Ms. Elisa Calcaterra (IUCN), Mr. Oliver Hillel (SCBD), and Dr. Lena Chan (National Parks Board). It was tasked to fine-tune the indicators and prepare the User's Manual.

In developing the index, there were several pre-conditions that had to be met. It had to be a self-assessment tool that would be easy for city officials to apply, scientifically credible, and an objective tool that would be unbiased and could be applied by cities worldwide. As discussions progressed, three core components were identified. First, city officials need to know the biodiversity that exists within their cities. Next, they must be able to identify the services that the biodiversity and ecosystems provide. Finally, as this index was targeted at city authorities, it was decided that indicators for good governance and management of biodiversity should be included. Participants of the workshop agreed to steer further discussions on the CBI along these three central components. At the First Expert Workshop in 2009, participants identified 25 preliminary indicators. A quantitative scoring methodology was agreed on and developed in greater detail. The first version of the User's Manual was uploaded on the CBD website in November 2009, and both cities and experts were invited to comment on the applicability of the index.

The Second Expert Workshop, held in July 2010, saw participants examining further the general approach to the selection of the indicators and the scoring ranges, with particular attention paid to developing scoring ranges that were unbiased and applicable to cities across all regions. The feedback from cities and experts was discussed and addressed and amendments were incorporated into the revised User's Manual, which was uploaded on the CBD website in September 2010.

A key outcome of the Second Expert Workshop was the finalisation of the indicators (Chan et al. 2010). The total number of indicators in the revised User's Manual was reduced from 25 to 23 indicators, of which seven required scoring

"It does not matter what governments do if the cities do not implement it. Life happens in cities; it is where change happens."

—Mr. Alfredo Vincente de Castro Trinidad, Technical Coordinator for Biodiversity, City of Curitiba, Brazil

“Edmonton and Montreal scored a perfect 10 for their biodiversity monitoring efforts and I think that the CBI contributed significantly to this ranking.”

—Mr. Grant Pearsell, Director of the Office of Natural Areas, Edmonton, on a study conducted by **Corporate Knights**¹ on good sustainable development practices in Canadian cities



ABOVE Nagoya (top) and Curitiba (bottom) are examples of cities where biodiversity conservation is incorporated into city planning and development. They are also among the 14 cities that have tested the Index and provided data for the establishment of the scoring ranges (Photos: City of Nagoya (top) and City of Curitiba (bottom)).

PART II—INDICATORS

Ecosystem Services	11.	Regulation of Quantity of Water	4 points
	12.	Climate Regulation: Carbon Storage and Cooling Effect of Vegetation	4 points
	13.	Recreation and Education: Area of Parks with Natural Areas	4 points
	14.	Recreation and Education: Number of Formal Education Visits Per Child Below 16 Years to Parks with Natural Areas per Year	4 points
Governance and Management of Biodiversity	15.	Budget Allocated to Biodiversity	4 points
	16.	Number of Biodiversity Projects Implemented by the City Annually	4 points
	17.	Existence of Local Biodiversity Strategy and Action Plan	4 points
	18.	Institutional Capacity: Number of Biodiversity-related Functions	4 points
	19.	Institutional Capacity: Number of City or Local Government Agencies Involved in Inter-agency Cooperation Pertaining to Biodiversity Matters	4 points
	20.	Participation and Partnership: Existence of Formal or Informal Public Consultation Process	4 points
	21.	Participation and Partnership: Number of Agencies/ Private Companies/ NGOs/ Academic Institutions/ International Organisations with which the City is Partnering in Biodiversity Activities, Projects, and Programmes	4 points
	22.	Education and Awareness: Is Biodiversity or Nature Awareness Included in the School Curriculum	4 points
	23.	Education and Awareness: Number of Outreach or Public Awareness Events Held in the City Per Year	4 points
		Native Biodiversity in the City (Sub-total for Indicators 1-10)	40 points
		Ecosystem Services (Sub-total for Indicators 11-14)	16 points
		Governance and Management of Biodiversity (Sub-total for Indicators 15-23)	36 points
		MAXIMUM TOTAL:	92 points



ABOVE Cyrene Reef (Southern Island, Singapore) lies in the middle of busy shipping lanes and industries, yet the seagrass meadows are teeming with marine biodiversity, such as the Large Knobbly Sea Star. Under Part 1—Profile of the City, ecosystems and species that exist within a city's boundaries are listed (Photos: Kevin Lam (right) and Neo Mei Lin (left)).

ranges to be reestablished. It was observed that the existing scoring ranges for these seven indicators did not favour temperate cities, and a statistical analysis of sample data from at least 20 cities would be carried out to establish fairer scoring ranges.

The Third Expert Workshop was organised from 10 to 13 October 2011, with the primary objective of finalising the scoring ranges. Fourteen cities had provided data for the seven indicators—Curitiba, Brussels, Montreal, Edmonton, Nagoya, London, Bandung, Bangkok, Auckland, Lisbon, Montpellier, Hamilton, and Singapore. It was agreed that a larger sample size was required before the scoring ranges are determined and an appropriate statistical methodology adopted. Participants also reviewed all 23 indicators of the index and, where necessary, proposed improvements to provide greater clarity in the explanation of the methodology.

Structure of the Index

The Singapore Index is developed as a self-assessment tool to allow cities to benchmark and monitor the progress of biodiversity conservation efforts against their own individual baselines. The focus should be on the trends between periodical assessments of the index, which will show either an improve-

ment or decline in the effectiveness of biodiversity conservation efforts by a particular city. It was not designed as a tool for comparison between cities. A comparative global study of biodiversity in cities would have to stratify the cities across several criteria. For example, cities in the temperate region have an inherently lower biodiversity compared to tropical cities. The different sizes of cities would also mean varying biodiversity richness.

