2018 BIODIVERSITY REPORT

City of Los Angeles

Appendix B: Singapore Index Methods for Los Angeles

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Appendix B

Singapore Index Detailed Methods

Appendix B Table of Contents

Appendix B1: Singapore Index Indicator 1

SI Indicator 1: Proportion of Natural Areas in the City

1. **Datasets Used:**
    a. Dataset Name: CALVEG Southern Coast Section (CALVEG = "Classification and Assessment with Landsat of Visible Ecological Groupings")
        i. Dataset Filename: ExistingVegSouthCoast2002_2010_v2.gdb
        ii. Dataset Location: \\htpgis3\General_Users\RAD
        iii. Original Source: https://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192
        iv. Original Source Metadata:

            https://www.fs.fed.us/r5/rsl/projects/gis/data/vegcovs/scoast/ExistingVegSouthCoast2002_2010_v2.html
        v. Dataset Discussion: Only complete and uniform dataset of vegetation available for the entire City. Some level of error due to statewide extent and resolution. This dataset does not identify small natural, naturalized, or restoration areas well. Also, data was collected over 10 years starting approximately 1998 which will result in some error due to landcover change.

2. **Other Datasets Considered**
    a. Data from LA Sanitation EIRs contains various descriptions of natural areas on associated properties. However, it is not digitized in most cases.
    b. More detailed vegetation mapping has been performed for sub-areas of the City including the Santa Monica Mountains, Griffith Park and the Ballona Wetlands. This data would need to be reprocessed and assembled to integrate with available Citywide data such as CALVEG.
    c. Councilman Koretz's team has collected a list of areas of "obvious biodiversity" from the Biodiversity Motion Working group. While not complete and includes some non-natural areas of relatively high wildlife diversity, this list likely includes additional natural areas that could be mapped and incorporated in the future.

d. Various environmental groups working in the City, as well as citizen scientist data such as iNaturalist, likely possess spatial data that could be used to identify natural areas.

e. NDVI data (greenness) is available for the City and provides an indication of vegetative growth but not naturalness.

f. The National Wildlife Federation habitat gardens program has a database of residential and school habitat areas.

3. Method

a. Indicator #1 GIS Map File Location: \\htpgis3\General_Users\RAD

b. In GIS, clip CALVEG to Los Angeles City Boundary

c. Classify CALVEG Field: “Regional D” vegetation types as “native” natural areas (See Table 1.2).

d. Measure total area of “native” natural areas, total area of City in hectares and determine %.

4. Methods Notes

a. This will likely be an underestimate since it does not capture small areas and “naturalized” or “restored” vegetation well.

b. A few areas that were inspected, including the LAX Dunes, revealed native natural areas classified as non-native vegetation.

Table 1.1: Singapore Index User's Manual Instructions for Indicator 1

PART II: INDICATORS OF THE SINGAPORE INDEX ON CITIES' BIODIVERSITY

CBI	INDICATORS	VARIABLES	SCORE
Native Biodiversity	**INDICATOR 1: PROPORTION OF NATURAL AREAS IN THE CITY**		
	RATIONALE FOR SELECTION OF INDICATOR Natural ecosystems harbour more species than disturbed or man-made landscapes, hence, the higher the percentage of natural areas compared to that of the total city area gives an indication of the amount of biodiversity there. However, a city by definition has a high proportion of modified land area and this is factored into the scoring. Taking into account the inherent differences in the richness in biodiversity of tropical versus temperate regions, new versus mature cities, large versus small cities, developing versus developed countries, it was agreed at the Third Expert Workshop on the Development of the City Biodiversity Index that the working definition of "natural areas" is as follows: Natural areas comprise predominantly native species and natural ecosystems, which are not, or no longer, or only slightly influenced by human actions, except where such actions are intended to conserve, enhance or restore native biodiversity. Natural ecosystems are defined as all areas that are natural and not highly disturbed or completely man-made landscapes. Some examples of natural ecosystems are forests, mangroves, freshwater swamps, natural grasslands, streams, lakes, etc. Parks, golf courses, roadside plantings are not considered as natural. However, natural ecosystems within parks where native species are dominant can be included in the computation. The definition also takes into consideration "restored ecosystems" and "naturalised areas" in order to recognise efforts made by cities to increase the natural areas of their city. Restoration helps increase natural areas in the city and cities are encouraged to restore their impacted ecosystems.	HOW TO CALCULATE INDICATOR (Total area of natural, restored and naturalised areas) ÷ (Total area of city) × 100% WHERE TO GET DATA FOR CALCULATIONS Possible sources of data on natural areas include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc. Google maps and satellite images can also provide relevant information for calculating this indicator.	BASIS OF SCORING Based on the assumption that, by definition, a city comprises mainly man-made landscapes, the maximum score will be accorded to cities with natural areas occupying more than 20% of the total city area. 0 points: < 1.0% 1 point: 1.0% – 6.9% 2 points: 7.0% – 13.9% 3 points: 14.0% – 20.0% 4 points: > 20.0%

Table 1.2 CALVEG 2000-2010 Vegetation Alliances in the City of LA, Singapore Index Reclassification

CALVEG Code	Veg Alliance	SI Classification
A1	CONIFER AGRICULTURE	Agriculture
A3	TILLED EARTH AGRICULTURE	Agriculture
A4	ORCHARD AGRICULTURE	Agriculture
A6	GRAIN AND CROP AGRICULTURE	Agriculture
A8	AGRICULTURAL NURSERIES	Agriculture
HG	ANNUAL GRASSES AND FORBS ALLIANCE	Natural (Degraded)
BA	BARREN	Natural
IB	URBAN-RELATED BARE SOIL	Bare Soil
OS	BEACH SAND	Natural (Degraded)
CA	CHAMISE ALLIANCE	Natural
CC	CEANOTHUS CHAPARRAL ALLIANCE	Natural
CK	COYOTE BRUSH ALLIANCE	Natural
CQ	LOWER MONTANE MIXED CHAPARRAL	Natural
CS	SCRUB OAK ALLIANCE	Natural
DM	BIGCONE DOUGLAS-FIR ALLIANCE	Natural
DU	DUNE	Natural
EX	COASTAL MIXED HARDWOOD ALLIANCE	Natural
HC	PICKLEWEED - CHORDGRASS ALLIANCE	Natural
HM	PERENNIAL GRASSES AND FORBS ALLIANCE	Natural
HT	TULE - CATTAIL ALLIANCE	Natural
LS	SCALEBROOM ALLIANCE	Natural
ML	BACCHARIS (RIPARIAN) ALLIANCE	Natural
NM	RIPARIAN MIZED SHRUB ALLIANCE	Natural
NR	RIPARIAN MIXED HARDWOOD ALLIANCE	Natural
NX	INTERIOR MIXED HARDWOOD ALLIANCE	Natural
QA	COAST LIVE OAK ALLIANCE	Natural
QB	CALIFORNIA BAY ALLIANCE	Natural
QC	CANYON LIVE OAK ALLIANCE	Natural
QE	WHITE ALDER ALLIANCE	Natural
QF	FREMONT COTTONWOOD ALLIANCE	Natural
QL	VALLEY OAK ALLIANCE	Natural
QO	WILLOW ALLIANCE	Natural
QP	CALIFORNIA SYCAMORE ALLIANCE	Natural
QV	BLACK WALNUT ALLIANCE	Natural
RS	RIVERSIDEAN ALLUVIAL SCRUB ALLIANCE	Natural
SB	BUCKWHEAT ALLIANCE	Natural
SE	ENCELIA SCRUB ALLIANCE	Natural
SM	SUMAC SHRUB ALLIANCE	Natural
SO	COASTAL CACTUS ALLIANCE	Natural
SQ	SOFT SCRUB - MIXED CHAPARRAL ALLIANCE	Natural
SS	CALIFORNIA SAGEBRUSH ALLIANCE	Natural
WL	WILLOW (SHRUB) ALLIANCE	Natural
WM	BIRCHLEAF MOUNTAIN MAHOGANY ALLIANCE	Natural

CALVEG Code	Veg Alliance	SI Classification
IG	NON-NATIVE/ORNIMENTAL GRASS ALLIANCE	Non-Native Perennial Grasses
IA	GIANT REED/PAMPUS GRASS ALLIANCE	Natural (Degraded)
IC	NON-NATIVE/ORNIMENTAL CONIFER	Non-Native Shrubs and Trees
IH	NON-NATIVE/ORNAMENTAL HARDWOOD	Non-Native Shrubs and Trees
IM	NON-NATIVE/ORNEMENTAL	Non-Native Shrubs and Trees
IS	NON-NATIVE/ORNAMENTAL SHRUB ALLIANCE	Non-Native Shrubs and Trees
QZ	EUCALYPTUS ALLIANCE	Non-Native Shrubs and Trees
UB	URBAN OR DEVELOPED	Urban or Developed
IW	DEVELOPED WATER FEATURES	Water
W2	SEASONAL WATER?	Water
W3	SEASONAL WATER?	Water
WA	WATER	Water

Appendix B2: Singapore Index Indicator 2

SI Indicator 2: Connectivity Measures to Counter Habitat Fragmentation

1. **Datasets Used:**
    a. Dataset 1 Name: CALVEG Southern Coast Section
        i. Dataset Filename: ExistingVegSouthCoast2002_2010_v2.gdb
        ii. Dataset Location: \\htpgis3\General_Users\RAD
        iii. Original Source: https://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192
        iv. Original Source Metadata:

        https://www.fs.fed.us/r5/rsl/projects/gis/data/vegcovs/scoast/ExistingVegSouthCoast2002_2010_v2.html
        v. Dataset Discussion: Only complete and uniform dataset of natural vegetation available for the entire City. Some level of error due to statewide extent and resolution. This dataset does not identify small natural, naturalized, or restoration areas well. Also, data was collected over 10 years starting approximately 1998 which will result in some error due to landcover change.

    b. Dataset 2 Name: CAMS Streets
        i. Dataset Filename: CAMS.gdb
        ii. Dataset Location: \\htpgis3\General_Users\RAD
        iii. Original Source: http://egis3.lacounty.gov/dataportal/2014/06/16/2011-la-county-street-centerline-street-address-file/
        iv. Dataset Discussion: Includes streets, roadways, rail, trails, etc., and related information for Los Angeles County.

2. **Other Datasets Considered**
    a. See SI Indicator 1 discussion of other datasets for natural areas.
    b. Night lighting may be a useful indicator for connectivity and should be considered further.

c. The role of urban landscape pattern of non-natural areas in connectivity should be considered further.

d. Connectivity analysis that folds in information such as Koretz team's list of "areas of obvious biodiversity", NWF habitat gardens, LA City project information, etc could provide stronger approach.

e. Selection and modeling of movement of indicator species has been suggested. Birds and other mobile species ("adapters", "avoiders", "wobblers") have been suggested.

3. Method

a. See Singapore Index Methods for Indicator 2 (Table 2.1)

b. Indicator #2 GIS Map File Name: SI2017_NaturalAreasMaster (note: data layers used to generate the map graphic need to be reproduced since some layers are missing; however, data used to produce results in Fragstats is intact)

c. Indicator #2 GIS Map File Location: \\htpgis3\General_Users\RAD

d. Indicator #2 Fragstats File Name: Mesh_COLA

e. Indicator #2 Fragstats File Location: \\htpgis3\General_Users\RAD

f. In GIS, buffer CALVEG natural areas (from SI Indicator 1) 50 meters. Select "All" to dissolve individual buffers.

g. Isolate CAMS layers for "Freeways", "Primary", "Highway" and "Railroad" into Layer file, buffer 7.5 meters.

h. Union CALVEG 50M buffer, CAMS 7.5 meter buffer, City of LA boundary. Add "Frag" field, add values to new field: only CALVEG 50M buffer not overlapping CAMS 7.5 meter buffer is value "1" all other values "999".

i. Convert "Frag" field to raster, 1 meter grid preferred.

j. Process raster patches file in Fragstats, select "Effective Mesh" metric in "Class" and "Landscape" metrics tabs.

k. Report effective mesh size in hectares.

4. Methods Notes

a. Singapore Index leadership has recently proposed a new method to measure this indicator. It is similar but makes several improvements. The following publication on the method also presents additional modifications

that other cities, including Montreal and Lisbon, have implemented for managing connectivity. https://pubag.nal.usda.gov/catalog/5658683

b. Effective mesh size does not fully address configuration of ecological networks, only total connectivity. Identifying priority areas for connectivity and areas where connectivity is being reduced are important considerations. Projects are underway to evaluate and plan for connectivity such as the National Park Service's Rim of the Valley Corridor, the LA Planning Department's Open Space Element Update, and LASAN's GRASS green infrastructure strategy. Modeling connectivity using the Circuitscape tool was considered and is recommended to identify priority corridors and areas for connectivity enhancement to better address configuration.

c. Connectivity modeling, such as Circuitscape, that considers movement potential of various indicator species has been suggested by the Expert Council. Particularly, considering "adapters", "avoiders", "wobblers" of mobile species such as birds. Also considering habitat preferences (e.g., coastal sage scrub, uplands, wetlands, oak woodlands, freshwater, etc.). Dispersal of plant species by wind and water could also be considered.

d. Incorporating connectivity potential of other green spaces, landscape, and compatible land uses in the connectivity measurement would be an improvement.

Table 2.1: Singapore Index User's Manual Instructions for Indicator 2

CBI	INDICATORS	VARIABLES	SCORE
Native Biodiversity	**INDICATOR 2: CONNECTIVITY MEASURES OR ECOLOGICAL NETWORKS TO COUNTER FRAGMENTATION**		
	RATIONALE FOR SELECTION OF INDICATOR Fragmentation of natural areas is one of the main threats to the sustainability of biodiversity in a city. Hence, it has been selected as an indicator to chart possible future trends. However, it is not easy to measure fragmentation. Some of the ways to measure fragmentation include mean patch size or distance between patches or effective mesh size, etc. It is recognised that the fragmentation of natural areas affects different species differently. For example, a road may not be a barrier for birds but it can seriously fragment a population of arboreal primates. A strip of urbanisation may not affect the dispersal of wind-pollinated plants but a plant that depends on small mammals for dispersal will be adversely affected. While these differences have been considered, a pragmatic approach towards the calculation of this indicator is adopted, as reflected in the formula used here. Furthermore, to encourage positive actions to increase connectivity or reduce barriers to connectivity, it would be more meaningful to measure connectivity rather than fragmented plots. This indicator score can be improved when more of the fragments are connected.	HOW TO CALCULATE INDICATOR $Indicator\ 2 = \frac{1}{A_{total}}\left(A_1^2 + A_2^2 + A_3^2 + ... + A_n^2\right)$ Where: • A_{total} is the total area of all natural areas • A_1 to A_n are areas that are distinct from each other (i.e. more than or equal to 100m apart) • n is the total number of connected natural areas This measures effective mesh size of the natural areas in the city. A_1 to A_n may consist of areas that are the sum of two or more smaller patches which are connected. In general, patches are considered as connected if they are less than 100m apart. However, exceptions to the above rule includes anthropogenic barriers such as: • Roads (15m or more in width; or are smaller but have a high traffic volume of more than 5000 cars per day) • Rivers that are highly modified and other artificial barriers such as heavily concretised canals and heavily built up areas • Any other artificial structures that the city would consider as a barrier Details and illustrations of how this indicator may be calculated are included in **Annex D**. WHERE TO GET DATA FOR CALCULATIONS Satellite images can be used in the computation of this indicator.	BASIS OF SCORING The effective mesh size is an expression of the probability that two points randomly chosen within the natural areas of a city are in the same patch or are considered connected (< 100m between the patches with no major barrier between). It can also be interpreted as the ability of two animals of the same species placed randomly in the natural areas to find each other. The more barriers in the landscape, the lower the probability that the two locations will be connected, and the lower the effective mesh size. Therefore, larger values of the effective mesh sizes indicate higher connectivity. 0 points: < 200 ha 1 point: 201 - 500 ha 2 points: 501 - 1000 ha 3 points: 1001 - 1500 ha 4 points: > 1500 ha

Appendix B3: Singapore Index Indicator 3

SI Indicator 3: Birds in Built Up Areas in the City

1. **Datasets Used:**
    a. Dataset Name: eBird Observation Point Data
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: https://secure.birds.cornell.edu/cassso/login?service=https%3A%2F%2Febird.org%2Febird%2Flogin%2Fcas%3Fportal%3Debird&locale=en_US
        iii. Original Source Metadata: http://ebird.org/content/ebird/about/
        iv. Original Source Citation: eBird Basic Dataset. Version: EBD_relMay-2013. Cornell Lab of Ornithology, Ithaca, New York. May 2013.
        v. Dataset Discussion: This dataset was assessed by Ryan Harrigan at UCLA. It contains a variety of observations of bird species by citizens, bird watchers, and scientists. Observation error is likely, but the quantity of observations may reduce the influence of error. Observations are also cumulative and can date as far back as observers want to enter their old records. Only the last 5 years of observations are included in this analysis.

    b. Dataset #2 Name: CALVEG Southern Coast Section
        i. Dataset Filename: ExistingVegSouthCoast2002_2010_v2.gdb
        ii. Dataset Location: \\htpgis3\General_Users\RAD
        iii. Original Source: https://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192
        iv. Original Source Metadata:

        https://www.fs.fed.us/r5/rsl/projects/gis/data/vegcovs/scoast/ExistingVegSouthCoast2002_2010_v2.html
        v. Dataset Discussion: Only complete and uniform dataset of natural vegetation available for the entire City. Some level of error due to statewide extent and resolution. This dataset does not identify small natural, naturalized, or restoration areas well. Also, data was

collected over 10 years starting approximately 1998 which will result in some error due to landcover change.

2. Other Datasets Considered

a. Los Angeles County Breeding Bird Atlas. The difficulty is that it is breeding birds only.

b. BIOSCAN (Future)

3. Method

a. Indicator #3 GIS Map File Location: \\htpgis3\General_Users\RAD.

b. Buffer natural areas from indicator 1 by 100 feet (buffer not required by Singapore Index, but will filter out "noise" of observations made from locations adjacent to natural areas into the natural areas). See Singapore Index Methods for Indicator 1 (Table 1.1). Remove natural areas plus buffer from the analysis.

c. Clip remining points to the City of Los Angeles boundary.

d. For remaining areas, produce list of point observations since 1/1/2011 (or 5 years since datset end date).

e. Filter out for species that have only been observed a minimum # or seem suspicious.

f. Classify native vs non-native species based on the County Bird list from Los Angeles Audubon Society.

g. Count number of native bird species observed and report.

4. Methods Notes

a. Distribution of species by land use type, council district, landscape/ecosystem type, or connectivity would be a useful exercise to better evaluate distribution of birds species in the built environment.

Table 3.1: Singapore Index User's Manual Instructions for Indicator 3

CBI	INDICATORS	VARIABLES	SCORE
Native Biodiversity	**INDICATOR 3: NATIVE BIODIVERSITY IN BUILT UP AREAS (BIRD SPECIES)**		
	RATIONALE FOR SELECTION OF INDICATOR It is acknowledged that cities comprise largely of built up areas and brownfield sites with anthropogenic green spaces and minimal natural features. However, it should be recognised that built up areas and brownfield sites do harbour biodiversity, e.g., birds, like swallows and swiftlets, nest under roofs of buildings; plants grow on buildings; butterflies rely on shrubs and grassy patches for food, dragonflies breed in water features, etc. Some built up areas and brownfield sites have more biodiversity than others. By enhancing certain features in such areas, the biodiversity could be improved. Hence, native biodiversity in built up areas and brownfield sites should be an indicator. Most cities have data on bird species, hence, this taxonomic group will be used as an indicator. The number of native bird species in built up areas and anthropogenic green spaces is inevitably lower than that found in sites with natural ecosystems; however implementing appropriate measures such as planting fruit trees, shrubs with berries, etc. may attract birds into built up areas of the city.	HOW TO CALCULATE INDICATOR Number of native bird species in built up areas where built up areas include impermeable surfaces like buildings, roads, drainage channels, etc., and anthropogenic green spaces like roof gardens, roadside planting, golf courses, private gardens, cemeteries, lawns, urban parks, etc. Areas that are counted as natural areas in indicator 1 should not be included in this indicator. WHERE TO GET DATA FOR CALCULATIONS City councils, universities, NGOs, etc.	BASIS OF SCORING The number of bird species in built up areas and anthropogenic greenery and green spaces is inevitably lower than that found in sites with natural ecosystems. 0 points: < 19 bird species 1 point: 19 - 27 bird species 2 points: 28 - 46 bird species 3 points: 47 - 68 bird species 4 points: > 68 bird species

Table 3.2: Native bird species (common names) in built areas. List compiled by Ryan Harrigan at UCLA and he retains the full list of observations and locations.

Acorn Woodpecker	Evening Grosbeak	Red-eyed Vireo
Allen's Hummingbird	Ferruginous Hawk	Red-naped Sapsucker
American Avocet	Field Sparrow	Red-necked Phalarope
American Bittern	Forster's Tern	Red-shouldered Hawk
American Coot	Fox Sparrow	Red-tailed Hawk
American Crow	Glaucous-winged Gull	Red-throated Loon
American Goldfinch	Glossy Ibis	Red-throated Pipit
American Kestrel	Golden Eagle	Red-winged Blackbird
American Pipit	Golden-crowned Kinglet	Reddish Egret
American Redstart	Golden-crowned Sparrow	Ring-billed Gull
American Robin	Grasshopper Sparrow	Ring-necked Duck
American Wigeon	Gray Flycatcher	Rock Wren
Anna's Hummingbird	Great Egret	Rose-breasted Grosbeak
Ash-throated Flycatcher	Great-tailed Grackle	Ross's Goose
Baird's Sandpiper	Greater Roadrunner	Royal Tern
Bald Eagle	Greater Scaup	Ruby-crowned Kinglet
Baltimore Oriole	Greater Yellowlegs	Ruddy Duck
Band-tailed Pigeon	Green Heron	Ruddy Turnstone
Bank Swallow	Green-tailed Towhee	Rufous Hummingbird
Barn Owl	Green-winged Teal	Rufous-crowned Sparrow
Barn Swallow	Hairy Woodpecker	Sage Thrasher
Bell's Vireo	Hammond's Flycatcher	Savannah Sparrow
Belted Kingfisher	Harris's Hawk	Say's Phoebe
Bewick's Wren	Heermann's Gull	Scarlet Tanager
Black Oystercatcher	Hermit Thrush	Scissor-tailed Flycatcher
Black Phoebe	Hermit Warbler	Scott's Oriole
Black Scoter	Herring Gull	Semipalmated Plover
Black Skimmer	Hooded Merganser	Semipalmated Sandpiper
Black Swift	Hooded Oriole	Sharp-shinned Hawk
Black Turnstone	Horned Grebe	Short-billed Dowitcher
Black-and-white Warbler	Horned Lark	Short-eared Owl
Black-bellied Plover	House Finch	Snow Goose
Black-chinned Hummingbird	House Wren	Snowy Egret
Black-chinned Sparrow	Hutton's Vireo	Snowy Plover
Black-crowned Night-Heron	Indigo Bunting	Solitary Sandpiper
Black-headed Grosbeak	Lark Bunting	Song Sparrow
Black-necked Stilt	Lark Sparrow	Sooty Shearwater
Black-throated Sparrow	Lawrence's Goldfinch	Spotted Sandpiper
Black-vented Shearwater	Lazuli Bunting	Spotted Towhee

Blackburnian Warbler	Least Bittern	Steller's Jay
Blackpoll Warbler	Least Flycatcher	Summer Tanager
Blue Grosbeak	Least Sandpiper	Surf Scoter
Blue-gray Gnatcatcher	Least Tern	Swainson's Hawk
Blue-winged Teal	Lesser Goldfinch	Swainson's Thrush
Bonaparte's Gull	Lesser Nighthawk	Swamp Sparrow
Brandt's Cormorant	Lesser Scaup	Tennessee Warbler
Brewer's Blackbird	Lesser Yellowlegs	Thayer's Gull
Brewer's Sparrow	Lewis's Woodpecker	Townsend's Solitaire
Broad-winged Hawk	Lincoln's Sparrow	Townsend's Warbler
Brown Creeper	Loggerhead Shrike	Tree Swallow
Brown Pelican	Long-billed Curlew	Tricolored Blackbird
Brown-headed Cowbird	Long-billed Dowitcher	Tropical Kingbird
Bullock's Oriole	Long-eared Owl	Turkey Vulture
Burrowing Owl	Long-tailed Duck	Varied Thrush
Cackling Goose	MacGillivray's Warbler	Vaux's Swift
Cactus Wren	Marbled Godwit	Vermilion Flycatcher
California Condor	Marsh Wren	Vesper Sparrow
California Gnatcatcher	Mew Gull	Violet-green Swallow
California Gull	Mountain Bluebird	Virginia Rail
California Quail	Mountain Chickadee	Virginia's Warbler
California Scrub-Jay	Mourning Dove	Wandering Tattler
California Thrasher	Nashville Warbler	Warbling Vireo
California Towhee	Northern Flicker	Western Bluebird
Calliope Hummingbird	Northern Fulmar	Western Grebe
Canada Goose	Northern Harrier	Western Gull
Canada Warbler	Northern Mockingbird	Western Kingbird
Canyon Wren	Northern Parula	Western Meadowlark
Caspian Tern	Northern Pintail	Western Sandpiper
Cassin's Finch	Northern Shoveler	Western Screech-Owl
Cassin's Kingbird	Northern Waterthrush	Western Tanager
Cassin's Vireo	Nuttall's Woodpecker	Western Wood-Pewee
Cattle Egret	Oak Titmouse	White-breasted Nuthatch
Cedar Waxwing	Olive-sided Flycatcher	White-crowned Sparrow
Chestnut-sided Warbler	Orange-crowned Warbler	White-faced Ibis
Chimney Swift	Orchard Oriole	White-headed Woodpecker
Chipping Sparrow	Pacific Loon	White-tailed Kite
Cinnamon Teal	Pacific Wren	White-throated Sparrow
Clark's Grebe	Pacific-slope Flycatcher	White-throated Swift
Clay-colored Sparrow	Painted Bunting	White-winged Dove
Cliff Swallow	Painted Redstart	White-winged Scoter
Common Gallinule	Palm Warbler	Williamson's Sapsucker
Common Goldeneye	Parasitic Jaeger	Willow Flycatcher

Common Loon	Pectoral Sandpiper	Wilson's Phalarope
Common Merganser	Pelagic Cormorant	Wilson's Warbler
Common Murre	Peregrine Falcon	Wood Duck
Common Poorwill	Pied-billed Grebe	Worm-eating Warbler
Common Raven	Pigeon Guillemot	Yellow Warbler
Common Tern	Pine Siskin	Yellow-bellied Sapsucker
Common Yellowthroat	Pine Warbler	Yellow-breasted Chat
Cooper's Hawk	Pink-footed Shearwater	Yellow-crowned Night-Heron
Costa's Hummingbird	Plumbeous Vireo	Yellow-headed Blackbird
Dark-eyed Junco	Prairie Falcon	Yellow-rumped Warbler
Double-crested Cormorant	Purple Finch	Yellow-throated Warbler
Downy Woodpecker	Purple Martin	Zone-tailed Hawk
Dusky Flycatcher	Pygmy Nuthatch	
Eared Grebe	Red Knot	
Eastern Phoebe	Red-breasted Merganser	
Elegant Tern	Red-breasted Nuthatch	
Eurasian Wigeon	Red-breasted Sapsucker	

Appendix B4: Singapore Index Indicator 4

SI Indicator 4: Change in # Vascular Plant Species

1. **Datasets Used:**
    a. Dataset Name: Calflora Observation Point Data
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: http://www.Calflora.org/entry/wsearch.html
        iii. Original Source Metadata: http://www.Calflora.org/occ/about.html
        iv. Dataset Discussion: This dataset contains a compilation of recorded observations across the state going back decades. Observation accuracy is considered high, but location precision varies. Many observations are from more wild areas of the state and likely does not represent a complete inventory of urban areas, including Los Angeles. Many additional species are certainly present in the City. Also, name changes that have occurred over time for some species, and both names may be included in the Table 4.2. Obvious name changes have been identified and the species has been counted only once; however, there are certainly additional species that have undergone name changes, and the names have not been aggregated (i.e., the species is double counted).

    b. Dataset Name: Calscape Database, California Native Plant Society, Web-based mapper
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: http://Calscape.org/loc-California/
        iii. Original Source Metadata: http://Calscape.org/about.php
        iv. Dataset Discussion: This dataset contains projected native species ranges based on observation data and analysis of suitable ecological conditions of the species. Importantly, this database is an estimate for the purposes of restoration, and species presence may not actually occur at present. This dataset may be useful to help determine native plant species that may be present in Los Angeles, but do not have observations recorded in Calflora or iNaturalist. Lists were generatated using the online mapper for a

number of locations in the City. Contact Calscape to see if dataset is available for download.

2. Other Datasets Considered

a. iNaturalist is a valuable dataset, however without functionality to differentiate between native and non-native, processing will be time consuming. Many of the observations in Calflora are from iNaturalist.

b. Surveys from Griffith Park, Ballona Wetlands

c. http://ucjeps.berkeley.edu/consortium/

d. Local herbaria (NHM, Huntington Gardens?)

e. Watershed planning documents, EIRs

f. BIOSCAN

3. Method

IMPORTANT NOTE: This measurement is a preliminary baseline measurement and future measurements are required to determine change.

a. Indicator #4 GIS Map File Location: \\htpgis3\General_Users\RAD

b. Download Calflora data from LA County for “Natural Status” = “Wild” and “Planted: Restoration Site”; “Plant Status” = “Native”

c. Clip point data to City Boundary

d. Generate species list, see Table 4.2

e. Select multiple locations in the City in Calscape mapper to generate projected native species lists. Locations were selected based on assumption that they include a more or less complete cross section of the major ecological zones of the City. Locations mapped include:

   i. Griffith Park

   ii. Topanga State Park

   iii. Mt. Lukens

   iv. Downtown Los Angeles

   v. Kenneth Hahn State Park

   vi. Machado Lake

   vii. Ballona Wetlands

viii. Elysian Park

ix. Sepulveda Basin

x. Granada Hills

xi. Big Tujunga Wash

Compile lists to generate total list, see Table 4.3

4. Methods Notes

a. A scientific survey of plants in the City would be necessary to complete this assessment in a more defensible way.

b. As was mentioned in the Expert Council workshop, emphasis on species that are known to be rare or extirpated from the City would provide a more focused approach. A list of these species should be produced in the future.

c. Another approach would be to task an intern in City Planning to extract species lists from all City EIRs going back a certain amount of time.

d. Citizen scientist initiative to try and find plants listed as potential in Calscape but not observed in Calflora could be a beneficial initiative.

Table 4.1: Singapore Index User's Manual Instructions for Indicator 4

CBI	INDICATORS	VARIABLES	SCORE
Native Biodiversity	**INDICATORS 4 - 8: CHANGE IN NUMBER OF NATIVE SPECIES**		
	RATIONALE FOR SELECTION OF INDICATOR As this is an Index focussing on biodiversity in cities, it is essential that the native flora and fauna diversity be incorporated as indicators. Three key taxonomic groups that are most surveyed worldwide, i.e., plants, birds and butterflies, have been selected as "core indicators". To ensure fairness and objectivity in the Index, cities can select two other taxonomic groups that would reflect their best biodiversity. To ensure that these five indicators on species are unbiased against any city based on its geographical location, ecological history, size, land use, etc., it was decided that • All cities and local authorities are requested to list the number of native species of a) vascular plants, b) birds, c) butterflies, d) at least two other taxonomic groups, and e) any other taxonomic groups that they have data, in Part I: Profile of the City • The indicators will measure the change in number of species over time rather than the absolute number of species • The first year of application will be taken as the baseline year for the species count. The net change in species numbers (increase in number of species due to re-introduction or restoration efforts minus the number of species that went extinct) will be incorporated in the subsequent calculations of the Singapore Index. Conducting more surveys on the target groups (to document new species or rediscoveries) and reintroducing locally extinct native species would help to increase the number of extant native species.	HOW TO CALCULATE INDICATORS The change in number of native species is used for indicators 4 to 8. The three core groups are: • Indicator 4 : vascular plants • Indicator 5 : birds • Indicator 6 : butterflies These groups have been selected as data are most easily available and to enable some common comparison. Cities can select any two other taxonomic groups for indicators 7 and 8 (e.g., bryophytes, fungi, amphibians, reptiles, freshwater fish, molluscs, dragonflies, beetles, spiders, hard corals, marine fish, seagrasses, sponges, etc.) The above data from the first application of the Singapore Index would be recorded in Part I: Profile of the City as the baseline. Net change in species from the previous survey to the most recent survey is calculated as: Total increase in number of species (as a result of re-introduction, rediscovery, new species found, etc.) minus number of species that have gone extinct. WHERE TO GET DATA FOR CALCULATIONS Possible sources of data include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.	BASIS OF SCORING Data listed in Part I: Profile of the City will be used to measure change in species diversity. Cities' first application will be considered as the baseline information for all subsequent monitoring. In their subsequent applications of the Index, cities will calculate the net change in species for the respective taxonomic groups. The scoring range below is based on the acceptance that it is not easy to recover or re-introduce species successfully over a short period of time. However, species recovery, re-introduction and restoration efforts must be given due recognition. 0 points: maintaining or a decrease in the number of species 1 point: 1 species increase 2 points: 2 species increase 3 points: 3 species increase 4 points: 4 species or more increase

Table 4.2: Native plants observed in Los Angeles in the Calflora database based on City of Los Angeles Boundary. *Download and compilation by Natalie Farnham at Santa Monica Community College).* A full list of observations and locations is stored on the LASAN server at \\htpgis3\General_Users\RAD (* = not counted)

Scientific Name	Scientific Name	Scientific Name
Abronia umbellata	*Epilobium ciliatum*	*Penstemon spectabilis* ssp. *Subviscosus*
Acer macrophyllum	*Epipactis gigantea*	*Pentagramma triangularis*
Achillea millefolium	*Equisetum arvense*	*Peritoma arborea*
Achyrachaena mollis	*Equisetum hyemale* ssp. *Affine*	*Perityle emoryi*
*Acmispon americanum**	*Equisetum laevigatum*	*Phacelia cicutaria*
Acmispon americanus	*Equisetum telmateia*	*Phacelia distans*
Acmispon argophyllus	*Eragrostis mexicana*	*Phacelia grandiflora*
Acmispon glaber	*Eremocarpus setigerus*	*Phacelia hubbyi*
Acmispon glaber var. *glaber**	*Eremothera boothii*	*Phacelia longipes*
Acmispon grandiflorus	*Eriastrum sapphirinum*	*Phacelia minor*
Acmispon maritimus	*Ericameria palmeri*	*Phacelia ramosissima*
*Acmispon maritimus var. maritimus**	*Ericameria parishii*	*Phacelia tanacetifolia*
Acmispon micranthus	*Ericameria pinifolia*	*Phacelia viscida*
Acmispon wrangelianus	*Erigeron canadensis*	*Phacelia viscida* var. *albiflora*
Acourtia microcephala	*Erigeron foliosus*	*Pholistoma auritum*
Adenostoma fasciculatum	*Eriodictyon crassifolium*	*Pholistoma auritum* var. *auritum**
Adiantum capillus-veneris	*Eriogonum cinereum*	*Phoradendron macrophyllum*
Adiantum jordanii	*Eriogonum elongatum*	*Phyla nodiflora*
Aesculus californica	*Eriogonum fasciculatum*	*Phyllospadix torreyi*
Allium peninsulare	*Eriogonum fasciculatum* var. *polifolium*	*Plagiobothrys canescens*
Allophyllum glutinosum	*Eriogonum gracile*	*Plagiobothrys nothofulvus*
Alnus rhombifolia	*Eriogonum parvifolium*	*Plantago erecta*
Amaranthus blitoides	*Eriophyllum confertiflorum*	*Platanus racemosa*
Ambrosia acanthicarpa	*Eschscholzia caespitosa*	*Platystemon californicus*
Ambrosia confertiflora	*Eschscholzia californica*	*Pluchea sericea*
Ambrosia psilostachya	*Eucrypta chrysanthemifolia*	*Poa secunda*
Ammannia coccinea	*Eulobus californicus*	*Polycarpon depressum*
Amsinckia intermedia	*Euphorbia albomarginata*	*Polygala cornuta*
Amsinckia menziesii	*Euphorbia melanadenia*	*Polypodium californicum*
Anemopsis californica	*Euphorbia serpens*	*Populus fremontii*
Antirrhinum coulterianum	*Festuca octoflora*	*Populus trichocarpa*
Apiastrum angustifolium	*Filago californica*	*Potentilla glandulosa*
Arctostaphylos glandulosa	*Fragaria vesca*	*Primula clevelandii*
Arctostaphylos glauca	*Frangula californica*	*Prunus ilicifolia*
Argemone munita	*Fraxinus dipetala*	*Prunus ilicifolia* ssp. *lyonii*
Artemisia californica	*Fraxinus velutina*	*Pseudognaphalium biolettii*
Artemisia douglasiana	*Fritillaria biflora*	*Pseudognaphalium californicum*

Scientific Name	Scientific Name	Scientific Name
Artemisia dracunculus	*Funastrum cynanchoides*	*Pseudognaphalium canescens*
Asclepias eriocarpa	*Galium angustifolium**	*Pseudognaphalium microcephalum*
Asclepias fascicularis	*Galium angustifolium* ssp. *Angustifolium*	*Psilocarphus tenellus*
Aspidotis californica	*Galium aparine*	*Pteridium aquilinum*
Aster subulatus	*Galium nuttallii*	*Pterostegia drymarioides*
Astragalus brauntonii	*Garrya veatchii*	*Quercus agrifolia*
Astragalus trichopodus	*Geranium carolinianum*	*Quercus agrifolia* var. *agrifolia**
Atriplex canescens	*Gilia angelensis*	*Quercus berberidifolia*
Atriplex lentiformis	*Gilia capitata*	*Quercus chrysolepis*
Baccharis pilularis	*Gnaphalium microcephalum*	*Quercus lobata*
Baccharis plummerae	*Gnaphalium palustre*	*Quercus wislizeni*
Baccharis salicifolia	*Grindelia camporum*	*Rafinesquia californica*
Baccharis sergiloides	*Gutierrezia californica*	*Ranunculus californicus*
Berberis nevinii	*Gutierrezia sarothrae*	*Ranunculus hebecarpus*
Bidens frondosa	*Hazardia squarrosa*	*Rhamnus californica*
Bidens laevis	*Helianthemum scoparium*	*Rhamnus crocea*
Bloomeria crocea	*Helianthus annuus*	*Rhamnus ilicifolia*
Bothriochloa barbinodis	*Helianthus gracilentus*	*Rhus aromatica*
Bowlesia incana	*Heliotropium curassavicum*	*Rhus integrifolia*
Boykinia occidentalis	*Hemizonia fasciculata*	*Rhus laurina*
Brickellia californica	*Hemizonia minthornii*	*Rhus ovata*
Brickellia nevinii	*Hesperocnide tenella*	*Ribes aureum*
Bromus arizonicus	*Hesperocyparis forbesii*	*Ribes californicum*
Bromus carinatus	*Hesperoyucca whipplei*	*Ribes indecorum*
Bromus laevipes	*Heteromeles arbutifolia*	*Ribes malvaceum*
Bromus maritimus	*Heterotheca grandiflora*	*Ribes speciosum*
Bromus vulgaris	*Heterotheca sessiliflora*	*Rorippa nasturtium-aquaticum*
Calandrinia ciliata	*Holodiscus discolor*	*Rosa californica*
Calandrinia menziesii	*Horkelia cuneata*	*Rubus ursinus*
Calochortus catalinae	*Isocoma menziesii*	*Rumex fueginus*
Calochortus clavatus	*Juglans californica*	*Rupertia physodes*
Calochortus clavatus var. *gracilis*	*Juglans californica* var. *californica**	*Salix gooddingii*
Calochortus plummerae	*Juncus acutus*	*Salix laevigata*
Calochortus venustus	*Juncus bufonius*	*Salix lasiolepis*
Calochortus weedii	*Juncus patens*	*Salvia apiana*
Calystegia macrostegia	*Keckiella cordifolia*	*Salvia columbariae*
Calystegia macrostegia ssp. *intermedia*	*Lasthenia californica*	*Salvia leucophylla*
Camissonia lewisii	*Lathyrus vestitus*	*Salvia mellifera*
Camissoniopsis hirtella	*Layia platyglossa*	*Salvia spathacea*
Camissoniopsis micrantha	*Lepidium nitidum*	*Sambucus mexicana*
Cardamine californica	*Lepidospartum squamatum*	*Sambucus nigra*

Scientific Name	Scientific Name	Scientific Name
Carex senta	*Leptochloa fascicularis*	*Sambucus nigra* ssp. *Caerulea*
Carex triquetra	*Leptosiphon parviflorus*	*Samolus parviflorus*
Castilleja affinis	*Lessingia filaginifolia*	*Sanicula arguta*
Castilleja applegatei	*Leymus condensatus*	*Sanicula crassicaulis*
Castilleja exserta	*Lilium humboldtii*	*Sanicula tuberosa*
Castilleja foliolosa	*Linanthus californicus*	*Sarcostemma cynanchoides*
Caulanthus heterophyllus	*Linanthus dianthiflorus*	*Saxifraga californica*
Ceanothus crassifolius var. *crassifolius*	*Lithophragma affine*	*Schoenoplectus americanus*
Ceanothus leucodermis	*Lomatium dasycarpum*	*Scrophularia californica*
Ceanothus megacarpus	*Lomatium lucidum*	*Scutellaria tuberosa*
Ceanothus oliganthus	*Lonicera subspicata*	*Selaginella bigelovii*
Ceanothus spinosus	*Lotus purshianus*	*Senecio flaccidus*
Cercis occidentalis	*Lotus scoparius*	*Setaria gracilis*
Cercocarpus betuloides	*Ludwigia peploides*	*Silene antirrhina*
Chaenactis artemisiifolia	*Lupinus argenteus*	*Silene coniflora*
Chaenactis glabriuscula var. *orcuttiana*	*Lupinus bicolor*	*Silene laciniata*
Chamaesyce melanadenia	*Lupinus formosus*	*Silene umbellate* ssp. *laciniate**
Chamaesyce polycarpa	*Lupinus hirsutissimus*	*Simmondsia chinensis*
Chenopodium berlandieri	*Lupinus longifolius*	*Sisyrinchium bellum*
Chenopodium californicum	*Lupinus sparsiflorus*	*Solanum americanum*
Chilopsis linearis	*Lupinus succulentus*	*Solanum douglasii*
Chorizanthe staticoides	*Lupinus truncatus*	*Solanum umbelliferum*
Cirsium occidentale	*Madia gracilis*	*Solanum xanti*
Clarkia amoena	*Madia sativa*	*Solidago californica*
Clarkia bottae	*Malacothamnus**	*Solidago velutina* ssp. *californica*
Clarkia cylindrica	*Malacothamnus davidsonii*	*Sphaeralcea ambigua*
Clarkia epilobioides	*Malacothamnus fasciculatus*	*Stachys albens*
Clarkia purpurea	*Malacothrix clevelandii*	*Stachys bullata*
Clarkia rhomboidea	*Malacothrix saxatilis*	*Stachys rigida*
Clarkia unguiculata	*Malacothrix saxatilis* var. *tenuifolia*	*Stebbinsoseris heterocarpa*
Claytonia perfoliata	*Malosma laurina*	*Stephanomeria cichoriacea*
Clematis lasiantha	*Malvella leprosa*	*Stephanomeria diegensis*
Clematis ligusticifolia	*Marah fabacea*	*Stephanomeria exigua*
Collinsia heterophylla	*Marah macrocarpa*	*Stephanomeria virgata*
Collinsia parryi	*Marah macrocarpus**	*Stephanomeria umbella* ssp. *virgate**
Comarostaphylis diversifolia	*Matricaria discoidea*	*Stipa coronata*
Conyza canadensis	*Meconella denticulata*	*Suaeda calceoliformis*
Conyza canadensis var. *canadensis**	*Melica californica*	*Suaeda taxifolia*
Coreopsis bigelovii	*Melica imperfecta*	*Symphoricarpos mollis*
Coreopsis gigantea	*Mentzelia laevicaulis*	*Symphyotrichum subulatum*
Corethrogyne filaginifolia	*Mentzelia micrantha*	*Tauschia arguta*