The index comprises two parts: first, the "Profile of the City" provides comprehensive background information on the city; and second, a city's self assessment of the 23 indicators based on the guidelines and methodology provided.

Part I—Profile of the City

In addition to serving as an introduction, this section captures other information that provides a holistic picture of a city and places its evaluation of the index in proper perspective. Here, cities provide information on the location, climate, size, demographics, economic parameters, physical characteristics, and biodiversity features. Expanding further on the biodiversity information, cities can include details of the ecosystems, populations of key taxonomic groups, and the conservation status of these species.



ABOVE Bukit Timah Expressway (BKE), where Central Catchment Nature Reserve lies on one side of the expressway, and Bukit Panjang Residential town sits on the other. The Singapore Index can be used as a planning tool for urban planners to designate protected areas and balance conservation and development (Photo: Wong Tuan Wah).

“For the last 20 years, we (Brussels) have been looking at biodiversity, so we had a lot of data on that. But it showed we lacked precise data on how many programmes and visits to nature areas that we have, which is part of the ecosystem service component.”

—Ms. Machteld Gryseels, Director of Brussels Environment Division

The Singapore Index is developed as a self-assessment tool to allow cities to benchmark and monitor the progress of biodiversity conservation efforts against their own individual baselines.



ABOVE Officers from the National Parks Board Singapore conducting biodiversity studies at Berlayar Creek, a patch of mangrove nestled within a highly urbanised landscape (Photo: Cai Yixiong).

Part II—Indicators

The 23 indicators are grouped under three broad components: native biodiversity in the city, ecosystem services, and governance and management of biodiversity. For each indicator, the rationale, calculation methods, and possible data sources are stated clearly in a tabular format. Ten indicators have been selected to measure native biodiversity in the city, including proportion of natural areas in a city, connectivity of natural ecosystems, and changes in plant, bird, butterfly, and other biodiversity species. Four indicators—regulation of the quantity of water, carbon storage, cooling effect of vegetation, and recreational and educational services of biodiversity serve as proxy measures of the ecosystem services in the city. Under good governance and management, nine indicators are listed, covering cities' biodiversity budgets, projects, collaborations and partnerships, biodiversity institutions, and local biodiversity action plans. A large emphasis is placed on good governance and management to encourage proactive action by city officials who will be the ones applying the index.

The scoring of the index is quantitative in nature. A maximum score of four has been allocated to each indicator, and with the current count of 23 indicators, the total possible score of the index is 92 points. Individual scores of the 23 indicators are summed up to give the final Singapore Index total score. The year in which a city first embarks on this scoring will be taken as the baseline year and this will be measured against future applications of the index to chart its progress in conserving biodiversity.

Applications and Way Forward

The Singapore Index is a dynamic tool, continuously improved on to be more scientifically robust and applicable to more cities. In the two years of developing and promoting the index, it has evolved beyond being just an evaluation tool for cities to benchmark their biodiversity conservation efforts. Other potential applications of the index have surfaced. Biodiversity input from the index can be used in the decision making and master planning of cities. Good practices can be made into case studies for sustainable development and certain indicators can form the basis for the calculations of economic values of biodiversity and ecosystem services.

The uses and benefits are multi-faceted, and various organisations and research institutes are exploring possible collaborations with National Parks Board (NParks). In many instances, broader applications of the index are already taking place. At the national level, NParks is currently working with Housing Development Board and Urban Redevelopment Authority to apply an adapted version of the Singapore Index as a planning tool in the development of Punggol Eco-town and Marina Bay respectively. These pioneer sites will serve as useful baselines and case studies in the assessment of the potential of the Singapore Index for application at the sub-city level. NParks is also working with Building Construction Authority to incorporate the adapted index into the Green Mark for Districts. At the international level, the index is being considered as a tool for cities to factor their biodiversity conservation efforts into the national reporting framework to the CBD.

Moving forward, it is imperative that the Singapore Index remains relevant, credible, and at the same time flexible enough to be adapted and incorporated into a broader framework. Cities' experiences will be consolidated in a publication to be launched at the World Cities Summit 2012 in Singapore. The true litmus test of the index's success lies in cities applying and testing the index regularly on a long-term basis, thus charting their progress in benchmarking and monitoring biodiversity conservation efforts. 

¹ *Corporate Knights* is quarterly Canadian magazine dedicated towards advocating responsible business practices within Canada and promoting sustainable development globally.

References:

- Chan, Lena, Elisa Calcaterra, Thomas Elmqvist, Oliver Hillel, Nancy Holman, Andre Mader, and Peter Werner. 2010. *User's Manual for the City Biodiversity Index*, 27 September 2010 version. Posted on the website of the Convention on Biological Diversity. www.cbd.int
- Economist Intelligence Unit (EIU). 2010. "City Report—Singapore." In *Asian Green City Index*.
- Esty, Daniel C., Marc Levy, Tanja Srebotnjak, and Alexander de Sherbinin. 2005. "Appendix D—Component and Indicator Tables." In *2005 Environmental Sustainability Index: Benchmarking National Environmental Stewardship*. New Haven: Yale Center for Environmental Law & Policy.
- Secretariat for the Convention on Biological Diversity (SCBD). 2010. *Progress Report on the CBD Initiative on Cities, Local Authorities and Biodiversity, UNEP/CBD/COP/10/INF/8*.
- United Nations. 2008. "Key Findings of the 2007 Revision." In *World Urbanization Prospects: The 2007 Revision*.
- United Nations Environment Programme (UNEP), and United Nations Humans Settlements Programme (UN-HABITAT). 2005. *Ecosystems and Biodiversity: Role of Cities*.