Scientific Name	Scientific Name	Scientific Name
Crassula connata	*Microsteris gracilis*	*Tauschia hartwegii*
Croton californicus	*Mimulus aurantiacus*	*Thalictrum fendleri*
Croton setiger	*Mimulus brevipes*	*Thysanocarpus curvipes*
Croton setigerus	*Mimulus cardinalis*	*Thysanocarpus laciniatus*
Cryptantha clevelandii	*Mimulus floribundus*	*Toxicodendron diversilobum*
Cryptantha intermedia	*Mimulus guttatus*	*Toxicoscordion fremontii*
Cryptantha micromeres	*Mirabilis laevis*	*Trichostema lanatum*
Cryptantha microstachys	*Monolopia lanceolata*	*Trichostema lanceolatum*
Cryptantha muricata	*Muhlenbergia microsperma*	*Trifolium fucatum*
Cucurbita foetidissima	*Muhlenbergia rigens*	*Trifolium willdenovii*
Cuscuta californica	*Nassella cernua*	*Tropidocarpum gracile*
Cuscuta subinclusa	*Nassella lepida*	*Typha latifolia*
Cylindropuntia prolifera	*Nassella pulchra*	*Umbellularia californica*
Cyperus esculentus	*Nasturtium officinale*	*Uropappus lindleyi*
Datura wrightii	*Navarretia hamata* ssp. *hamata*	*Urtica dioica*
Daucus pusillus	*Nemophila menziesii*	*Venegasia carpesioides*
Deinandra fasciculata	*Neogaerrhinum kelloggii*	*Verbena lasiostachys*
Deinandra minthornii	*Nicotiana quadrivalvis*	*Vicia americana*
Delphinium cardinale	*Notholaena californica*	*Viola pedunculata*
Delphinium parryi	*Oenothera elata*	*Vitis girdiana*
Delphinium patens	*Opuntia engelmannii*	*Woodwardia fimbriata*
Dendromecon rigida	*Opuntia littoralis*	*Xanthium spinosum*
Descurainia pinnata	*Opuntia occidentalis*	*Xanthium strumarium*
Dichelostemma capitatum	*Orobanche californica*	*Yucca whipplei*
Dodecatheon clevelandii	*Orobanche fasciculata*	
Dryopteris arguta	*Osmorhiza brachypoda*	
Dudleya lanceolata	*Oxalis albicans*	
Dudleya pulverulenta	*Oxalis californica*	
Dudleya virens	*Oxalis umbellate* ssp. *pilosa*	
Ehrendorferia ochroleuca	*Paeonia californica*	
Eleocharis montevidensis	*Papaver californicum*	
Eleocharis parishii	*Parietaria hespera*	
Eleocharis radicans	*Paspalum distichum*	
Elymus condensatus	*Pectocarya linearis*	
Elymus glaucus	*Pedicularis densiflora*	
Emmenanthe penduliflora	*Pellaea andromedifolia*	
Encelia californica	*Pellaea mucronata*	
Encelia farinosa	*Penstemon centranthifolius*	
Epilobium adenocaulon	*Penstemon heterophyllus*	
Epilobium canum	*Penstemon spectabilis*	

* = not counted

Table 4.3: Potential native plants in Los Angeles based on Calscape – California Native Plant Society projections. Estimates are based on project conditions in Los Angeles, however some species may not be present and actual suitability should be verified (e.g. *Abies concolor* may be at the edge of its range at Mt. Lukens, but is likely not present there). "*" denotes species that are duplicated in this list and were not included in the species count.

Abies concolor	*Clematis lasiantha*	*Hosackia oblongifolia* var. *oblongifolia**	*Phacelia viscida*
Abronia maritima	*Clematis ligusticifolia*	*Hulsea heterochroma*	*Phalaris lemmonii*
Abronia umbellata	*Clematis pauciflora*	*Hulsea vestita*	*Pholisma arenarium*
Abronia umbellate var. *umbellate**	*Clinopodium douglasii*	*Hulsea vestita* ssp. *gabrielensis*	*Pholistoma auritum*
Abutilon palmeri	*Clinopodium mimuloides*	*Hydrocotyle ranunculoides*	*Pholistoma auritum* var. *auritum**
Acanthomintha ilicifolia	*Collinsia concolor*	*Hydrocotyle umbellata*	*Phragmites australis*
Acer macrophyllum	*Collinsia heterophylla*	*Hydrocotyle verticillata*	*Phyla lanceolata*
Acer negundo	*Collinsia parryi*	*Imperata brevifolia*	*Phyla nodiflora*
Achillea millefolium	*Collomia grandiflora*	*Isocoma menziesii*	*Phyllospadix scouleri*
Achyrachaena mollis	*Comarostaphylis diversifolia*	*Isocoma menziesii* var. *decumbens*	*Pickeringia montana*
Acmispon americanus	*Comarostaphylis diversifolia* ssp. *planifolia*	*Isocoma menziesii* var. *menziesii**	*Pickeringia montana* var. *montana**
Acmispon americanus var. *americanus**	*Convolvulus simulans*	*Isocoma menziesii* var. *sedoides*	*Pinus attenuata*
Acmispon argophyllus	*Cordylanthus rigidus*	*Isocoma menziesii* var. *vernonioides*	*Pinus contorta*
Acmispon argophyllus var. *argophyllus**	*Cordylanthus rigidus ssp. setiger*	*Isolepis cernua*	*Pinus coulteri*
Acmispon glaber	*Corethrogyne filaginifolia*	*Iva axillaris*	*Pinus lambertiana*
Acmispon glaber var. *glaber**	*Cornus glabrata*	*Jaumea carnosa*	*Pinus monophylla*
Acmispon grandiflorus	*Cornus sericea*	*Juglans californica*	*Pinus ponderosa*
Acmispon grandiflorus var. *grandiflorus**	*Cornus sericea* ssp. *occidentalis*	*Juglans hindsii*	*Piperia cooperi*
Acmispon heermannii	*Cornus sericea* ssp. *sericea**	*Juncus acutus*	*Plagiobothrys acanthocarpus*
Acmispon maritimus	*Crassula connata*	*Juncus acutus* ssp. *leopoldii*	*Plagiobothrys arizonicus*
Acmispon maritimus var. *maritimus**	*Cressa truxillensis*	*Juncus balticus*	*Plagiobothrys canescens*
Acmispon micranthus	*Crocanthemum scoparium*	*Juncus bufonius*	*Plagiobothrys collinus*
Acmispon strigosus	*Croton californicus*	*Juncus bufonius* var. *bufonius**	*Plagiobothrys collinus* var. *fulvescens*
Acmispon wrangelianus	*Croton Setiger*	*Juncus bufonius* var. *occidentalis*	*Plagiobothrys nothofulvus*
Acourtia microcephala	*Cryptantha barbigera*	*Juncus macrophyllus*	*Plagiobothrys tenellus*
Adenostoma fasciculatum	*Cryptantha circumscissa*	*Juncus mexicanus*	*Plantago elongata*
*Adenostoma fasciculatum var. fasciculatum**	*Cryptantha clevelandii*	*Juncus occidentalis*	*Plantago erecta*
Adenostoma sparsifolium	*Cryptantha clevelandii* var. *florosa*	*Juncus patens*	*Plantago ovata*
Adiantum capillus-veneris	*Cryptantha clokeyi*	*Juncus phaeocephalus*	*Plantago patagonica*
Adiantum jordanii	*Cryptantha decipiens*	*Juncus phaeocephalus* var. *paniculatus*	*Plantago subnuda*
Aesculus californica	*Cryptantha flaccida*	*Juncus rugulosus*	*Platanus racemosa*
Agoseris grandiflora	*Cryptantha intermedia*	*Juncus textilis*	*Platystemon californicus*
Agoseris grandiflora var. *grandiflora**	*Cryptantha leiocarpa*	*Juncus tiehmii*	*Plectritis ciliosa*
Agoseris retrorsa	*Cryptantha micrantha*	*Juncus xiphioides*	*Pluchea odorata*
Agrostis exarata	*Cryptantha micromeres*	*Juniperus californica*	*Pluchea odorata* var. *odorata**
Agrostis pallens	*Cryptantha microstachys*	*Keckiella antirrhinoides*	*Pluchea sericea*
Alisma triviale	*Cryptantha muricata*	*Keckiella breviflora*	*Poa howellii*

Allium haematochiton	*Cryptantha muricata* var. *denticulata*	*Keckiella cordifolia*	*Poa secunda*
Allium monticola	*Cryptantha muricata* var. *jonesii*	*Keckiella ternata*	*Poa secunda* ssp. *secunda**
Allium peninsulare	*Cryptantha muricata var. muricata**	*Keckiella ternata var. septentrionalis*	*Polycarpon depressum*
Allium peninsulare var. *peninsulare**	*Cryptantha nevadensis*	*Keckiella ternata* var. *ternata**	*Polygala cornuta*
Allophyllum divaricatum	*Cryptantha nevadensis* var. *rigida*	*Koeleria macrantha*	*Polygala cornuta* var. *fishiae*
Allophyllum gilioides	*Cryptantha oxygona*	*Laennecia coulteri*	*Polypodium californicum*
Allophyllum gilioides ssp. *violaceum*	*Cryptantha similis*	*Lagophylla ramosissima*	*Polystichum imbricans*
Allophyllum glutinosum	*Cryptantha simulans*	*Lastarriaea coriacea*	*Polystichum imbricans* ssp. *curtum*
Alnus rhombifolia	*Cucurbita foetidissima*	*Lasthenia californica*	*Polystichum imbricans* ssp. *imbricans**
Amaranthus blitoides	*Cupressus arizonica*	*Lasthenia coronaria*	*Polystichum munitum*
Amaranthus powellii	*Cuscuta californica*	*Lasthenia glabrata*	*Populus fremontii*
Amblyopappus pusillus	*Cuscuta californica* var. *californica**	*Lasthenia glabrata* ssp. *coulteri*	*Populus fremontii* ssp. *fremontii**
Ambrosia acanthicarpa	*Cuscuta campestris*	*Lasthenia gracilis*	*Populus trichocarpa*
Ambrosia chamissonis	*Cuscuta indecora*	*Lathyrus vestitus*	*Potamogeton foliosus*
Ambrosia confertiflora	*Cuscuta salina*	*Lathyrus vestitus var. vestitus**	*Potentilla anserina*
Ambrosia psilostachya	*Cuscuta subinclusa*	*Layia glandulosa*	*Potentilla anserina* ssp. *pacifica*
Ammannia coccinea	*Cylindropuntia californica*	*Layia hieracioides*	*Primula clevelandii*
Ammannia robusta	*Cylindropuntia californica* var. *parkeri*	*Layia platyglossa*	*Primula clevelandii* var. *gracilis*
Amorpha californica	*Cylindropuntia prolifera*	*Lemna gibba*	*Prunus ilicifolia*
Amorpha californica var. *californica**	*Cyperus eragrostis*	*Lemna minor*	*Prunus ilicifolia* ssp. *ilicifolia**
Amsinckia douglasiana	*Cyperus erythrorhizos*	*Lemna valdiviana*	*Pseudognaphalium beneolens*
Amsinckia eastwoodiae	*Cyperus esculentus*	*Lepechinia fragrans*	*Pseudognaphalium biolettii*
Amsinckia intermedia	*Cyperus laevigatus*	*Lepidium densiflorum*	*Pseudognaphalium californicum*
Amsinckia menziesii	*Cyperus niger*	*Lepidium lasiocarpum*	*Pseudognaphalium canescens*
Amsinckia retrorsa	*Cyperus odoratus*	*Lepidium lasiocarpum* ssp. *lasiocarpum**	*Pseudognaphalium leucocephalum*
Amsinckia spectabilis	*Cystopteris fragilis*	*Lepidium latipes*	*Pseudognaphalium microcephalum*
Amsinckia tessellata	*Datisca glomerata*	*Lepidium nitidum*	*Pseudognaphalium ramosissimum*
*Amsinckia tessellata var. tessellata**	*Datura wrightii*	*Lepidium oblongum*	*Pseudognaphalium stramineum*
Ancistrocarphus filagineus	*Daucus pusillus*	*Lepidium strictum*	*Pseudotsuga macrocarpa*
Andropogon glomeratus	*Deinandra fasciculata*	*Lepidium virginicum*	*Psilocarphus brevissimus*
Andropogon glomeratus var. *scabriglumis*	*Deinandra paniculata*	*Lepidospartum squamatum*	*Psilocarphus tenellus*
Anemopsis californica	*Delphinium cardinale*	*Leptochloa fusca*	*Pteridium aquilinum*
Antirrhinum coulterianum	*Delphinium parishii*	*Leptochloa fusca ssp. fascicularis*	*Pteridium aquilinum* var. *pubescens*
Antirrhinum kelloggii	*Delphinium parishii ssp. parishii**	*Leptochloa fusca* ssp. *uninervia*	*Pterostegia drymarioides*
Antirrhinum multiflorum	*Delphinium parryi*	*Leptosiphon androsaceus*	*Purshia tridentata*
Antirrhinum nuttallianum	*Delphinium parryi* ssp. *maritimum*	*Leptosiphon aureus*	*Pycnanthemum californicum*
Antirrhinum nuttallianum ssp. *nuttallianum**	*Delphinium parryi* ssp. *parryi**	*Leptosiphon breviculus*	*Quercus agrifolia*
Antirrhinum nuttallianum ssp. *subsessile*	*Delphinium patens*	*Leptosiphon ciliatus*	*Quercus agrifolia* var. *agrifolia**

Aphanisma blitoides	*Delphinium patens* ssp. *hepaticoideum*	*Leptosiphon liniflorus*	*Quercus berberidifolia*
Apiastrum angustifolium	*Delphinium patens* ssp. *montanum*	*Leptosiphon parviflorus*	*Quercus chrysolepis*
Apocynum cannabinum	*Dendromecon rigida*	*Leptosyne bigelovii*	*Quercus dumosa*
Aquilegia formosa	*Deschampsia danthonioides*	*Leptosyne gigantea*	*Quercus durata*
Arctostaphylos glandulosa	*Descurainia pinnata*	*Lessingia glandulifera*	*Quercus durata* var. *gabrielensis*
Arctostaphylos glandulosa ssp. *cushingiana*	*Dichelostemma capitatum*	*Lessingia glandulifera* var. *glandulifera**	*Quercus engelmannii*
Arctostaphylos glandulosa ssp. *glandulosa**	*Dichelostemma capitatum ssp. capitatum**	*Lilium humboldtii*	*Quercus lobata*
Arctostaphylos glandulosa ssp. *mollis*	*Dichondra occidentalis*	*Lilium humboldtii* ssp. *ocellatum*	*Quercus wislizeni*
Arctostaphylos glauca	*Dieteria canescens*	*Limonium californicum*	*Quercus wislizeni* var. *frutescens*
Arctostaphylos mewukka	*Distichlis spicata*	*Linanthus californicus*	*Rafinesquia californica*
Arctostaphylos parryana	*Dodecahema leptoceras*	*Linanthus dianthiflorus*	*Ranunculus californicus*
Arctostaphylos pungens	*Drymocallis glandulosa*	*Linanthus pungens*	*Ranunculus californicus* var. *californicus**
Arctostaphylos tomentosa	*Drymocallis glandulosa var. glandulosa**	*Lithophragma affine*	*Ranunculus cymbalaria*
Argemone munita	*Drymocallis glandulosa* var. *reflexa*	*Lithophragma bolanderi*	*Ranunculus hebecarpus*
Aristida adscensionis	*Drymocallis glandulosa* var. *wrangelliana*	*Lithophragma heterophyllum*	*Rhamnus crocea*
Aristida divaricata	*Dryopteris arguta*	*Lobelia dunnii*	*Rhamnus ilicifolia*
Aristida ternipes	*Dudleya cymosa*	*Lobelia dunnii* var. *serrata*	*Rhus aromatica*
Aristida ternipes var. *gentilis*	*Dudleya cymosa ssp. pumila*	*Loeflingia squarrosa*	*Rhus integrifolia*
Artemisia californica	*Dudleya lanceolata*	*Logfia filaginoides*	*Rhus ovata*
Artemisia douglasiana	*Dudleya multicaulis*	*Lomatium dasycarpum*	*Ribes amarum*
Artemisia dracunculus	*Dudleya pulverulenta*	*Lomatium dasycarpum* ssp. *dasycarpum**	*Ribes aureum*
Artemisia tridentata	*Dudleya virens*	*Lomatium lucidum*	*Ribes aureum* var. *gracillimum*
Artemisia tridentata ssp. *tridentata**	*Echinochloa muricata*	*Lomatium utriculatum*	*Ribes californicum*
Arthrocnemum subterminale	*Echinodorus berteroi*	*Lomatium vaginatum*	*Ribes californicum* var. *hesperium*
Asclepias californica	*Eclipta prostrata*	*Lonicera hispidula*	*Ribes divaricatum*
Asclepias eriocarpa	*Ehrendorferia chrysantha*	*Lonicera interrupta*	*Ribes divaricatum* var. *pubiflorum*
Asclepias fascicularis	*Ehrendorferia ochroleuca*	*Lonicera subspicata*	*Ribes indecorum*
Aspidotis californica	*Elatine californica*	*Lonicera subspicata* var. *denudata*	*Ribes malvaceum*
Asplenium vespertinum	*Eleocharis acicularis*	*Lupinus affinis*	*Ribes malvaceum* var. *malvaceum**
Astragalus brauntonii	*Eleocharis macrostachya*	*Lupinus albifrons*	*Ribes malvaceum* var. *viridifolium*
Astragalus didymocarpus	*Eleocharis montevidensis*	*Lupinus albifrons* var. *albifrons**	*Ribes nevadense*
Astragalus didymocarpus var. *didymocarpus**	*Eleocharis parishii*	*Lupinus andersonii*	*Ribes roezlii*
Astragalus douglasii	*Eleocharis radicans*	*Lupinus arboreus*	*Ribes roezlii* var. *roezlii**
Astragalus gambelianus	*Elymus condensatus*	*Lupinus bicolor*	*Ribes speciosum*
Astragalus pycnostachyus	*Elymus elymoides*	*Lupinus chamissonis*	*Romneya coulteri*
Astragalus pycnostachyus var. *lanosissimus*	*Elymus elymoides var. elymoides**	*Lupinus concinnus*	*Romneya trichocalyx*
Astragalus trichopodus	*Elymus glaucus*	*Lupinus excubitus*	*Rorippa curvisiliqua*
Astragalus trichopodus var. *lonchus*	*Elymus glaucus* ssp. *glaucus**	*Lupinus excubitus* var. *austromontanus*	*Rosa californica*
Astragalus trichopodus var. *phoxus*	*Elymus multisetus*	*Lupinus excubitus* var. *excubitus**	*Rosa woodsii*

Athyrium filix-femina	*Elymus triticoides*	*Lupinus excubitus* var. *hallii*	*Rubus leucodermis*
Athyrium filix-femina var. *cyclosorum*	*Emmenanthe penduliflora*	*Lupinus formosus*	*Rubus parviflorus*
Athysanus pusillus	*Emmenanthe penduliflora* var. *penduliflora**	*Lupinus formosus* var. *formosus**	*Rubus ursinus*
Atriplex argentea	*Encelia californica*	*Lupinus formosus* var. *robustus*	*Rumex fueginus*
Atriplex argentea var. *expansa*	*Encelia farinosa*	*Lupinus hirsutissimus*	*Rumex hymenosepalus*
Atriplex canescens	*Ephedra viridis*	*Lupinus latifolius*	*Rumex salicifolius*
Atriplex canescens var. *canescens**	*Epilobium brachycarpum*	*Lupinus latifolius* var. *latifolius**	*Rupertia physodes*
Atriplex coulteri	*Epilobium canum*	*Lupinus latifolius* var. *parishii*	*Sagina decumbens*
Atriplex lentiformis	*Epilobium canum* ssp. *canum**	*Lupinus longifolius*	*Sagina decumbens* ssp. *occidentalis*
Atriplex lentiformis ssp. *breweri*	*Epilobium canum* ssp. *latifolium*	*Lupinus microcarpus*	*Salicornia bigelovii*
Atriplex lentiformis ssp. *lentiformis*	*Epilobium ciliatum*	*Lupinus microcarpus* var. *densiflorus*	*Salix exigua*
Atriplex leucophylla	*Epilobium ciliatum* ssp. *ciliatum**	*Lupinus microcarpus* var. *microcarpus**	*Salix exigua* var. *hindsiana*
Atriplex pacifica	*Epipactis gigantea*	*Lupinus nanus*	*Salix gooddingii*
Atriplex patula	*Equisetum arvense*	*Lupinus sparsiflorus*	*Salix laevigata*
Atriplex serenana	*Equisetum hyemale*	*Lupinus sparsiflorus* ssp. *sparsiflorus**	*Salix lasiandra*
Atriplex serenana var. *davidsonii*	*Equisetum hyemale* ssp. *affine*	*Lupinus succulentus*	*Salix lasiandra* var. *lasiandra**
Atriplex serenana var. *serenana**	*Equisetum laevigatum*	*Lupinus truncatus*	*Salix lasiolepis*
Azolla filiculoides	*Equisetum telmateia*	*Lycium andersonii*	*Saltugilia australis*
Baccharis glutinosa	*Equisetum telmateia* ssp. *braunii*	*Lycium brevipes*	*Saltugilia splendens*
Baccharis pilularis	*Eragrostis mexicana*	*Lycium californicum*	*Saltugilia splendens* ssp. *grantii*
Baccharis pilularis ssp. *consanguinea*	*Eragrostis mexicana* ssp. *virescens*	*Lythrum californicum*	*Saltugilia splendens* ssp. *splendens**
Baccharis plummerae	*Eragrostis pectinacea*	*Madia elegans*	*Salvia apiana*
Baccharis plummerae ssp. *plummerae**	*Eragrostis pectinacea* var. *pectinacea**	*Madia exigua*	*Salvia carduacea*
Baccharis salicifolia	*Eremothera boothii*	*Madia gracilis*	*Salvia columbariae*
Baccharis salicifolia ssp. *salicifolia**	*Eremothera boothii* ssp. *decorticans*	*Madia sativa*	*Salvia leucophylla*
Baccharis salicina	*Eriastrum densifolium*	*Malacothamnus davidsonii*	*Salvia mellifera*
Barbarea orthoceras	*Eriastrum densifolium* ssp. *austromontanum*	*Malacothamnus fasciculatus*	*Salvia spathacea*
Batis maritima	*Eriastrum densifolium* ssp. *densifolium*	*Malacothamnus fasciculatus* var. *fasciculatus**	*Sambucus nigra*
Berberis aquifolium	*Eriastrum densifolium* ssp. *elongatum*	*Malacothamnus fremontii*	*Sambucus nigra* ssp. *caerulea*
Berberis nevinii	*Eriastrum filifolium*	*Malacothrix clevelandii*	*Samolus parviflorus*
Berberis pinnata	*Eriastrum sapphirinum*	*Malacothrix glabrata*	*Sanicula arguta*
Berberis pinnata ssp. *pinnata**	*Eriastrum sapphirinum* ssp. *dasyanthum*	*Malacothrix saxatilis*	*Sanicula bipinnata*
Berula erecta	*Ericameria cooperi*	*Malacothrix saxatilis* var. *tenuifolia*	*Sanicula bipinnatifida*
Bidens frondosa	*Ericameria cooperi* var. *cooperi**	*Malosma laurina*	*Sanicula crassicaulis*
Bidens laevis	*Ericameria cuneata*	*Malva assurgentiflora*	*Sanicula tuberosa*
Blennosperma nanum	*Ericameria cuneata* var. *cuneata**	*Malvella leprosa*	*Schoenoplectus acutus*
Blennosperma nanum var. *nanum**	*Ericameria ericoides*	*Marah fabacea*	*Schoenoplectus acutus* var. *occidentalis*
Bloomeria crocea	*Ericameria linearifolia*	*Marah macrocarpa*	*Schoenoplectus americanus*

Bloomeria crocea var. *crocea**	*Ericameria nauseosa*	*Marsilea vestita*	*Schoenoplectus californicus*
Boechera arcuata	*Ericameria nauseosa* var. *bernardina*	*Matricaria discoidea*	*Schoenoplectus pungens*
Boechera californica	*Ericameria nauseosa* var. *hololeuca*	*Matricaria occidentalis*	*Scirpus microcarpus*
Boechera sparsiflora	*Ericameria nauseosa* var. *mohavensis*	*Meconella denticulata*	*Scrophularia californica*
Bolboschoenus maritimus	*Ericameria palmeri*	*Melica californica*	*Scutellaria siphocampyloides*
Bolboschoenus maritimus ssp. *paludosus*	*Ericameria palmeri* var. *pachylepis*	*Melica imperfecta*	*Scutellaria tuberosa*
Bothriochloa barbinodis	*Ericameria parishii*	*Melica stricta*	*Sedum spathulifolium*
Bowlesia incana	*Ericameria parishii* var. *parishii**	*Mentha canadensis*	*Selaginella asprella*
Boykinia occidentalis	*Ericameria pinifolia*	*Mentzelia affinis*	*Selaginella bigelovii*
Boykinia rotundifolia	*Erigeron canadensis*	*Mentzelia congesta*	*Selaginella cinerascens*
Brickellia californica	*Erigeron foliosus*	*Mentzelia dispersa*	*Senecio aphanactis*
Brickellia nevinii	*Erigeron foliosus* var. *foliosus**	*Mentzelia laevicaulis*	*Senecio californicus*
Brodiaea jolonensis	*Erigeron philadelphicus*	*Mentzelia lindleyi*	*Senecio flaccidus*
Brodiaea terrestris	*Eriodictyon crassifolium*	*Mentzelia micrantha*	*Senecio flaccidus* var. *douglasii*
Brodiaea terrestris ssp. *kernensis*	*Eriodictyon crassifolium* var. *crassifolium**	*Mentzelia montana*	*Sesuvium verrucosum*
Bromus arizonicus	*Eriodictyon crassifolium* var. *nigrescens*	*Mentzelia veatchiana*	*Setaria parviflora*
Bromus carinatus	*Eriodictyon parryi*	*Micranthes californica*	*Sidalcea malviflora*
Bromus carinatus var. *carinatus**	*Eriodictyon trichocalyx*	*Micropus californicus*	*Sidalcea malviflora* ssp. *malviflora**
Bromus grandis	*Eriodictyon trichocalyx var. trichocalyx**	*Micropus californicus* var. *californicus*	*Sidalcea neomexicana*
Bromus laevipes	*Eriogonum angulosum*	*Microseris douglasii*	*Sidalcea sparsifolia*
Calandrinia breweri	*Eriogonum baileyi*	*Microseris douglasii* ssp. *douglasii**	*Sidotheca trilobata*
Calandrinia ciliata	*Eriogonum baileyi* var. *baileyi**	*Microseris douglasii* ssp. *platycarpha*	*Silene antirrhina*
Calandrinia menziesii	*Eriogonum cinereum*	*Microseris elegans*	*Silene laciniata*
Callitriche marginata	*Eriogonum cithariforme*	*Microsteris gracilis*	*Silene laciniata* ssp. *laciniata**
Calocedrus decurrens	*Eriogonum cithariforme* var. *agninum*	*Mimulus aurantiacus*	*Silene lemmonii*
Calochortus albus	*Eriogonum davidsonii*	*Mimulus aurantiacus* var. *aurantiacus**	*Silene parishii*
Calochortus catalinae	*Eriogonum elongatum*	*Mimulus aurantiacus* var. *pubescens*	*Silene verecunda*
Calochortus clavatus	*Eriogonum elongatum* var. *elongatum**	*Mimulus aurantiacus* var. *puniceus*	*Sisyrinchium bellum*
Calochortus clavatus var. *clavatus**	*Eriogonum fasciculatum*	*Mimulus brevipes*	*Solanum americanum*
Calochortus clavatus var. *gracilis*	*Eriogonum fasciculatum* var. *fasciculatum**	*Mimulus cardinalis*	*Solanum douglasii*
Calochortus clavatus var. *pallidus*	*Eriogonum fasciculatum* var. *foliolosum*	*Mimulus floribundus*	*Solanum umbelliferum*
Calochortus fimbriatus	*Eriogonum fasciculatum* var. *polifolium*	*Mimulus fremontii*	*Solanum xanti*
Calochortus plummerae	*Eriogonum gracile*	*Mimulus fremontii* var. *fremontii**	*Solidago confinis*
Calochortus splendens	*Eriogonum gracile* var. *gracile**	*Mimulus guttatus*	*Solidago velutina*
Calochortus venustus	*Eriogonum gracillimum*	*Mimulus johnstonii*	*Solidago velutina* ssp. *californica*
Calochortus weedii	*Eriogonum hirtiflorum*	*Mimulus palmeri*	*Sparganium eurycarpum* var. *greenei*
Calochortus weedii var. *intermedius*	*Eriogonum nudum*	*Mimulus parishii*	*Spartina foliosa*

Calyptridium monandrum	*Eriogonum nudum* var. *deductum*	*Mimulus pilosus*	*Spergularia macrotheca*
Calystegia longipes	*Eriogonum nudum* var. *pauciflorum*	*Minuartia douglasii*	*Spergularia macrotheca* var. *leucantha*
Calystegia macrostegia	*Eriogonum parvifolium*	*Mirabilis laevis*	*Sporobolus airoides*
Calystegia macrostegia ssp. *arida*	*Eriogonum roseum*	*Mirabilis laevis* var. *crassifolia*	*Sporobolus cryptandrus*
Calystegia macrostegia ssp. *cyclostegia*	*Eriogonum saxatile*	*Mirabilis multiflora*	*Stachys ajugoides*
Calystegia macrostegia ssp. *intermedia*	*Eriogonum thurberi*	*Mirabilis multiflora* var. *pubescens*	*Stachys albens*
Calystegia macrostegia ssp. *macrostegia**	*Eriogonum umbellatum*	*Monardella breweri*	*Stachys bullata*
Calystegia occidentalis	*Eriogonum umbellatum* var. *munzii*	*Monardella breweri ssp. lanceolata*	*Stachys rigida*
Calystegia occidentalis ssp. *fulcrata*	*Eriogonum wrightii*	*Monardella hypoleuca*	*Stachys rigida* var. *quercetorum*
Calystegia peirsonii	*Eriogonum wrightii* var. *subscaposum*	*Monolepis nuttalliana*	*Stachys rigida* var. *rigida*
Calystegia sepium	*Eriophyllum confertiflorum*	*Monolopia lanceolata*	*Stanleya pinnata*
Calystegia sepium ssp. *binghamiae*	*Eriophyllum confertiflorum* var. *confertiflorum**	*Morella californica*	*Stanleya pinnata* var. *pinnata*
Calystegia sepium ssp. *limnophila*	*Eriophyllum wallacei*	*Mucronea californica*	*Stebbinsoseris heterocarpa*
Calystegia soldanella	*Eryngium aristulatum*	*Muhlenbergia asperifolia*	*Stellaria nitens*
Camissonia campestris	*Eryngium aristulatum* var. *parishii*	*Muhlenbergia californica*	*Stephanomeria cichoriacea*
Camissonia campestris ssp. *campestris**	*Erysimum capitatum*	*Muhlenbergia microsperma*	*Stephanomeria diegensis*
Camissonia strigulosa	*Erysimum capitatum* var. *capitatum**	*Muhlenbergia rigens*	*Stephanomeria exigua*
Camissoniopsis bistorta	*Erysimum insulare*	*Muilla maritima*	*Stephanomeria exigua* ssp. *coronaria*
Camissoniopsis cheiranthifolia	*Erysimum suffrutescens*	*Myriopteris covillei*	*Stephanomeria exigua* ssp. *deanei*
Camissoniopsis cheiranthifolia ssp. *suffruticosa*	*Eschscholzia caespitosa*	*Najas guadalupensis*	*Stephanomeria exigua* ssp. *exigua**
Camissoniopsis confusa	*Eschscholzia californica*	*Nama californica*	*Stephanomeria pauciflora*
Camissoniopsis hirtella	*Eschscholzia californica ssp. californica**	*Nasturtium officinale*	*Stephanomeria virgata*
Camissoniopsis intermedia	*Eschscholzia hypecoides*	*Navarretia atractyloides*	*Stephanomeria virgata* ssp. *pleurocarpa*
Camissoniopsis lewisii	*Eucrypta chrysanthemifolia*	*Navarretia fossalis*	*Stephanomeria virgata* ssp. *virgata**
Camissoniopsis micrantha	*Eucrypta chrysanthemifolia* var. *chrysanthemifolia**	*Navarretia hamata*	*Stillingia linearifolia*
Cardamine californica	*Eulobus californicus*	*Navarretia hamata* ssp. *hamata**	*Stipa cernua*
Cardamine oligosperma	*Euphorbia albomarginata*	*Navarretia hamata* ssp. *parviloba*	*Stipa coronata*
Cardionema ramosissimum	*Euphorbia melanadenia*	*Navarretia ojaiensis*	*Stipa hymenoides*
Carex alma	*Euphorbia polycarpa*	*Navarretia prostrata*	*Stipa lepida*
Carex barbarae	*Euphorbia serpyllifolia*	*Nemacaulis denudata*	*Stipa occidentalis*
Carex densa	*Euphorbia spathulata*	*Nemacaulis denudata* var. *denudata**	*Stipa Pulchra*
Carex fracta	*Euthamia occidentalis*	*Nemacladus longiflorus*	*Stipa speciosa*
Carex multicaulis	*Extriplex californica*	*Nemacladus longiflorus* var. *longiflorus**	*Stuckenia pectinata*
Carex pellita	*Festuca californica*	*Nemacladus pinnatifidus*	*Stylocline gnaphaloides*
Carex praegracilis	*Festuca microstachys*	*Nemacladus ramosissimus*	*Styrax redivivus*
Carex schottii	*Festuca octoflora*	*Nemacladus sigmoideus*	*Suaeda calceoliformis*
Carex senta	*Frangula californica*	*Nemophila menziesii*	*Suaeda californica*

Carex spissa	*Frangula californica* ssp. *californica**	*Nemophila menziesii* var. *integrifolia*	*Suaeda esteroa*
Carex subfusca	*Frangula californica* ssp. *cuspidata*	*Nemophila menziesii* var. *menziesii**	*Suaeda nigra*
Carex triquetra	*Frangula californica* ssp. *tomentella*	*Nemophila pedunculata*	*Suaeda taxifolia*
Castilleja affinis	*Frankenia salina*	*Nemophila pulchella*	*Symphoricarpos albus*
Castilleja affinis ssp. *affinis**	*Fraxinus dipetala*	*Nemophila spatulata*	*Symphoricarpos albus* var. *laevigatus*
Castilleja applegatei	*Fraxinus latifolia*	*Nicotiana attenuata*	*Symphoricarpos mollis*
Castilleja exserta	*Fraxinus velutina*	*Nicotiana clevelandii*	*Symphyotrichum defoliatum*
Castilleja exserta ssp. *exserta**	*Fremontodendron californicum*	*Nicotiana quadrivalvis*	*Symphyotrichum greatae*
Castilleja foliolosa	*Fritillaria biflora*	*Nitrophila occidentalis*	*Symphyotrichum lanceolatum*
Castilleja gleasoni	*Fritillaria biflora* var. *biflora**	*Notholaena californica*	*Symphyotrichum lanceolatum var. hesperium*
Castilleja linariifolia	*Funastrum cynanchoides*	*Nuttallanthus texanus*	*Symphyotrichum subulatum*
Castilleja miniata	*Funastrum cynanchoides* var. *hartwegii*	*Oenanthe sarmentosa*	*Symphyotrichum subulatum* var. *parviflorum*
Castilleja miniata ssp. *miniata**	*Galium andrewsii*	*Oenothera californica*	*Syntrichopappus lemmonii*
Castilleja minor	*Galium angustifolium*	*Oenothera californica* ssp. *californica**	*Tauschia arguta*
Castilleja minor ssp. *spiralis*	*Galium angustifolium* ssp. *angustifolium**	*Oenothera elata*	*Tauschia hartwegii*
Castilleja subinclusa	*Galium aparine*	*Oenothera elata* ssp. *hirsutissima*	*Tauschia parishii*
Caulanthus amplexicaulis	*Galium cliftonsmithii*	*Oligomeris linifolia*	*Tetradymia canescens*
Caulanthus coulteri	*Galium grande*	*Opuntia littoralis*	*Tetradymia comosa*
Caulanthus heterophyllus	*Galium johnstonii*	*Opuntia oricola*	*Thalictrum fendleri*
Caulanthus lasiophyllus	*Galium nuttallii*	*Opuntia phaeacantha*	*Thalictrum fendleri* var. *fendleri**
Ceanothus crassifolius	*Galium porrigens*	*Orobanche bulbosa*	*Thalictrum fendleri* var. *polycarpum*
Ceanothus crassifolius var. *crassifolius**	*Galium porrigens* var. *porrigens**	*Orobanche californica*	*Thysanocarpus curvipes*
Ceanothus cuneatus	*Galium trifidum*	*Orobanche fasciculata*	*Thysanocarpus laciniatus*
Ceanothus cuneatus var. *cuneatus**	*Garrya flavescens*	*Orobanche parishii*	*Toxicodendron diversilobum*
Ceanothus cyaneus	*Garrya veatchii*	*Orobanche parishii* ssp. *parishii**	*Toxicoscordion fremontii*
Ceanothus greggii	*Gayophytum diffusum*	*Osmadenia tenella*	*Trichostema lanatum*
Ceanothus integerrimus	*Gayophytum diffusum* ssp. *parviflorum*	*Osmorhiza brachypoda*	*Trichostema lanceolatum*
Ceanothus integerrimus var. *macrothyrsus*	*Gayophytum heterozygum*	*Oxalis californica*	*Trichostema parishii*
Ceanothus leucodermis	*Gayophytum oligospermum*	*Oxalis pilosa*	*Trifolium albopurpureum*
Ceanothus megacarpus	*Geranium carolinianum*	*Packera breweri*	*Trifolium bifidum*
Ceanothus megacarpus var. *megacarpus**	*Gilia achilleifolia*	*Packera ionophylla*	*Trifolium bifidum* var. *decipiens*
Ceanothus oliganthus	*Gilia achilleifolia* ssp. *achilleifolia**	*Paeonia californica*	*Trifolium ciliolatum*
Ceanothus oliganthus var. *oliganthus**	*Gilia achilleifolia* ssp. *multicaulis*	*Panicum acuminatum*	*Trifolium depauperatum*
Ceanothus spinosus	*Gilia angelensis*	*Panicum capillare*	*Trifolium depauperatum* var. *truncatum*
Ceanothus thyrsiflorus	*Gilia brecciarum*	*Papaver californicum*	*Trifolium fucatum*
Ceanothus vestitus	*Gilia brecciarum* ssp. *brecciarum**	*Parietaria hespera*	*Trifolium gracilentum*
Centromadia parryi	*Gilia capitata*	*Parietaria hespera* var. *californica*	*Trifolium microcephalum*

Centromadia parryi ssp. *australis*	*Gilia capitata* ssp. *abrotanifolia*	*Parietaria hespera* var. *hespera**	*Trifolium obtusiflorum*
Centromadia pungens	*Gilia clivorum*	*Paspalum distichum*	*Trifolium variegatum*
Centromadia pungens ssp. *laevis*	*Gilia diegensis*	*Pectocarya linearis*	*Trifolium willdenovii*
Cercis occidentalis	*Gilia inconspicua*	*Pectocarya linearis* ssp. *ferocula*	*Trifolium wormskioldii*
Cercocarpus betuloides	*Gilia latiflora*	*Pectocarya penicillata*	*Triglochin maritima*
Cercocarpus betuloides var. *betuloides**	*Gilia leptantha*	*Pectocarya setosa*	*Triodanis biflora*
Cercocarpus betuloides var. *blancheae*	*Gilia minor*	*Pedicularis densiflora*	*Triteleia ixioides*
Cercocarpus ledifolius	*Gilia ochroleuca*	*Pellaea andromedifolia*	*Tropidocarpum gracile*
Chaenactis artemisiifolia	*Gilia ochroleuca* ssp. *bizonata*	*Pellaea mucronata*	*Turritis glabra*
Chaenactis glabriuscula	*Gilia tricolor*	*Pellaea mucronata* var. *californica*	*Typha domingensis*
Chaenactis glabriuscula var. *glabriuscula**	*Githopsis diffusa*	*Pellaea mucronata* var. *mucronata**	*Typha latifolia*
Chaenactis glabriuscula var. *lanosa*	*Githopsis diffusa* ssp. *diffusa**	*Penstemon centranthifolius*	*Umbellularia californica*
Chaenactis glabriuscula var. *orcuttiana*	*Gnaphalium palustre*	*Penstemon grinnellii*	*Uropappus lindleyi*
Chaenactis santolinoides	*Grindelia camporum*	*Penstemon grinnellii* var. *grinnellii**	*Urtica dioica*
Chamerion latifolium	*Gutierrezia californica*	*Penstemon heterophyllus*	*Urtica dioica* ssp. *holosericea*
Chenopodium atrovirens	*Gutierrezia sarothrae*	*Penstemon heterophyllus* var. *australis*	*Venegasia carpesioides*
Chenopodium berlandieri	*Harpagonella palmeri*	*Penstemon heterophyllus* var. *heterophyllus**	*Verbena bracteata*
Chenopodium californicum	*Hazardia squarrosa*	*Penstemon labrosus*	*Verbena lasiostachys*
Chenopodium desiccatum	*Hazardia squarrosa* var. *grindelioides*	*Penstemon rostriflorus*	*Verbena lasiostachys* var. *lasiostachys**
Chenopodium fremontii	*Hazardia squarrosa* var. *squarrosa**	*Penstemon spectabilis*	*Verbena lasiostachys* var. *scabrida*
Chlorogalum pomeridianum	*Helenium puberulum*	*Penstemon spectabilis* var. *subviscosus*	*Veronica americana*
Chlorogalum pomeridianum var. *pomeridianum**	*Helianthus annuus*	*Pentachaeta aurea*	*Veronica peregrina*
Chloropyron maritimum	*Helianthus gracilentus*	*Pentagramma triangularis*	*Veronica peregrina* ssp. *xalapensis*
Chloropyron maritimum ssp. *maritimum**	*Helianthus nuttallii*	*Pentagramma triangularis* ssp. *triangularis**	*Veronica serpyllifolia*
Chorizanthe parryi	*Heliotropium curassavicum*	*Perideridia parishii*	*Vicia americana*
Chorizanthe parryi var. *fernandina*	*Heliotropium curassavicum* var. *oculatum*	*Perideridia parishii* ssp. *latifolia*	*Vicia americana* ssp. *americana**
Chorizanthe parryi var. *parryi**	*Hemizonia congesta*	*Peritoma arborea*	*Vicia hassei*
Chorizanthe procumbens	*Hesperocnide tenella*	*Peritoma arborea* var. *angustata*	*Vicia ludoviciana*
Chorizanthe staticoides	*Hesperolinon micranthum*	*Peritoma arborea var. arborea**	*Vicia ludoviciana* ssp. *ludoviciana**
Chorizanthe xanti	*Hesperoyucca whipplei*	*Peritoma arborea* var. *globosa*	*Viola pedunculata*
Chorizanthe xanti var. *xanti**	*Heterocodon rariflorum*	*Perityle emoryi*	*Viola purpurea*
Chrysolepis sempervirens	*Heteromeles arbutifolia*	*Persicaria hydropiperoides*	*Viola purpurea* ssp. *purpurea**
Cicuta maculata	*Heterotheca grandiflora*	*Persicaria lapathifolia*	*Vitis girdiana*
Cicuta maculata var. *bolanderi*	*Heterotheca sessiliflora*	*Persicaria punctata*	*Woodwardia fimbriata*
Cirsium brevistylum	*Heterotheca sessiliflora* ssp. *echioides*	*Petunia parviflora*	*Xanthium strumarium*
Cirsium occidentale	*Heterotheca sessiliflora* ssp. *fastigiata*	*Phacelia affinis*	*Xylococcus bicolor*

Cirsium occidentale var. *californicum*	*Heterotheca subaxillaris*	*Phacelia brachyloba*	*Yabea microcarpa*
Cirsium occidentale var. *occidentale**	*Heuchera caespitosa*	*Phacelia campanularia*	*Zannichellia palustris*
Cirsium occidentale var. *venustum*	*Heuchera parishii*	*Phacelia cicutaria*	*Zeltnera venusta*
Clarkia bottae	*Heuchera rubescens*	*Phacelia cicutaria* var. *hispida*	
Clarkia cylindrica	*Hieracium argutum*	*Phacelia cryptantha*	
Clarkia cylindrica ssp. *cylindrica**	*Hieracium horridum*	*Phacelia curvipes*	
Clarkia dudleyana	*Hoffmannseggia glauca*	*Phacelia davidsonii*	
Clarkia epilobioides	*Hoita macrostachya*	*Phacelia distans*	
Clarkia purpurea	*Holodiscus discolor*	*Phacelia douglasii*	
Clarkia purpurea ssp. *quadrivulnera*	*Holodiscus discolor* var. *discolor**	*Phacelia fremontii*	
Clarkia purpurea ssp. *viminea*	*Holodiscus discolor* var. *microphyllus*	*Phacelia grandiflora*	
Clarkia rhomboidea	*Hordeum brachyantherum*	*Phacelia hubbyi*	
Clarkia similis	*Hordeum brachyantherum* ssp. *brachyantherum**	*Phacelia imbricata*	
Clarkia unguiculata	*Hordeum brachyantherum* ssp. *californicum*	*Phacelia imbricata* var. *imbricata**	
Claytonia parviflora	*Hordeum depressum*	*Phacelia imbricata* var. *patula*	
Claytonia parviflora ssp. *parviflora**	*Hordeum intercedens*	*Phacelia longipes*	
Claytonia parviflora ssp. *utahensis*	*Horkelia cuneata*	*Phacelia minor*	
Claytonia parviflora ssp. *viridis*	*Horkelia cuneata* var. *puberula*	*Phacelia parryi*	
Claytonia perfoliata	*Hosackia crassifolia*	*Phacelia ramosissima*	
Claytonia perfoliata ssp. *mexicana*	*Hosackia crassifolia* var. *crassifolia**	*Phacelia stellaris*	
Claytonia perfoliata ssp. *perfoliata**	*Hosackia oblongifolia*	*Phacelia tanacetifolia*	

Table 4.4: Potential native plants in Los Angeles based on Calscape that are not listed in Calflora. These species may be present in the City of Los Angeles based on Calscape habitat suitability estimates.

Abies concolor	*Collomia grandiflora*	*Hydrocotyle verticillata*	*Phacelia affinis*
Abronia maritima	*Comarostaphylis diversifolia* ssp. *planifolia*	*Imperata brevifolia*	*Phacelia brachyloba*
Abutilon palmeri	*Convolvulus simulans*	*Isocoma menziesii* var. *decumbens*	*Phacelia campanularia*
Acanthomintha ilicifolia	*Cordylanthus rigidus*	*Isocoma menziesii* var. *sedoides*	*Phacelia cicutaria* var. *hispida*
Acer negundo	*Cordylanthus rigidus ssp. setiger*	*Isocoma menziesii* var. *vernonioides*	*Phacelia cryptantha*
Acmispon heermannii	*Cornus glabrata*	*Isolepis cernua*	*Phacelia curvipes*
Acmispon strigosus	*Cornus sericea*	*Iva axillaris*	*Phacelia davidsonii*
Adenostoma sparsifolium	*Cornus sericea* ssp. *occidentalis*	*Jaumea carnosa*	*Phacelia douglasii*
Agoseris grandiflora	*Cressa truxillensis*	*Juglans hindsii*	*Phacelia fremontii*
Agoseris retrorsa	*Crocanthemum scoparium*	*Juncus acutus* ssp. *leopoldii*	*Phacelia imbricata*
Agrostis exarata	*Cryptantha barbigera*	*Juncus balticus*	*Phacelia imbricata* var. *patula*
Agrostis pallens	*Cryptantha circumscissa*	*Juncus bufonius* var. *occidentalis*	*Phacelia parryi*
Alisma triviale	*Cryptantha clevelandii* var. *florosa*	*Juncus macrophyllus*	*Phacelia stellaris*
Allium haematochiton	*Cryptantha clokeyi*	*Juncus mexicanus*	*Phalaris lemmonii*
Allium monticola	*Cryptantha decipiens*	*Juncus occidentalis*	*Pholisma arenarium*
Allophyllum divaricatum	*Cryptantha flaccida*	*Juncus phaeocephalus*	*Phragmites australis*
Allophyllum gilioides	*Cryptantha leiocarpa*	*Juncus phaeocephalus* var. *paniculatus*	*Phyla lanceolata*
Allophyllum gilioides ssp. *violaceum*	*Cryptantha micrantha*	*Juncus rugulosus*	*Phyllospadix scouleri*
Amaranthus powellii	*Cryptantha muricata* var. *denticulata*	*Juncus textilis*	*Pickeringia montana*
Amblyopappus pusillus	*Cryptantha muricata* var. *jonesii*	*Juncus tiehmii*	*Pinus attenuata*
Ambrosia chamissonis	*Cryptantha nevadensis*	*Juncus xiphioides*	*Pinus contorta*
Ammannia robusta	*Cryptantha nevadensis* var. *rigida*	*Juniperus californica*	*Pinus coulteri*
Amorpha californica	*Cryptantha oxygona*	*Keckiella antirrhinoides*	*Pinus lambertiana*
Amsinckia douglasiana	*Cryptantha similis*	*Keckiella breviflora*	*Pinus monophylla*
Amsinckia eastwoodiae	*Cryptantha simulans*	*Keckiella ternata*	*Pinus ponderosa*
Amsinckia retrorsa	*Cupressus arizonica*	*Keckiella ternata var. septentrionalis*	*Piperia cooperi*
Amsinckia spectabilis	*Cuscuta campestris*	*Koeleria macrantha*	*Plagiobothrys acanthocarpus*
Amsinckia tessellata	*Cuscuta indecora*	*Laennecia coulteri*	*Plagiobothrys arizonicus*
Ancistrocarphus filagineus	*Cuscuta salina*	*Lagophylla ramosissima*	*Plagiobothrys collinus*
Andropogon glomeratus	*Cylindropuntia californica*	*Lastarriaea coriacea*	*Plagiobothrys collinus* var. *fulvescens*
Andropogon glomeratus var. *scabriglumis*	*Cylindropuntia californica* var. *parkeri*	*Lasthenia coronaria*	*Plagiobothrys tenellus*
Antirrhinum kelloggii	*Cyperus eragrostis*	*Lasthenia glabrata*	*Plantago elongata*
Antirrhinum multiflorum	*Cyperus erythrorhizos*	*Lasthenia glabrata* ssp. *coulteri*	*Plantago ovata*

Antirrhinum nuttallianum	*Cyperus laevigatus*	*Lasthenia gracilis*	*Plantago patagonica*
Antirrhinum nuttallianum ssp. *subsessile*	*Cyperus niger*	*Layia glandulosa*	*Plantago subnuda*
Aphanisma blitoides	*Cyperus odoratus*	*Layia hieracioides*	*Plectritis ciliosa*
Apocynum cannabinum	*Cystopteris fragilis*	*Lemna gibba*	*Pluchea odorata*
Aquilegia formosa	*Datisca glomerata*	*Lemna minor*	*Poa howellii*
Arctostaphylos glandulosa ssp. *cushingiana*	*Deinandra paniculata*	*Lemna valdiviana*	*Polygala cornuta* var. *fishiae*
Arctostaphylos glandulosa ssp. *mollis*	*Delphinium parishii*	*Lepechinia fragrans*	*Polystichum imbricans*
Arctostaphylos mewukka	*Delphinium parryi* ssp. *maritimum*	*Lepidium densiflorum*	*Polystichum imbricans* ssp. *curtum*
Arctostaphylos parryana	*Delphinium patens* ssp. *hepaticoideum*	*Lepidium lasiocarpum*	*Polystichum munitum*
Arctostaphylos pungens	*Delphinium patens* ssp. *montanum*	*Lepidium latipes*	*Potamogeton foliosus*
Arctostaphylos tomentosa	*Deschampsia danthonioides*	*Lepidium oblongum*	*Potentilla anserina*
Aristida adscensionis	*Dichondra occidentalis*	*Lepidium strictum*	*Potentilla anserina* ssp. *pacifica*
Aristida divaricata	*Dieteria canescens*	*Lepidium virginicum*	*Primula clevelandii* var. *gracilis*
Aristida ternipes	*Distichlis spicata*	*Leptochloa fusca*	*Pseudognaphalium beneolens*
Aristida ternipes var. *gentilis*	*Dodecahema leptoceras*	*Leptochloa fusca ssp. fascicularis*	*Pseudognaphalium leucocephalum*
Artemisia tridentata	*Drymocallis glandulosa*	*Leptochloa fusca* ssp. *uninervia*	*Pseudognaphalium ramosissimum*
Arthrocnemum subterminale	*Drymocallis glandulosa* var. *reflexa*	*Leptosiphon androsaceus*	*Pseudognaphalium stramineum*
Asclepias californica	*Drymocallis glandulosa* var. *wrangelliana*	*Leptosiphon aureus*	*Pseudotsuga macrocarpa*
Asplenium vespertinum	*Dudleya cymosa*	*Leptosiphon breviculus*	*Psilocarphus brevissimus*
Astragalus didymocarpus	*Dudleya cymosa ssp. pumila*	*Leptosiphon ciliatus*	*Pteridium aquilinum* var. *pubescens*
Astragalus douglasii	*Dudleya multicaulis*	*Leptosiphon liniflorus*	*Purshia tridentata*
Astragalus gambelianus	*Echinochloa muricata*	*Leptosyne bigelovii*	*Pycnanthemum californicum*
Astragalus pycnostachyus	*Echinodorus berteroi*	*Leptosyne gigantea*	*Quercus dumosa*
Astragalus pycnostachyus var. *lanosissimus*	*Eclipta prostrata*	*Lessingia glandulifera*	*Quercus durata*
Astragalus trichopodus var. *lonchus*	*Ehrendorferia chrysantha*	*Lilium humboldtii* ssp. *ocellatum*	*Quercus durata* var. *gabrielensis*
Astragalus trichopodus var. *phoxus*	*Elatine californica*	*Limonium californicum*	*Quercus engelmannii*
Athyrium filix-femina	*Eleocharis acicularis*	*Linanthus pungens*	*Quercus wislizeni* var. *frutescens*
Athyrium filix-femina var. *cyclosorum*	*Eleocharis macrostachya*	*Lithophragma bolanderi*	*Ranunculus cymbalaria*
Athysanus pusillus	*Elymus elymoides*	*Lithophragma heterophyllum*	*Ribes amarum*
Atriplex argentea	*Elymus multisetus*	*Lobelia dunnii*	*Ribes aureum* var. *gracillimum*
Atriplex argentea var. *expansa*	*Elymus triticoides*	*Lobelia dunnii* var. *serrata*	*Ribes californicum* var. *hesperium*
Atriplex coulteri	*Ephedra viridis*	*Loeflingia squarrosa*	*Ribes divaricatum*
Atriplex lentiformis ssp. *breweri*	*Epilobium brachycarpum*	*Logfia filaginoides*	*Ribes divaricatum* var. *pubiflorum*
Atriplex lentiformis ssp. *lentiformis*	*Epilobium canum* ssp. *latifolium*	*Lomatium utriculatum*	*Ribes malvaceum* var. *viridifolium*
Atriplex leucophylla	*Equisetum hyemale*	*Lomatium vaginatum*	*Ribes nevadense*

Atriplex pacifica	*Equisetum telmateia* ssp. *braunii*	*Lonicera hispidula*	*Ribes roezlii*
Atriplex patula	*Eragrostis mexicana* ssp. *virescens*	*Lonicera interrupta*	*Romneya coulteri*
Atriplex serenana	*Eragrostis pectinacea*	*Lonicera subspicata* var. *denudata*	*Romneya trichocalyx*
Atriplex serenana var. *davidsonii*	*Eremothera boothii* ssp. *decorticans*	*Lupinus affinis*	*Rorippa curvisiliqua*
Azolla filiculoides	*Eriastrum densifolium*	*Lupinus albifrons*	*Rosa woodsii*
Baccharis glutinosa	*Eriastrum densifolium* ssp. *austromontanum*	*Lupinus andersonii*	*Rubus leucodermis*
Baccharis pilularis ssp. *consanguinea*	*Eriastrum densifolium* ssp. *densifolium*	*Lupinus arboreus*	*Rubus parviflorus*
Baccharis salicina	*Eriastrum densifolium* ssp. *elongatum*	*Lupinus chamissonis*	*Rumex hymenosepalus*
Barbarea orthoceras	*Eriastrum filifolium*	*Lupinus concinnus*	*Rumex salicifolius*
Batis maritima	*Eriastrum sapphirinum* ssp. *dasyanthum*	*Lupinus excubitus*	*Sagina decumbens*
Berberis aquifolium	*Ericameria cooperi*	*Lupinus excubitus* var. *austromontanus*	*Sagina decumbens* ssp. *occidentalis*
Berberis pinnata	*Ericameria cuneata*	*Lupinus excubitus* var. *hallii*	*Salicornia bigelovii*
Berula erecta	*Ericameria ericoides*	*Lupinus formosus* var. *robustus*	*Salix exigua*
Blennosperma nanum	*Ericameria linearifolia*	*Lupinus latifolius*	*Salix exigua* var. *hindsiana*
Boechera arcuata	*Ericameria nauseosa*	*Lupinus latifolius* var. *parishii*	*Salix lasiandra*
Boechera californica	*Ericameria nauseosa* var. *bernardina*	*Lupinus microcarpus*	*Saltugilia australis*
Boechera sparsiflora	*Ericameria nauseosa* var. *hololeuca*	*Lupinus microcarpus* var. *densiflorus*	*Saltugilia splendens*
Bolboschoenus maritimus	*Ericameria nauseosa* var. *mohavensis*	*Lupinus nanus*	*Saltugilia splendens* ssp. *grantii*
Bolboschoenus maritimus ssp. *paludosus*	*Ericameria palmeri* var. *pachylepis*	*Lycium andersonii*	*Salvia carduacea*
Boykinia rotundifolia	*Erigeron philadelphicus*	*Lycium brevipes*	*Sanicula bipinnata*
Brodiaea jolonensis	*Eriodictyon crassifolium* var. *nigrescens*	*Lycium californicum*	*Sanicula bipinnatifida*
Brodiaea terrestris	*Eriodictyon parryi*	*Lythrum californicum*	*Schoenoplectus acutus*
Brodiaea terrestris ssp. *kernensis*	*Eriodictyon trichocalyx*	*Madia elegans*	*Schoenoplectus acutus* var. *occidentalis*
Bromus grandis	*Eriogonum angulosum*	*Madia exigua*	*Schoenoplectus californicus*
Calandrinia breweri	*Eriogonum baileyi*	*Malacothamnus fremontii*	*Schoenoplectus pungens*
Callitriche marginata	*Eriogonum cithariforme*	*Malacothrix glabrata*	*Scirpus microcarpus*
Calocedrus decurrens	*Eriogonum cithariforme* var. *agninum*	*Malva assurgentiflora*	*Scutellaria siphocampyloides*
Calochortus albus	*Eriogonum davidsonii*	*Marsilea vestita*	*Sedum spathulifolium*
Calochortus clavatus var. *pallidus*	*Eriogonum fasciculatum* var. *foliolosum*	*Matricaria occidentalis*	*Selaginella asprella*
Calochortus fimbriatus	*Eriogonum gracillimum*	*Melica stricta*	*Selaginella cinerascens*
Calochortus splendens	*Eriogonum hirtiflorum*	*Mentha canadensis*	*Senecio aphanactis*
Calochortus weedii var. *intermedius*	*Eriogonum nudum*	*Mentzelia affinis*	*Senecio californicus*
Calyptridium monandrum	*Eriogonum nudum* var. *deductum*	*Mentzelia congesta*	*Senecio flaccidus* var. *douglasii*
Calystegia longipes	*Eriogonum nudum* var. *pauciflorum*	*Mentzelia dispersa*	*Sesuvium verrucosum*
Calystegia macrostegia ssp. *arida*	*Eriogonum roseum*	*Mentzelia lindleyi*	*Setaria parviflora*

Calystegia macrostegia ssp. *cyclostegia*	*Eriogonum saxatile*	*Mentzelia montana*	*Sidalcea malviflora*
Calystegia occidentalis	*Eriogonum thurberi*	*Mentzelia veatchiana*	*Sidalcea neomexicana*
Calystegia occidentalis ssp. *fulcrata*	*Eriogonum umbellatum*	*Micranthes californica*	*Sidalcea sparsifolia*
Calystegia peirsonii	*Eriogonum umbellatum* var. *munzii*	*Micropus californicus*	*Sidotheca trilobata*
Calystegia sepium	*Eriogonum wrightii*	*Microseris douglasii*	*Silene lemmonii*
Calystegia sepium ssp. *binghamiae*	*Eriogonum wrightii* var. *subscaposum*	*Microseris douglasii* ssp. *platycarpha*	*Silene parishii*
Calystegia sepium ssp. *limnophila*	*Eriophyllum wallacei*	*Microseris elegans*	*Silene verecunda*
Calystegia soldanella	*Eryngium aristulatum*	*Mimulus aurantiacus* var. *pubescens*	*Solidago confinis*
Camissonia campestris	*Eryngium aristulatum* var. *parishii*	*Mimulus aurantiacus* var. *puniceus*	*Solidago velutina*
Camissonia strigulosa	*Erysimum capitatum*	*Mimulus fremontii*	*Sparganium eurycarpum* var. *greenei*
Camissoniopsis bistorta	*Erysimum insulare*	*Mimulus johnstonii*	*Spartina foliosa*
Camissoniopsis cheiranthifolia	*Erysimum suffrutescens*	*Mimulus palmeri*	*Spergularia macrotheca*
Camissoniopsis cheiranthifolia ssp. *suffruticosa*	*Eschscholzia hypecoides*	*Mimulus parishii*	*Spergularia macrotheca* var. *leucantha*
Camissoniopsis confusa	*Euphorbia polycarpa*	*Mimulus pilosus*	*Sporobolus airoides*
Camissoniopsis intermedia	*Euphorbia serpyllifolia*	*Minuartia douglasii*	*Sporobolus cryptandrus*
Camissoniopsis lewisii	*Euphorbia spathulata*	*Mirabilis laevis* var. *crassifolia*	*Stachys ajugoides*
Cardamine oligosperma	*Euthamia occidentalis*	*Mirabilis multiflora*	*Stachys rigida* var. *quercetorum*
Cardionema ramosissimum	*Extriplex californica*	*Mirabilis multiflora* var. *pubescens*	*Stachys rigida* var. *rigida*
Carex alma	*Festuca californica*	*Monardella breweri*	*Stanleya pinnata*
Carex barbarae	*Festuca microstachys*	*Monardella breweri ssp. lanceolata*	*Stanleya pinnata* var. *pinnata*
Carex densa	*Frangula californica* ssp. *cuspidata*	*Monardella hypoleuca*	*Stellaria nitens*
Carex fracta	*Frangula californica* ssp. *tomentella*	*Monolepis nuttalliana*	*Stephanomeria exigua* ssp. *coronaria*
Carex multicaulis	*Frankenia salina*	*Morella californica*	*Stephanomeria exigua* ssp. *deanei*
Carex pellita	*Fraxinus latifolia*	*Mucronea californica*	*Stephanomeria pauciflora*
Carex praegracilis	*Fremontodendron californicum*	*Muhlenbergia asperifolia*	*Stephanomeria virgata* ssp. *pleurocarpa*
Carex schottii	*Funastrum cynanchoides* var. *hartwegii*	*Muhlenbergia californica*	*Stillingia linearifolia*
Carex spissa	*Galium andrewsii*	*Muilla maritima*	*Stipa cernua*
Carex subfusca	*Galium cliftonsmithii*	*Myriopteris covillei*	*Stipa hymenoides*
Castilleja gleasoni	*Galium grande*	*Najas guadalupensis*	*Stipa lepida*
Castilleja linariifolia	*Galium johnstonii*	*Nama californica*	*Stipa occidentalis*
Castilleja miniata	*Galium porrigens*	*Navarretia atractyloides*	*Stipa pulchra*
Castilleja minor	*Galium trifidum*	*Navarretia fossalis*	*Stipa speciosa*
Castilleja minor ssp. *spiralis*	*Garrya flavescens*	*Navarretia hamata*	*Stuckenia pectinata*
Castilleja subinclusa	*Gayophytum diffusum*	*Navarretia hamata* ssp. *parviloba*	*Stylocline gnaphaloides*
Caulanthus amplexicaulis	*Gayophytum diffusum* ssp. *parviflorum*	*Navarretia ojaiensis*	*Styrax redivivus*

Caulanthus coulteri	*Gayophytum heterozygum*	*Navarretia prostrata*	*Suaeda californica*
Caulanthus lasiophyllus	*Gayophytum oligospermum*	*Nemacaulis denudata*	*Suaeda esteroa*
Ceanothus crassifolius	*Gilia achilleifolia*	*Nemacladus longiflorus*	*Suaeda nigra*
Ceanothus cuneatus	*Gilia achilleifolia* ssp. *multicaulis*	*Nemacladus pinnatifidus*	*Symphoricarpos albus*
Ceanothus cyaneus	*Gilia brecciarum*	*Nemacladus ramosissimus*	*Symphoricarpos albus* var. *laevigatus*
Ceanothus greggii	*Gilia capitata* ssp. *abrotanifolia*	*Nemacladus sigmoideus*	*Symphyotrichum defoliatum*
Ceanothus integerrimus	*Gilia clivorum*	*Nemophila menziesii* var. *integrifolia*	*Symphyotrichum greatae*
Ceanothus integerrimus var. *macrothyrsus*	*Gilia diegensis*	*Nemophila pedunculata*	*Symphyotrichum lanceolatum*
Ceanothus thyrsiflorus	*Gilia inconspicua*	*Nemophila pulchella*	*Symphyotrichum lanceolatum var. hesperium*
Ceanothus vestitus	*Gilia latiflora*	*Nemophila spatulata*	*Symphyotrichum subulatum* var. *parviflorum*
Centromadia parryi	*Gilia leptantha*	*Nicotiana attenuata*	*Syntrichopappus lemmonii*
Centromadia parryi ssp. *australis*	*Gilia minor*	*Nicotiana clevelandii*	*Tauschia parishii*
Centromadia pungens	*Gilia ochroleuca*	*Nitrophila occidentalis*	*Tetradymia canescens*
Centromadia pungens ssp. *laevis*	*Gilia ochroleuca* ssp. *bizonata*	*Nuttallanthus texanus*	*Tetradymia comosa*
Cercocarpus betuloides var. *blancheae*	*Gilia tricolor*	*Oenanthe sarmentosa*	*Thalictrum fendleri* var. *polycarpum*
Cercocarpus ledifolius	*Githopsis diffusa*	*Oenothera californica*	*Trichostema parishii*
Chaenactis glabriuscula	*Harpagonella palmeri*	*Oenothera elata* ssp. *hirsutissima*	*Trifolium albopurpureum*
Chaenactis glabriuscula var. *lanosa*	*Hazardia squarrosa* var. *grindelioides*	*Oligomeris linifolia*	*Trifolium bifidum*
Chaenactis santolinoides	*Helenium puberulum*	*Opuntia oricola*	*Trifolium bifidum* var. *decipiens*
Chamerion latifolium	*Helianthus nuttallii*	*Opuntia phaeacantha*	*Trifolium ciliolatum*
Chenopodium atrovirens	*Heliotropium curassavicum* var. *oculatum*	*Orobanche bulbosa*	*Trifolium depauperatum*
Chenopodium desiccatum	*Hemizonia congesta*	*Orobanche parishii*	*Trifolium depauperatum* var. *truncatum*
Chenopodium fremontii	*Hesperolinon micranthum*	*Osmadenia tenella*	*Trifolium gracilentum*
Chlorogalum pomeridianum	*Heterocodon rariflorum*	*Oxalis pilosa*	*Trifolium microcephalum*
Chloropyron maritimum	*Heterotheca sessiliflora* ssp. *echioides*	*Packera breweri*	*Trifolium obtusiflorum*
Chorizanthe parryi	*Heterotheca sessiliflora* ssp. *fastigiata*	*Packera ionophylla*	*Trifolium variegatum*
Chorizanthe parryi var. *fernandina*	*Heterotheca subaxillaris*	*Panicum acuminatum*	*Trifolium wormskioldii*
Chorizanthe procumbens	*Heuchera caespitosa*	*Panicum capillare*	*Triglochin maritima*
Chorizanthe xanti	*Heuchera parishii*	*Parietaria hespera* var. *californica*	*Triodanis biflora*
Chrysolepis sempervirens	*Heuchera rubescens*	*Pectocarya linearis* ssp. *ferocula*	*Triteleia ixioides*
Cicuta maculata	*Hieracium argutum*	*Pectocarya penicillata*	*Turritis glabra*
Cicuta maculata var. *bolanderi*	*Hieracium horridum*	*Pectocarya setosa*	*Typha domingensis*
Cirsium brevistylum	*Hoffmannseggia glauca*	*Pellaea mucronata* var. *californica*	*Urtica dioica* ssp. *holosericea*
Cirsium occidentale var. *californicum*	*Hoita macrostachya*	*Penstemon grinnellii*	*Verbena bracteata*
Cirsium occidentale var. *venustum*	*Holodiscus discolor* var. *microphyllus*	*Penstemon heterophyllus* var. *australis*	*Verbena lasiostachys* var. *scabrida*

Clarkia dudleyana	*Hordeum brachyantherum*	*Penstemon labrosus*	*Veronica americana*
Clarkia purpurea ssp. *quadrivulnera*	*Hordeum brachyantherum* ssp. *californicum*	*Penstemon rostriflorus*	*Veronica peregrina*
Clarkia purpurea ssp. *viminea*	*Hordeum depressum*	*Penstemon spectabilis* var. *subviscosus*	*Veronica peregrina* ssp. *xalapensis*
Clarkia similis	*Hordeum intercedens*	*Pentachaeta aurea*	*Veronica serpyllifolia*
Claytonia parviflora	*Horkelia cuneata* var. *puberula*	*Perideridia parishii*	*Vicia hassei*
Claytonia parviflora ssp. *utahensis*	*Hosackia crassifolia*	*Perideridia parishii* ssp. *latifolia*	*Vicia ludoviciana*
Claytonia parviflora ssp. *viridis*	*Hosackia oblongifolia*	*Peritoma arborea* var. *angustata*	*Viola purpurea*
Claytonia perfoliata ssp. *mexicana*	*Hulsea heterochroma*	*Peritoma arborea* var. *globosa*	*Xylococcus bicolor*
Clematis pauciflora	*Hulsea vestita*	*Persicaria hydropiperoides*	*Yabea microcarpa*
Clinopodium douglasii	*Hulsea vestita* ssp. *gabrielensis*	*Persicaria lapathifolia*	*Zannichellia palustris*
Clinopodium mimuloides	*Hydrocotyle ranunculoides*	*Persicaria punctata*	*Zeltnera venusta*
Collinsia concolor	*Hydrocotyle umbellata*	*Petunia parviflora*	

Appendix B5: Singapore Index Indicator 5

SI Indicator 5: Change in # Bird Species

1. **Datasets Used:**
    a. Dataset Name: eBird Observation Point Data
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: https://secure.birds.cornell.edu/cassso/login?service=https%3A%2F%2Febird.org%2Febird%2Flogin%2Fcas%3Fportal%3Debird&locale=en_US
        iii. Original Source Metadata: http://ebird.org/content/ebird/about/
        iv. Original Source Citation: eBird Basic Dataset. Version: EBD_relMay-2013. Cornell Lab of Ornithology, Ithaca, New York. May 2013.
        v. Dataset Discussion: This dataset was assessed by Ryan Harrigan at UCLA. It contains a variety of observations of bird species by citizens, bird watchers, and scientists. Observation error is possible, but eBird platform includes quality control measures. Also, the quantity of observations may reduce the influence of error, particularly on total # of species. Observations are also cumulative and can date as far back as observers want to enter their old records. Only the last 5 years of observations are included in this analysis since 5 year intervals are envisioned as a suitable interval for Singapore Index measurements.

2. **Other Datasets Considered**
    a. Los Angeles County Breeding Bird Atlas
    b. BIOSCAN (future)

3. **Method**

    IMPORTANT NOTE: This measurement is a preliminary baseline measurement and future measurements are required to determine change.

    a. Indicator #5 GIS Map File Location: \\htpgis3\General_Users\RAD
    b. Download eBird observation points
    c. Clip point data to City Boundary

d. Classify native vs non-native species based on the County Bird list from Los Angeles Audubon Society. Filter for potential erroneous observations (single or few observations?).

e. Generate species list

4. Methods Notes

a. A scientific field survey, or more extensive verification of citizen science observations by experts expand “Research” grade observations in the City, would improve this assessment approach.

b. As was mentioned in the Expert Council workshop, emphasis on species that are known to be rare or extirpated from the City would provide a more focused approach. A list of these species should be produced and monitored in the future.

Table 5.1: Singapore Index User’s Manual Instructions for Indicator 5

CBI	INDICATORS	VARIABLES	SCORE
Native Biodiversity	**INDICATORS 4 - 8: CHANGE IN NUMBER OF NATIVE SPECIES**		
	RATIONALE FOR SELECTION OF INDICATOR As this is an Index focussing on biodiversity in cities, it is essential that the native flora and fauna diversity be incorporated as indicators. Three key taxonomic groups that are most surveyed worldwide, i.e., plants, birds and butterflies, have been selected as “core indicators”. To ensure fairness and objectivity in the Index, cities can select two other taxonomic groups that would reflect their best biodiversity. To ensure that these five indicators on species are unbiased against any city based on its geographical location, ecological history, size, land use, etc., it was decided that • All cities and local authorities are requested to list the number of native species of a) vascular plants, b) birds, c) butterflies, d) at least two other taxonomic groups, and e) any other taxonomic groups that they have data, in Part I: Profile of the City • The indicators will measure the change in number of species over time rather than the absolute number of species • The first year of application will be taken as the baseline year for the species count. The net change in species numbers (increase in number of species due to re-introduction or restoration efforts minus the number of species that went extinct) will be incorporated in the subsequent calculations of the Singapore Index. Conducting more surveys on the target groups (to document new species or rediscoveries) and reintroducing locally extinct native species would help to increase the number of extant native species.	HOW TO CALCULATE INDICATORS The change in number of native species is used for indicators 4 to 8. The three core groups are: • Indicator 4 : vascular plants • Indicator 5 : birds • Indicator 6 : butterflies These groups have been selected as data are most easily available and to enable some common comparison. Cities can select any two other taxonomic groups for indicators 7 and 8 (e.g., bryophytes, fungi, amphibians, reptiles, freshwater fish, molluscs, dragonflies, beetles, spiders, hard corals, marine fish, seagrasses, sponges, etc.) The above data from the first application of the Singapore Index would be recorded in Part I: Profile of the City as the baseline. Net change in species from the previous survey to the most recent survey is calculated as: Total increase in number of species (as a result of re-introduction, rediscovery, new species found, etc.) minus number of species that have gone extinct. WHERE TO GET DATA FOR CALCULATIONS Possible sources of data include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.	BASIS OF SCORING Data listed in Part I: Profile of the City will be used to measure change in species diversity. Cities’ first application will be considered as the baseline information for all subsequent monitoring. In their subsequent applications of the Index, cities will calculate the net change in species for the respective taxonomic groups. The scoring range below is based on the acceptance that it is not easy to recover or re-introduce species successfully over a short period of time. However, species recovery, re-introduction and restoration efforts must be given due recognition. 0 points: maintaining or a decrease in the number of species 1 point: 1 species increase 2 points: 2 species increase 3 points: 3 species increase 4 points: 4 species or more increase

Tale 5.2: Native bird species observed in City of Los Angeles 2011-2016 (source eBird). List compiled by Ryan Harrigan at UCLA and he retains the full list of observations and locations.

Acorn Woodpecker	Elegant Tern	Red-breasted Merganser
Allen's Hummingbird	Eurasian Wigeon	Red-breasted Nuthatch
American Avocet	Evening Grosbeak	Red-breasted Sapsucker
American Bittern	Ferruginous Hawk	Red-eyed Vireo
American Coot	Field Sparrow	Red-naped Sapsucker
American Crow	Forster's Tern	Red-necked Grebe
American Dipper	Fox Sparrow	Red-necked Phalarope
American Goldfinch	Franklin's Gull	Red-shouldered Hawk
American Kestrel	Glaucous Gull	Red-tailed Hawk
American Pipit	Glaucous-winged Gull	Red-throated Loon
American Redstart	Glossy Ibis	Red-throated Pipit
American Robin	Golden Eagle	Red-winged Blackbird
American Wigeon	Golden-crowned Kinglet	Reddish Egret
Ancient Murrelet	Golden-crowned Sparrow	Rhinoceros Auklet
Anna's Hummingbird	Grasshopper Sparrow	Ring-billed Gull
Ash-throated Flycatcher	Gray Flycatcher	Ring-necked Duck
Baird's Sandpiper	Great Egret	Rock Wren
Bald Eagle	Great-tailed Grackle	Rose-breasted Grosbeak
Baltimore Oriole	Greater Roadrunner	Ross's Goose
Band-tailed Pigeon	Greater Scaup	Royal Tern
Bank Swallow	Greater Yellowlegs	Ruby-crowned Kinglet
Barn Owl	Green Heron	Ruddy Duck
Barn Swallow	Green-tailed Towhee	Ruddy Turnstone
Bell's Vireo	Green-winged Teal	Rufous Hummingbird
Belted Kingfisher	Gull-billed Tern	Rufous-crowned Sparrow
Bewick's Wren	Hairy Woodpecker	Rusty Blackbird
Black Oystercatcher	Hammond's Flycatcher	Sabine's Gull
Black Phoebe	Harris's Hawk	Sage Thrasher
Black Scoter	Harris's Sparrow	Sandhill Crane
Black Skimmer	Heermann's Gull	Savannah Sparrow
Black Swift	Hermit Thrush	Say's Phoebe
Black Tern	Hermit Warbler	Scarlet Tanager
Black Turnstone	Herring Gull	Scissor-tailed Flycatcher
Black-and-white Warbler	Hooded Merganser	Scott's Oriole
Black-bellied Plover	Hooded Oriole	Semipalmated Plover
Black-chinned Hummingbird	Hooded Warbler	Semipalmated Sandpiper
Black-chinned Sparrow	Horned Grebe	Sharp-shinned Hawk
Black-crowned Night-Heron	Horned Lark	Short-billed Dowitcher
Black-headed Grosbeak	House Finch	Short-eared Owl
Black-legged Kittiwake	House Wren	Short-tailed Shearwater
Black-necked Stilt	Hutton's Vireo	Snow Goose
Black-throated Sparrow	Indigo Bunting	Snowy Egret
Black-vented Shearwater	Lark Bunting	Snowy Plover
Blackburnian Warbler	Lark Sparrow	Solitary Sandpiper

Blackpoll Warbler	Lawrence's Goldfinch	Song Sparrow
Blue Grosbeak	Lazuli Bunting	Sooty Shearwater
Blue-footed Booby	Least Bittern	Spotted Sandpiper
Blue-gray Gnatcatcher	Least Flycatcher	Spotted Towhee
Blue-headed Vireo	Least Sandpiper	Steller's Jay
Blue-winged Teal	Least Tern	Summer Tanager
Bonaparte's Gull	Lesser Goldfinch	Surf Scoter
Brandt's Cormorant	Lesser Nighthawk	Swainson's Hawk
Brewer's Blackbird	Lesser Scaup	Swainson's Thrush
Brewer's Sparrow	Lesser Yellowlegs	Swamp Sparrow
Broad-winged Hawk	Lewis's Woodpecker	Tennessee Warbler
Brown Booby	Lincoln's Sparrow	Thayer's Gull
Brown Creeper	Loggerhead Shrike	Townsend's Solitaire
Brown Pelican	Long-billed Curlew	Townsend's Warbler
Brown-headed Cowbird	Long-billed Dowitcher	Tree Swallow
Bullock's Oriole	Long-eared Owl	Tricolored Blackbird
Burrowing Owl	Long-tailed Duck	Tropical Kingbird
Cackling Goose	MacGillivray's Warbler	Tundra Swan
Cactus Wren	Magnolia Warbler	Turkey Vulture
California Condor	Marbled Godwit	Varied Thrush
California Gnatcatcher	Marbled Murrelet	Vaux's Swift
California Gull	Marsh Wren	Vermilion Flycatcher
California Quail	Mew Gull	Vesper Sparrow
California Scrub-Jay	Mountain Bluebird	Violet-green Swallow
California Thrasher	Mountain Chickadee	Virginia Rail
California Towhee	Mourning Dove	Virginia's Warbler
Calliope Hummingbird	Nashville Warbler	Wandering Tattler
Canada Goose	Northern Flicker	Warbling Vireo
Canada Warbler	Northern Fulmar	Western Bluebird
Canyon Wren	Northern Harrier	Western Grebe
Caspian Tern	Northern Mockingbird	Western Gull
Cassin's Auklet	Northern Parula	Western Kingbird
Cassin's Finch	Northern Pintail	Western Meadowlark
Cassin's Kingbird	Northern Shoveler	Western Sandpiper
Cassin's Vireo	Northern Waterthrush	Western Screech-Owl
Cattle Egret	Nuttall's Woodpecker	Western Tanager
Cedar Waxwing	Oak Titmouse	Western Wood-Pewee
Chestnut-sided Warbler	Olive-sided Flycatcher	White Wagtail
Chimney Swift	Orange-crowned Warbler	White-breasted Nuthatch
Chipping Sparrow	Orchard Oriole	White-crowned Sparrow
Cinnamon Teal	Pacific Golden-Plover	White-eyed Vireo
Clark's Grebe	Pacific Loon	White-faced Ibis
Clay-colored Sparrow	Pacific Wren	White-headed Woodpecker
Cliff Swallow	Pacific-slope Flycatcher	White-tailed Kite
Common Gallinule	Painted Bunting	White-throated Sparrow
Common Goldeneye	Painted Redstart	White-throated Swift
Common Grackle	Palm Warbler	White-winged Dove
Common Ground-Dove	Parasitic Jaeger	White-winged Scoter

Common Loon	Pectoral Sandpiper	Williamson's Sapsucker
Common Merganser	Pelagic Cormorant	Willow Flycatcher
Common Murre	Peregrine Falcon	Wilson's Phalarope
Common Poorwill	Pied-billed Grebe	Wilson's Warbler
Common Raven	Pigeon Guillemot	Wood Duck
Common Tern	Pine Siskin	Worm-eating Warbler
Common Yellowthroat	Pine Warbler	Yellow Warbler
Cooper's Hawk	Pink-footed Shearwater	Yellow-bellied Sapsucker
Costa's Hummingbird	Plumbeous Vireo	Yellow-billed Cuckoo
Crested Caracara	Pomarine Jaeger	Yellow-breasted Chat
Dark-eyed Junco	Prairie Falcon	Yellow-crowned Night-Heron
Double-crested Cormorant	Prothonotary Warbler	Yellow-headed Blackbird
Downy Woodpecker	Purple Finch	Yellow-rumped Warbler
Dusky Flycatcher	Purple Martin	Yellow-throated Warbler
Eared Grebe	Pygmy Nuthatch	Zone-tailed Hawk
Eastern Kingbird	Red Knot	
Eastern Phoebe	Red Phalarope	

Appendix B6: Singapore Index Indicator 6

SI Indicator 6: Change in # Butterfly and Moth Species

1. **Datasets Used:**
    a. Dataset Name: Natural History Museum Los Angeles County Butterfly Checklist
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: https://nhm.org/site/sites/default/files/activities/community_science/LAButterfly%20Checklist.pdf
        iii. Original Source Metadata: https://nhm.org/site/activities-programs/citizen-science/butterfly-survey/butterfly-data
        iv. Dataset Discussion: List of LA County species. Need to determine City of LA can be extracted from this list.

    b. Dataset #2 Name: iNaturalist Observation Data
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: https://www.inaturalist.org/observations/export
        iii. Original Source Metadata: https://www.inaturalist.org/pages/what+is+it
        iv. Dataset Discussion: Sortable list of citizen, expert, and scientist observations. Includes “research grade” observations which are suitable for this analysis. Observations are available since. Only the last 5 years of observations are included in this analysis.

2. **Other Datasets Considered**
    a. Butterfly species of Griffith Park (Dan Cooper - includes extirpated species)
    b. UCLA/NHM Re-survey of butterflies of the Santa Monica Mtns. including NHM bioscan data review (Elizabeth Wong)
    c. NHM BIOSCAN (Brian Brown)

3. Method

IMPORTANT NOTE: This measurement is a preliminary baseline measurement and future measurements are required to determine change.

a. Indicator #6 GIS Map File Location: \\htpgis3\General_Users\RAD

a. Download iNaturalist Butterfly and Moth Observations for 2011-2016 for City of Los Angeles rectangle (east boundary -118.156 decimal degrees lon; west boundary -118.668 decimal degrees lon; north boundary 34.337 decimal degrees lat; south boundary 33.704 decimal degrees lat)

b. Select only “research grade” observations

c. Produce list of species from iNaturalist, classify as native or non-native with expert assistance.

d. FUTURE: compare future observations to identify change

4. Methods Notes

a. A scientific field survey, or more extensive verification of citizen science observations by experts to expand “Research” grade observations in the City, would improve this assessment approach.

b. As was mentioned in the Expert Council workshop, emphasis on species that are known to be rare or extirpated from the City would provide a more focused approach. A list of these species should be produced and monitored in the future.

Table 6.1: Singapore Index User's Manual Instructions for Indicator 6

CBI	INDICATORS	VARIABLES	SCORE
Native Biodiversity	**INDICATORS 4 - 8: CHANGE IN NUMBER OF NATIVE SPECIES**		
	RATIONALE FOR SELECTION OF INDICATOR As this is an Index focussing on biodiversity in cities, it is essential that the native flora and fauna diversity be incorporated as indicators. Three key taxonomic groups that are most surveyed worldwide, i.e., plants, birds and butterflies, have been selected as "core indicators". To ensure fairness and objectivity in the Index, cities can select two other taxonomic groups that would reflect their best biodiversity. To ensure that these five indicators on species are unbiased against any city based on its geographical location, ecological history, size, land use, etc., it was decided that • All cities and local authorities are requested to list the number of native species of a) vascular plants, b) birds, c) butterflies, d) at least two other taxonomic groups, and e) any other taxonomic groups that they have data, in Part I: Profile of the City • The indicators will measure the change in number of species over time rather than the absolute number of species • The first year of application will be taken as the baseline year for the species count. The net change in species numbers (increase in number of species due to re-introduction or restoration efforts minus the number of species that went extinct) will be incorporated in the subsequent calculations of the Singapore Index. Conducting more surveys on the target groups (to document new species or rediscoveries) and reintroducing locally extinct native species would help to increase the number of extant native species.	HOW TO CALCULATE INDICATORS The change in number of native species is used for indicators 4 to 8. The three core groups are: • Indicator 4 : vascular plants • Indicator 5 : birds • Indicator 6 : butterflies These groups have been selected as data are most easily available and to enable some common comparison. Cities can select any two other taxonomic groups for indicators 7 and 8 (e.g., bryophytes, fungi, amphibians, reptiles, freshwater fish, molluscs, dragonflies, beetles, spiders, hard corals, marine fish, seagrasses, sponges, etc.) The above data from the first application of the Singapore Index would be recorded in Part I: Profile of the City as the baseline. Net change in species from the previous survey to the most recent survey is calculated as: Total increase in number of species (as a result of re-introduction, rediscovery, new species found, etc.) minus number of species that have gone extinct. WHERE TO GET DATA FOR CALCULATIONS Possible sources of data include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.	BASIS OF SCORING Data listed in Part I: Profile of the City will be used to measure change in species diversity. Cities' first application will be considered as the baseline information for all subsequent monitoring. In their subsequent applications of the Index, cities will calculate the net change in species for the respective taxonomic groups. The scoring range below is based on the acceptance that it is not easy to recover or re-introduce species successfully over a short period of time. However, species recovery, re-introduction and restoration efforts must be given due recognition. 0 points: maintaining or a decrease in the number of species 1 point: 1 species increase 2 points: 2 species increase 3 points: 3 species increase 4 points: 4 species or more increase

Table 6.2: Butterflies and Moths observed within City of Los Angeles extents rectangle (includes areas outside of the City and may include species not observed in the City).
Bold records indicate those that were included in the counts presented in the Biodiversity Report
A full list of observations and locations is stored on the LASAN Server at \\htpgis3\General_Users\RAD*.*

Scientific Name	Common Name	Scientific Name	Common Name
Abegesta remellalis	White-trimmed Abegesta	*Hypsopygia phoezalis*	
Achyra rantalis	Garden Webworm Moth	*Icaricia acmon*	Acmon Blue
Acrobasis tricolorella	Tricolored Acrobasis Moth	*Idaea bonifata*	Fortunate Idaea Moth
Adelpha californica	California Sister	*Idia occidentalis*	
Agraulis vanillae	Gulf Fritillary	*Iridopsis fragilaria*	
Agrotis volubilis	Voluble Dart Moth	*Junonia coenia*	Common Buckeye
Alpheias transferrens		*Lantanophaga pusillidactylus*	Lantana Plume Moth
Amblyptilia pica	Geranium Plume Moth	*Leptotes marina*	Marine Blue
Amorbia cuneana	Western Avocado Leafroller Moth	*Lerodea eufala*	Eufala Skipper
Anicla infecta	Green Cutworm Moth	*Limenitis lorquini*	Lorquin's Admiral
Annaphila astrologa		*Lineodes elcodes*	Lineodes elcodes
Anopina triangulana		*Lineodes integra*	Eggplant Leafroller Moth
Anstenoptilia marmarodactyla		*Litoprosopus coachella*	Palm Flower Moth
Antheraea polyphemus	Polyphemus Moth	*Lygropia octonalis*	Eight-barred Lygropia Moth
Anthocharis sara	Sara Orangetip	*Macrurocampa marthesia*	Mottled Prominent
Apodemia virgulti	Behr's Metalmark	*Manduca**	
Arachnis picta	Painted Tiger Moth	*Manduca quinquemaculata*	Five-spotted Hawk Moth
Archips argyrospila	Fruit-tree Leafroller Moth	*Manduca sexta*	Carolina Sphinx
Argyrotaenia franciscana	Orange Tortrix Moth	*Megalographa biloba*	Bilobed Looper Moth
Aristotelia callens		*Melittia gloriosa*	
Ascalapha odorata	Black Witch	*Monopis crocicapitella*	Bird Nest Moth
Atlides halesus	Great Purple Hairstreak	*Mythimna unipuncta*	White-Speck
Autographa californica	Alfalfa Looper	*Nathalis iole*	Dainty Sulphur
Autoplusia egenoides	Lesser Bean Looper	*Nemoria bistriaria*	Red-fringed Emerald
Batrachedra enormis	Large Batrachedra Moth	*Neoterpes edwardsata*	
Battus philenor	Pipevine Swallowtail	*Noctua pronuba*	Large Yellow Underwing
Bedellia somnulentella	Morning-glory Leafminer Moth	*Nomophila nearctica*	Lucerne Moth
Biston betularia	Peppered Moth	*Notarctia proxima*	Mexican Tiger Moth
Brephidium exilis	Western Pygmy Blue	*Nymphalis antiopa*	Mourning Cloak
Bulia deducta		*Nymphalis californica*	California Tortoiseshell
Calephelis nemesis	Fatal Metalmark	*Ochlodes agricola*	Rural Skipper
Callophrys augustinus	Brown Elfin	*Ochlodes sylvanoides*	Woodland Skipper

Scientific Name	Common Name	Scientific Name	Common Name
Callophrys dumetorum	Bramble Green Hairstreak	*Oegoconia novimundi*	Four-spotted Yellowneck Moth
Catocala piatrix	Penitent Underwing	*Oinophila v-flavum*	Yellow V Moth
Celastrina echo	Echo Azure	*Opogona omoscopa*	Detritus Moth
Chalcoela iphitalis	Sooty-winged Chalcoela Moth	*Orgyia vetusta*	Western Tussock Moth
Chloridea virescens	Tobacco Budworm Moth	*Orthonama obstipata*	Gem Moth
Chrysodeixis chalcites	Tomato Looper	*Panoquina errans*	Wandering Skipper
Clepsis peritana	Garden Tortrix	*Papilio eurymedon*	Pale Swallowtail
Coenonympha tullia	Common Ringlet	*Papilio polyxenes*	Black Swallowtail
Coenonympha tullia california	California Ringlet	*Papilio rutulus*	Western Tiger Swallowtail
Colias eurytheme	Orange Sulphur	*Papilio zelicaon*	Anise Swallowtail
Colias philodice	Clouded Sulphur	*Paranthrene robiniae*	Western Poplar Clearwing
Cosmopterix montisella		*Parapediasia teterrella*	Bluegrass Webworm Moth
*Crambus**		*Peridroma saucia*	Variegated Cutworm Moth
Crambus sperryellus		*Petrophila jaliscalis*	Jalisco Petrophila
Crocidosema plebejana	Cotton Tipworm Moth	*Phereoeca uterella*	Household Casebearer
Ctenoplusia oxygramma	Sharp-stigma Looper Moth	*Phoebis philea*	Orange-barred Sulphur
Ctenucha brunnea	Brown Ctenucha	*Phoebis sennae*	Cloudless Sulphur
Cyclophora dataria		*Phragmatobia fuliginosa*	Ruby Tiger Moth
Cyclophora nanaria	Dwarf Tawny Wave	*Phyllocnistis citrella*	Citrus Leafminer
Cydia latiferreana	Filbertworm Moth	*Pieris rapae*	Cabbage White
Cydia pomonella	Codling Moth	*Plataea californiaria*	
Danaus gilippus	Queen	*Plataea personaria*	
Danaus plexippus	Monarch	*Platynota labiosana*	
Diastictis fracturalis	Fractured Western Snout Moth	*Platynota stultana*	Omnivorous Leafroller Moth
Dichorda illustraria		*Plodia interpunctella*	Indian Meal Moth
Dicymolomia metalliferalis		*Plutella xylostella*	Diamondback Moth
Digrammia excurvata		*Poanes melane*	Umber Skipper
Digrammia imparilata		*Poanes zabulon*	Zabulon Skipper
Digrammia neptaria	Dark-bordered Granite	*Polites sabuleti*	Sandhill Skipper
Disclisioprocta stellata	Somber Carpet	*Polygonia satyrus*	Satyr Comma
Drasteria pallescens	Cowhead Arches Moth	*Pontia beckerii*	Becker's White
Drepanulatrix monicaria		*Pontia protodice*	Checkered White
Dryadaula terpsichorella	Hawaiian Dancing Moth	*Prolita sironae*	
Duponchelia fovealis	European Pepper Moth	*Protorthodes melanopis*	

Scientific Name	Common Name	Scientific Name	Common Name
Elasmopalpus lignosellus	Lesser Cornstalk Borer Moth	*Pterotaea lamiaria*	
Emmelina monodactyla	Morning-glory Plume Moth	*Pyralis farinalis*	Meal Moth
Ephestiodes gilvescentella	Dusky Raisin Moth	*Pyrausta californicalis*	California Pyrausta Moth
Epiblema strenuana	Ragweed Borer Moth	*Pyrausta inornatalis*	Inornate Pyrausta Moth
Epiphyas postvittana	Light Brown Apple Moth	*Pyrausta laticlavia*	Southern Purple Mint Moth
Erynnis funeralis	Funereal Duskywing	*Pyrausta volupialis*	Volupial Mint Moth
Erynnis tristis	Mournful Duskywing	*Pyrgus albescens*	White Checkered-Skipper
Estigmene acrea	Salt Marsh Moth	*Sabulodes aegrotata*	Omnivorous Looper
Ethmia discostrigella	Mountain-mahogany Moth	*Satyrium saepium*	Hedgerow Hairstreak
Eublemma minima	Everlasting Bud Moth	*Satyrium sylvinus*	Sylvan Hairstreak
Eublemma recta	Straight-lined Seed Moth	*Satyrium tetra*	Mountain Mahogany Hairstreak
Euchromius ocelleus	Belted Grass-veneer	*Scybalistodes periculosalis*	
Eudrepanulatrix rectifascia		*Smerinthus cerisyi*	One-eyed Sphinx
Eumorpha achemon	Achemon Sphinx	*Smerinthus saliceti*	
Euphilotes battoides allyni	El Segundo Blue	*Sphinx chersis*	Great Ash Sphinx
Euphilotes bernardino	Bernardino Dotted-Blue	*Sphinx perelegans*	Elegant Sphinx
*Euphydryas chalcedona**	Variable Checkerspot	*Spilosoma vestalis*	Vestal Tiger Moth
Euphydryas chalcedona chalcedona	Chalcedon Checkerspot	*Spodoptera exigua*	Small Mottled Willow
Eupithecia miserulata	Common Eupithecia Moth	*Spodoptera ornithogalli*	Yellow-striped Armyworm Moth
Eupithecia subapicata		*Strymon melinus*	Gray Hairstreak
Euptoieta claudia	Variegated Fritillary	*Strymon melinus pudica*	
Feltia subterranea	Subterranean Dart	*Synanthedon polygoni*	Buckwheat Root Borer
Fulgoraecia exigua	Planthopper Parasite Moth	*Synanthedon resplendens*	Sycamore Borer Moth
Galgula partita	Wedgling Moth	*Synchlora aerata*	Wavy-lined Emerald
Gelechia desiliens		*Synchlora frondaria*	Southern Emerald
Glaucopsyche lygdamus	Silvery Blue	*Tachystola hemisema*	
Glaucopsyche lygdamus palosverdesensis	Palos Verdes Blue	*Terastia meticulosalis*	Erythrina borer
Glyphodes onychinalis	Swan Plant Flower Moth	*Tetanolita palligera*	
Grammia ornata	Ornate Tiger Moth	*Tetracis cervinaria*	
Helicoverpa zea	Corn Earworm Moth	*Tinea apicimaculella*	Dark-collared Tinea Moth
Heliopetes ericetorum	Northern White-Skipper	*Tinea pellionella*	Case-bearing Clothes Moth
Heliothis phloxiphaga	Spotted Buff Gem Moth	*Toripalpus trabalis*	
Hellula rogatalis	Cabbage Webworm	*Trichoplusia ni*	Cabbage Looper

Scientific Name	Common Name	Scientific Name	Common Name
Hemaris thetis	Rocky Mountain Clearwing	*Triphosa californiata*	
Hemieuxoa rudens		*Uresiphita reversalis*	Genista Broom Moth
Henricus umbrabasana		*Vanessa annabella*	West Coast Lady
Heraclides rumiko	Western Giant Swallowtail	*Vanessa atalanta*	Red Admiral
Hofmannophila pseudospretella	Brown House Moth	*Vanessa atalanta rubria*	American Red Admiral
Homoeosoma electella	American Sunflower Moth	*Vanessa cardui*	Painted Lady
Hyalophora euryalus	Ceanothus Silk Moth	*Vanessa virginiensis*	American Lady
Hydriomena nubilofasciata	Oak Winter Highflier	*Xestia c-nigrum*	Setaceous Hebrew Character
Hylephila phyleus	Fiery Skipper	*Ypsolopha sp-sw*	
Hyles lineata	White-lined Sphinx	*Zale lunata*	Lunate Zale Moth

*=not counted (3 total)

Table 6.3: Natural History Museum Los Angeles County Butterfly List

CHECK-LIST OF THE BUTTERFLIES OF LOS ANGELES COUNTY, CALIFORNIA

Compiled by Lila Higgins, Natural History Museum of Los Angeles County.
This list covers the whole of Los Angeles County.

Hesperiidae: Skippers
__ Silver-spotted Skipper, *Epargyreus clarus*
__ Broken Silverdrop, *Epargyreus exadeus*
__ Hammock Skipper, *Polygonus leo*
__ Long-tailed Skipper, *Urbanus proteus*
__ Northern Cloudywing, *Thorybes pylades*
__ Sleepy Duskywing, *Erynnis brizo*
__ Propertius Duskywing, *Erynnis propertius*
__ Mournful Duskywing, *Erynnis tristis*
__ Pacuvius Duskywing, *Erynnis pacuvius*
__ Funereal Duskywing, *Erynnis funeralis*
__ Afranius Duskywing, *Erynnis afranius*
__ White Checkered-Skipper, *Pyrgus albescens*
__ Northern White-Skipper, *Heliopetes ericetorum*
__ Common Sootywing, *Pholisora catullus*
__ Mohave Sootywing, *Hesperopsis libya*
__ Saltbush Sootywing, *Hesperopsis alpheus*
__ Orange Skipperling, *Copaeodes aurantiaca*
__ Fiery Skipper, *Hylephila phyleus*
__ Alkali Skipper, *Pseudocopaeodes eunus*
__ Juba Skipper, *Hesperia juba*
__ Western Branded Skipper, *Hesperia colorado*
__ Columbian Skipper, *Hesperia columbia*
__ Lindsey's Skipper, *Hesperia lindseyi*
__ Sachem, *Atalopedes campestris*
__ Sandhill Skipper, *Polites sabuleti*
__ Sonora Skipper, *Polites sonora*
__ Woodland Skipper, *Ochlodes sylvanoides*
__ Rural Skipper, *Ochlodes agricola*
__ Umber Skipper, *Poanes melane*
__ Eufala Skipper, *Lerodea eufala*
__ Brazilian Skipper, *Calpodes ethlius*
__ Wandering Skipper, *Panoquina errans*
__ Yucca Giant-Skipper, *Megathymus yuccae*

Papilionidae: Parnassians and Swallowtails
__ Pipevine Swallowtail, *Battus philenor*
__ Polydamas Swallowtail, *Battus polydamas*
__ Old World Swallowtail, *Papilio machaon*
__ Black Swallowtail, *Papilio polyxenes*
__ Anise Swallowtail, *Papilio zelicaon*
__ Indra Swallowtail, *Papilio indra*
__ Western Tiger Swallowtail, *Papilio rutulus*
__ Pale Swallowtail, *Papilio eurymedon*

__ Painted Lady, *Vanessa cardui*
__ West Coast Lady, *Vanessa annabella*
__ American Lady, *Vanessa virginiensis*
__ Lorquin's Admiral, *Limenitis lorquini*
__ *Adelpha californica*
__ Common Ringlet, *Coenonympha tullia*
__ Great Basin Wood Nymph, *Cercyonis sthenele*

Thyatiridae: Thyatirid Moths
__ *Bycombia verdugoensis*

Saturniidae: Wild Silk Moths
__ Burns' buckmoth, *Hemileuca burnsi*
__ Electra buckmoth, *Hemileuca electra*
__ Nevada buckmoth, *Hemileuca nevadensis*
__ Polyphemus moth, *Antheraea polyphemus*
__ Ceanothus silkmoth, *Hyalophora euryalus*
__ White-streaked saturnia moth, *Saturnia albofasciata*
__ Walters' saturnia moth, *Saturnia walterorum*

Sphingidae: Sphinx Moths and Hawkmoths
__ Pink-spotted hawkmoth, *Agrius cingulata*
__ Five-spotted hawkmoth, *Manduca quinquemaculata*
__ Carolina sphinx, *Manduca sexta*
__ Big poplar sphinx, *Pachysphinx occidentalis*
__ One-eyed sphinx, *Smerinthus cerisyi*
__ Great ash sphinx, *Sphinx chersis*
__ Elegant sphinx, *Sphinx perelegans*
__ Sequoia sphinx, *Sphinx sequoiae*
__ Pacific green sphinx, *Arctonotus lucidus*
__ Cramer's sphinx, *Erinnyis crameri*
__ Ello sphinx, *Erinnyis ello*
__ Obscure sphinx, *Erinnyis obscura*
__ Achemon sphinx, *Eumorpha achemon*
__ Phaeton primrose sphinx, *Euproserpinus phaeton*
__ Snowberry clearwing, *Hemaris diffinis*
__ White-lined sphinx, *Hyles lineata*
__ Clark's sphinx, *Proserpinus clarkiae*

Notodontidae: Prominents
__ *Clostera apicalis*
__ Gray Furcula, *Furcula cinerea*
__ Zigzag Furcula Moth, *Furcula scolopendrina*
__ California Oakworm, *Phryganidia californica*
__ Unicorn Caterpillar Moth, *Schizura unicornis*

Arctiidae: Tiger and Lichen Moths
__ *Cisthene deserta*
__ *Cisthene dorsimacula*
__ *Cisthene liberomacula*
__ *Cisthene perrosea*
__ *Lycomorpha grotei*
__ Two-tailed Swallowtail, *Papilio multicaudata*
__ Giant Swallowtail, *Papilio cresphontes*

Pieridae: Whites and Sulphurs
__ Becker's White, *Pontia beckerii*
__ Checkered White, *Pontia protodice*
__ Spring White, *Pontia sisymbrii*
__ Cabbage White, *Pieris rapae*
__ California Marble, *Euchloe hyantis*
__ Desert Marble, *Euchloe lotta*
__ Desert Orangetip, *Anthocharis cethura*
__ Pacific Orangetip, *Anthocharis sara*
__ Gray Marble, *Anthocharis lanceolata*
__ Orange Sulphur, *Colias eurytheme*
__ Harford's Sulphur, *Colias harfordii*
__ Southern Dogface, *Zerene cesonia*
__ California Dogface, *Zerene eurydice*
__ Cloudless Sulphur, *Phoebis sennae*
__ Mexican Yellow, *Eurema mexicana*
__ Sleepy Orange, *Abaeis nicippe*
__ Dainty Sulphur, *Nathalis iole*

Lycaenidae: Gossamer-wing Butterflies
__ Tailed Copper, *Lycaena arota*
__ Great Copper, *Lycaena xanthoides*
__ Gorgon Copper, *Lycaena gorgon*
__ Blue Copper, *Lycaena heteronea*
__ Purplish Copper, *Lycaena helloides*
__ Golden Hairstreak, *Habrodais grunus*
__ Great Purple Hairstreak, *Atlides halesus*
__ Western Green Hairstreak, *Callophrys affinis*
__ *Callophrys perplexa*
__ Nelson's Hairstreak, *Callophrys nelsoni*
__ Juniper Hairstreak, *Callophrys gryneus*
__ Thicket Hairstreak, *Callophrys spinetorum*
__ Brown Elfin, *Callophrys augustinus*
__ Moss' Elfin, *Callophrys mossii*
__ Western Pine Elfin, *Callophrys eryphon*
__ California Hairstreak, *Satyrium californica*
__ Sylvan Hairstreak, *Satyrium sylvinus*
__ Gold-hunter's Hairstreak, *Satyrium auretorum*
__ Mountain Mahogany Hairstreak, *Satyrium tetra*
__ Hedgerow Hairstreak, *Satyrium saepium*
__ Behr's Hairstreak, *Satyrium behrii*
__ Silver-banded Hairstreak, *Chlorostrymon simaethis*
__ Gray Hairstreak, *Strymon melinus*
__ Avalon Scrub-Hairstreak, *Strymon avalona*
__ Marine Blue, *Leptotes marina*
__ Western Pygmy-Blue, *Brephidium exilis*
__ Western Tailed-Blue, *Cupido amyntula*
__ Echo Azure, *Celastrina echo*
__ Arrowhead Blue, *Glaucopsyche piasus*

__ Painted Tiger Moth, *Arachnis picta*
__ *Ectypia clio*
__ Salt Marsh Moth or Acrea Moth, *Estigmene acrea*
__ *Grammia behrii*
__ *Grammia nevadensis*
__ Ornate Tiger Moth, *Grammia ornata*
__ Edwards' Glassywing, *Hemihyalea edwardsii*
__ *Kodiosoma fulvum*
__ *Leptarctia californiae*
__ Spotted Tussock Moth or Yellow-Spotted Tiger Moth, *Lophocampa maculata*
__ Mexican Tiger Moth, *Notarctia proxima*
__ Isabella Tiger Moth or Banded Woolybear, *Pyrrharctia isabella*
__ Vestal Tiger Moth, *Spilosoma vestalis*
__ Yellow-Collared Scape Moth, *Cisseps fulvicollis*
__ Brown Ctenucha, *Ctenucha brunnea*
__ *Ctenucha multifaria*

Noctuidae: Owlet and Miller Moths
__ *Schinia a. aurantiaca*
__ *Schinia acutilinea*
__ *Schinia argentifascia*
__ *Schinia biundulata*
__ *Schinia buta*
__ *Schinia felicitata*
__ *Schinia graefiana*
__ *Schinia ligeae*
__ *Schinia luca*
__ *Schinia megarena*
__ *Schinia mortua*
__ *Schinia niveicosta*
__ *Schinia obliqua*
__ *Schinia oleagina*
__ *Schinia pulchripennis*
__ *Schinia scarletina*
__ *Schinia sexplagiata*
__ *Schinia sueta californica*
__ *Schinia tertia*
__ *Schinia tobia*
__ *Schinia velaris*

Oecophoridae: Oecophorid Moths
__ *Agonopterix posticella*
__ *Agonopterix sabulella*
__ *Exaeretia nechlys*
__ *Exaeretia thoracefasciella*
__ *Antaeotricha marizanitae*
__ *Borkhausenia nefrax*
__ *Decartha stonda*
__ White-shouldered House Moth, *Endrosis sarcitrella*
__ Brown House Moth, *Hofmannophila pseudospretella*
__ Silvery Blue, *Glaucopsyche lygdamus*
__ Sonoran Blue, *Philotes sonorensis*
__ Small Dotted-Blue, *Philotiella speciosa*
__ Western Square-dotted Blue, *Euphilotes battoides*
__ Bernardino Dotted-Blue, *Euphilotes bernardino*
__ Pacific Dotted-Blue, *Euphilotes enoptes*
__ Mojave Dotted-Blue, *Euphilotes mojave*
__ Pallid Dotted-Blue, *Euphilotes pallescens*
__ Ceraunus Blue, *Hemiargus ceraunus*
__ Reakirt's Blue, *Echinargus isola*
__ Melissa Blue (includes Karner Blue), *Plebejus melissa*
__ Greenish Blue, *Plebejus saepiolus*
__ San Emigdio Blue, *Plebejus emigdionis*
__ Boisduval's Blue, *Plebejus icarioides*
__ Acmon Blue, *Plebejus acmon*
__ Lupine Blue, *Plebejus lupini*
__ Veined Blue, *Plebejus neurona*

Riodinidae: Metalmarks
__ Fatal Metalmark, *Calephelis nemesis*
__ Mormon Metalmark, *Apodemia mormo*
__ Behr's Metalmark, *Apodemia virgulti*
__ Sonoran Metalmark, *Apodemia mejicanus*
__ Palmer's Metalmark, *Apodemia palmeri*

Nymphalidae: Brush-footed Butterflies
__ American Snout, *Libytheana carinenta*
__ Monarch, *Danaus plexippus*
__ Queen, *Danaus gilippus*
__ Gulf Fritillary, *Agraulis vanillae*
__ Variegated Fritillary, *Euptoieta claudia*
__ Mexican Fritillary, *Euptoieta hegesia*
__ Coronis Fritillary, *Speyeria coronis*
__ Callippe Fritillary, *Speyeria callippe*
__ Unsilvered Fritillary, *Speyeria adiaste*
__ Leanira Checkerspot, *Chlosyne leanira*
__ California Patch, *Chlosyne californica*
__ Northern Checkerspot, *Chlosyne palla*
__ Gabb's Checkerspot, *Chlosyne gabbii*
__ Sagebrush Checkerspot, *Chlosyne acastus*
__ Mylitta Crescent, *Phyciodes mylitta*
__ Field Crescent, *Phyciodes pulchella*
__ Edith's Checkerspot, *Euphydryas editha*
__ Chalcedon Checkerspot, *Euphydryas chalcedona*
__ Common Buckeye, *Junonia coenia*
__ Common Buckeye, *Junonia coenia*
__ Satyr Comma, *Polygonia satyrus*
__ Hoary Comma, *Polygonia gracilis*
__ Milbert's Tortoiseshell, *Aglais milberti*
__ Mourning Cloak, *Nymphalis antiopa*
__ California Tortoiseshell, *Nymphalis californica*
__ Red Admiral, *Vanessa atalanta*

__ *Pleurotus albastrigulella*
__ *Rectiostoma femaldella*
__ *Ethmia arctostaphylella*
__ *Ethmia brevistriga*
__ *Ethmia coquillettella*
__ *Ethmia discostrigella*
__ *Ethmia marmorea*
__ *Ethmia nadia*
__ *Ethmia scylla*
__ *Ethmia semitenebrella*
__ *Pyramidobela angelaum*

Erebidae: Erebid Moths
__ Black Witch, *Ascalapha odorata*

Total = 237 species

DATE:_____

NOTES:_____

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NATURAL HISTORY MUSEUM
LOS ANGELES COUNTY

Appendix B7: Singapore Index Indicator 7

SI Indicator 7: Change in # Benthic Macroinvertebrate and Freshwater Fish Species

1. **Datasets Used:**
    a. Dataset 1 Name: LARWMP (Los Angeles River Watershed Monitoring Program – Partnership between City of Los Angeles Dept. of Public Work, Council for Watershed Health, LA Water Board, Watershed Council
        i. Dataset Filename: LARWMP BMI Taxonomy 2008-2016
        ii. Dataset Location: \\htpgis3\General_Users\RAD
        iii. Contacts: Yareli Sanchez, yareli@watershedhealth.org; Karin Wisenbaker, karin@aquaticbioassay.com;
        iv. Original Source: Karin Wisenbaker, karin@aquaticbioassay.com
        v. Dataset Discussion: Data from sample sites in the LA River watershed

    b. Dataset 2 Name: Native freshwater fish data listed in 2006 City of Los Angeles CEQA Threshold Guide. No spatial data has been located.
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: 2006 City of Los Angeles CEQA Threshold Guide

2. **Other Datasets Considered**
    a. iNaturalist
    b. Los Angeles River Habitat Enhancement Study and Opportunities Assessment 2016
    c. Ballona Wetland Surveys, Raphael. Karin sent these but did not process them.

3. **Method**

    IMPORTANT NOTE: This measurement is a preliminary baseline measurement and future measurements are required to determine change.

    a. Indicator #8 GIS Map File Location: \\htpgis3\General_Users\RAD
    b. Count species lists from LARWMP surveys from 2008 to 2016.

4. Methods Notes

a. As was mentioned in the Expert Council workshop, emphasis on species that are known to be rare or extirpated from the City would provide a more focused approach. A list of these species should be produced and monitored in the future.

b. Topanga Canyon State Park and Dominguez Canal are other watersheds that may have additional benthic macroinvertebrate species. Rosi Dagit at RCD of Santa Monica Mountains may have data on Topanga Canyon State Park creeks and springs.

Table 7.1: Singapore Index User's Manual Instructions for Indicator 7

CBI	INDICATORS	VARIABLES	SCORE
Native Biodiversity	**INDICATORS 4 - 8: CHANGE IN NUMBER OF NATIVE SPECIES**		
	RATIONALE FOR SELECTION OF INDICATOR As this is an Index focussing on biodiversity in cities, it is essential that the native flora and fauna diversity be incorporated as indicators. Three key taxonomic groups that are most surveyed worldwide, i.e., plants, birds and butterflies, have been selected as "core indicators". To ensure fairness and objectivity in the Index, cities can select two other taxonomic groups that would reflect their best biodiversity. To ensure that these five indicators on species are unbiased against any city based on its geographical location, ecological history, size, land use, etc., it was decided that • All cities and local authorities are requested to list the number of native species of a) vascular plants, b) birds, c) butterflies, d) at least two other taxonomic groups, and e) any other taxonomic groups that they have data, in Part I: Profile of the City • The indicators will measure the change in number of species over time rather than the absolute number of species • The first year of application will be taken as the baseline year for the species count. The net change in species numbers (increase in number of species due to re-introduction or restoration efforts minus the number of species that went extinct) will be incorporated in the subsequent calculations of the Singapore Index. Conducting more surveys on the target groups (to document new species or rediscoveries) and reintroducing locally extinct native species would help to increase the number of extant native species.	HOW TO CALCULATE INDICATORS The change in number of native species is used for indicators 4 to 8. The three core groups are: • Indicator 4 : vascular plants • Indicator 5 : birds • Indicator 6 : butterflies These groups have been selected as data are most easily available and to enable some common comparison. Cities can select any two other taxonomic groups for indicators 7 and 8 (e.g., bryophytes, fungi, amphibians, reptiles, freshwater fish, molluscs, dragonflies, beetles, spiders, hard corals, marine fish, seagrasses, sponges, etc.) The above data from the first application of the Singapore Index would be recorded in Part I: Profile of the City as the baseline. Net change in species from the previous survey to the most recent survey is calculated as: Total increase in number of species (as a result of re-introduction, rediscovery, new species found, etc.) minus number of species that have gone extinct. WHERE TO GET DATA FOR CALCULATIONS Possible sources of data include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.	BASIS OF SCORING Data listed in Part I: Profile of the City will be used to measure change in species diversity. Cities' first application will be considered as the baseline information for all subsequent monitoring. In their subsequent applications of the Index, cities will calculate the net change in species for the respective taxonomic groups. The scoring range below is based on the acceptance that it is not easy to recover or re-introduce species successfully over a short period of time. However, species recovery, re-introduction and restoration efforts must be given due recognition. 0 points: maintaining or a decrease in the number of species 1 point: 1 species increase 2 points: 2 species increase 3 points: 3 species increase 4 points: 4 species or more increase

Table 7.2: Native freshwater fish listed in 2006 City of Los Angeles CEQA Threshold Guide and sensitivity status. (See Appendix A2 for codes).

Fish				
Catostomus santaanae	Santa Ana sucker	CSC, FT	1,3	RV
Eucyclogobius newberryi	tidewater goby	CSC, FE, FPD, FCH	4	BW
Gasterosteus aculeatus williamsoni	unarmored threespine stickleback	FE, FPCH, SE, SFP	Unknown	
Gila orcutti	arroyo chub	CSC	1,2,3,4	RV
Onchorhynchus mykiss	southern steelhead	FE, FCH, CSC	Unknown	
Rhinichthys osculus ssp. 3	Santa Ana speckled dace	CSC	1	RV

Appendix B8: Singapore Index Indicator 8

SI Indicator 8: Change in # Reptiles and Amphibian Species

1. **Datasets Used:**
    a. Dataset Name: Natural History Museum Los Angeles County/I-Naturalist RASCals
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: https://www.inaturalist.org/observations/export?projects%5B%5D=rascals
        iii. Original Source Metadata: https://nhm.org/site/activities-programs/citizen-science/rascals/about
        iv. Dataset Discussion: List and spatial data of reptile and amphibian species observed across in Southern California.

2. **Other Datasets Considered**
    a. UCLA CaleDNA

3. **Method**

    IMPORTANT NOTE: This measurement is a preliminary baseline measurement and future measurements are required to determine change.

    a. Indicator #8 GIS Map File Location: \\htpgis3\General_Users\RAD
    b. Download iNaturalist RASCals “project” observations
    c. Download iNaturalist RASCALs program observations.
    d. Remove all non-research grade observations.
    e. Remove all observations ouside of City extent rectangle (east boundary -118.156 decimal degrees lon; west boundary -118.668 decimal degrees lon; north boundary 34.337 decimal degrees lat; south boundary 33.704 decimal degrees lat).
    f. NOTE: some observations will be outside of City boundary.
    g. Create list (see Table 8.2).

h. Remove records only identified to genus level (to avoid possible double counting).

i. Classify as native or non-native (performed by Dr. Brad Schafer, UCLA)

j. FUTURE: compare future observations to identify change.

4. Methods Notes

a. A scientific field survey, or more extensive verification of citizen science observations by experts to expand “Research” grade observations in the City, would improve this assessment approach.

b. As was mentioned in the Expert Council workshop, emphasis on species that are known to be rare or extirpated from the City would provide a more focused approach. A list of these species should be produced and monitored in the future.

Table 8.1: Singapore Index User’s Manual Instructions for Indicator 8

CBI	INDICATORS	VARIABLES	SCORE
Native Biodiversity	**INDICATORS 4 - 8: CHANGE IN NUMBER OF NATIVE SPECIES**		
	RATIONALE FOR SELECTION OF INDICATOR As this is an Index focussing on biodiversity in cities, it is essential that the native flora and fauna diversity be incorporated as indicators. Three key taxonomic groups that are most surveyed worldwide, i.e., plants, birds and butterflies, have been selected as “core indicators”. To ensure fairness and objectivity in the Index, cities can select two other taxonomic groups that would reflect their best biodiversity. To ensure that these five indicators on species are unbiased against any city based on its geographical location, ecological history, size, land use, etc., it was decided that • All cities and local authorities are requested to list the number of native species of a) vascular plants, b) birds, c) butterflies, d) at least two other taxonomic groups, and e) any other taxonomic groups that they have data, in Part I: Profile of the City • The indicators will measure the change in number of species over time rather than the absolute number of species • The first year of application will be taken as the baseline year for the species count. The net change in species numbers (increase in number of species due to re-introduction or restoration efforts minus the number of species that went extinct) will be incorporated in the subsequent calculations of the Singapore Index. Conducting more surveys on the target groups (to document new species or rediscoveries) and reintroducing locally extinct native species would help to increase the number of extant native species.	HOW TO CALCULATE INDICATORS The change in number of native species is used for indicators 4 to 8. The three core groups are: • Indicator 4 : vascular plants • Indicator 5 : birds • Indicator 6 : butterflies These groups have been selected as data are most easily available and to enable some common comparison. Cities can select any two other taxonomic groups for indicators 7 and 8 (e.g., bryophytes, fungi, amphibians, reptiles, freshwater fish, molluscs, dragonflies, beetles, spiders, hard corals, marine fish, seagrasses, sponges, etc.) The above data from the first application of the Singapore Index would be recorded in Part I: Profile of the City as the baseline. Net change in species from the previous survey to the most recent survey is calculated as: Total increase in number of species (as a result of re-introduction, rediscovery, new species found, etc.) minus number of species that have gone extinct. WHERE TO GET DATA FOR CALCULATIONS Possible sources of data include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.	BASIS OF SCORING Data listed in Part I: Profile of the City will be used to measure change in species diversity. Cities’ first application will be considered as the baseline information for all subsequent monitoring. In their subsequent applications of the Index, cities will calculate the net change in species for the respective taxonomic groups. The scoring range below is based on the acceptance that it is not easy to recover or re-introduce species successfully over a short period of time. However, species recovery, re-introduction and restoration efforts must be given due recognition. 0 points: maintaining or a decrease in the number of species 1 point: 1 species increase 2 points: 2 species increase 3 points: 3 species increase 4 points: 4 species or more increase

Table 8.2 Reptiles and amphibians falling within the Los Angeles boundary extent rectangle (may include some species observed outside of the City). *Bold records indicate native species that were included in the counts presented in the Biodiversity Report.*

Species/Subspecies/Variety	*Species/Subspecies/Variety*
Actinemys pallida	***Hypsiglena ochrorhyncha***
Anaxyrus boreas	***Hypsiglena ochrorhyncha klauberi***
Anaxyrus boreas halophilus	*Lampropeltis*
Aneides lugubris	***Lampropeltis californiae***
Anniella	***Lampropeltis multifasciata***
Anniella stebbinsi	*Lithobates catesbeianus**
*Anolis carolinensis**	***Phrynosoma blainvillii***
*Apalone spinifera**	*Pituophis catenifer*
*Apalone spinifera emoryi**	***Pituophis catenifer annectens***
*Apalone spinifera spinifera**	***Pituophis catenifer catenifer***
Aspidoscelis tigris	*Plestiodon skiltonianus*
Aspidoscelis tigris stejnegeri	***Plestiodon skiltonianus skiltonianus***
Batrachoseps major	*Podarcis Siculus**
Batrachoseps major major	***Pseudacris cadaverina***
Batrachoseps nigriventris	***Pseudacris hypochondriaca***
*Chrysemys picta bellii**	*Pseudemys nelson**
Coluber flagellum	*Ramphotyphlops braminus**
Coluber flagellum piceus	***Rana draytonii***
Coluber lateralis	*Rena humilis*
Coluber lateralis lateralis	***Rena humilis humilis***
Crotalus oreganus	***Salvadora hexalepis virgultea***
Crotalus oreganus helleri	***Sceloporus occidentalis***
Diadophis punctatus	***Sceloporus occidentalis longipes***
Diadophis punctatus modestus	***Tantilla planiceps***
Elgaria multicarinata	***Taricha torosa***
Elgaria multicarinata multicarinata	***Thamnophis hammondii***
Elgaria multicarinata webbii	*Trachemys scripta**
Ensatina eschscholtzii eschscholtzii	*Trachemys scripta elegans**
*Graptemys pseudogeographica**	*Trachemys scripta scripta**
*Graptemys pseudogeographica kohnii**	***Uta stansburiana***
*Hemidactylus garnotii**	***Uta stansburiana elegans***
*Hemidactylus platyurus**	*Xenopus laevis**
*Hemidactylus turcicus**	

*= non-native species

Appendix B9: Singapore Index Indicator 9

SI Indicator 9: Proportion of Protected Natural Areas in the City

1. **Datasets Used:**
    a. Dataset 1 Name: California Protected Areas Database 2016
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: http://www.calands.org/data
        iii. Dataset Discussion: Includes all protected lands and can include parks, golf courses, cemeteries, habitat reserves, etc. Level of protection varies and most are owned by cites.

    b. Dataset 2 Name: California Conservation Easement Database 2016
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: http://www.calands.org/cced
        iii. Dataset Discussion: Includes all protected lands. High level of protection for all sites as most are managed by conservancies.

    c. Dataset 3 Name: CALVEG Southern Coast Section
        i. Dataset Filename: ExistingVegSouthCoast2002_2010_v2.gdb
        ii. Dataset Location: \\htpgis3\General_Users\RAD
        iii. Original Source: https://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192
        iv. Original Source Metadata:

            https://www.fs.fed.us/r5/rsl/projects/gis/data/vegcovs/scoast/ExistingVegSouthCoast2002_2010_v2.html
        v. Dataset Discussion: Only complete and uniform dataset of natural vegetation available for the entire City. Some level of error due to statewide extent and resolution. This dataset does not identify small natural, naturalized, or restoration areas well. Also, data was collected over 10 years starting approximately 1998 which will result in some error due to landcover change.

2. Other Datasets Considered

a. Los Angeles County Sensitive Ecological Areas - Level of protection varies, Expert Council deemed protection insufficient and dataset was not used.

b. The City of Los Angeles is also working on designating Sensitive Ecological Areas.

c. ESHAs (Environmental Sensitive Habitat Areas – California Coastal Zone, includes LAX Dunes and Ballona Wetlands – shapefile status unknown)

3. Method

a. Indicator #9 GIS Map File Location: \\htpgis3\General_Users\RAD

b. Natural areas delineation - see for Indicator 1 (Table 1.1)

c. Identify natural areas that fall within and outside of protected areas. All natural areas falling within CPAD and CCED polygons are considered protected.

d. Evaluate level of protection for SEAs to determine if all natural areas in this area are in fact protected. Define “protected” as needed.

e. Calculate total area protected natural areas, determine %.

4. Methods Notes

a. This will likely be an underestimate since it does not capture small areas and “naturalized” or “restored” vegetation well.

b. A few areas that were inspected, including the LAX Dunes, revealed native natural areas classified as non-native vegetation.

Table 9.1: Singapore Index User's Manual Instructions for Indicator 9

CBI	INDICATORS	VARIABLES	SCORE
Native Biodiversity	**INDICATOR 9: PROPORTION OF PROTECTED NATURAL AREAS**		
	RATIONALE FOR SELECTION OF INDICATOR Protected or secured natural areas indicate the city's commitment to biodiversity conservation. Hence, the proportion of protected or secured natural areas is an important indicator. The definition of protected natural areas should be broadened to include legally protected, formally secured areas, and other administratively protected areas, as different cities have different terminologies and means for protecting their natural areas.	HOW TO CALCULATE INDICATOR (Area of protected or secured natural areas) ÷ (Total area of the city) × 100% WHERE TO GET DATA FOR CALCULATIONS Possible sources of data include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.	BASIS OF SCORING The following points are awarded for the respective proportions of protected natural areas in the city: 0 points: < 1.4% 1 point: 1.4% - 7.3% 2 points: 7.4% - 11.1% 3 points: 11.2% - 19.4% 4 points: > 19.4%

Appendix B10: Singapore Index Indicator 10

SI Indicator 10: Proportion of Invasive Species

1. **Datasets Used (invasive plants only):**
    a. Dataset 1 Name: Cal-IPC Weedmaps
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: https://calweedmapper.cal-ipc.org/spatial-data/#download
        iii. Original Source Metadata: http://cal-ipc.org/ip/index.php
        iv. Dataset Discussion: This dataset contains a recorded observations of invasive species across the state and an indication of their level of abundance and spread by USGS quad. Specific locations within quads are not provided.
    b. Dataset 2 Name: Calflora Observation Point Data
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: http://www.Calflora.org/entry/wsearch.html
        iii. Original Source Metadata: http://www.Calflora.org/occ/about.html
        iv. Dataset Discussion: This dataset contains a compilation of recorded observations across the state going back decades. Observation accuracy is considered high, but location precision varies. Many observations are from more wild areas of the state and likely does not represent a complete inventory of urban areas.

2. **Other Datasets Considered**
    a. Center for Invasive Species Research at UC Riverside website includes list of invasive species. Unclear if all are present in Los Angeles. http://cisr.ucr.edu/invasive_species.html
    b. California Invasive Species List includes all species, in addition to plant species. Mapped data has not been located. http://ice.ucdavis.edu/invasives/home/species; http://www.iscc.ca.gov/docs/californiainvasivespecieslist.pdf
    c. Early Detection and Distribution Mapping System includes county-level mapping of non-plant invasive species (however only 9 species are listed

for Los Angeles County)
https://www.eddmaps.org/tools/recordsbysubject.cfm

d. Consortium of California Herbaria also has point and polygon data, but sorting for invasive species is time-prohibitive for this initial effort. Uncertain at this time if these records are included in Calflora. http://ucjeps.berkeley.edu/consortium/

e. CALVEG includes non-native vegetation types, several of which may include large proportions of invasive species.

3. Method

IMPORTANT NOTE: This measurement is a preliminary baseline measurement and future measurements are required to determine change.

a. Indicator #10 GIS Map File Location: \\htpgis3\General_Users\RAD

b. Download all invasive plant species quads for California from calweedmapper link per above.

c. Clip quads to City boundary

d. Identify list of species present in quads that intersect with the City boundary

e. Remove species listed as “Suspected Absent from Quad” and “Expert Was Not Familiar with the Species”, and “Presumed Eradicated from the Quad”.

f. Remining is list of species present in the City. See table 10.2

g. Count number of species divide by total # plant species per SI Indicator #4

4. Methods Notes

a. Inventory of non-plant invasive species is needed. However, determining % per SI user manual for all species requires a count of all species present in the county from all taxa, which is likely not available. However, the general assumption is that there are around 2000 named species of biota in the Los Angeles County. Number present in the City is unclear.

Table 10.1: Singapore Index User's Manual Instructions for Indicator 10

CBI	INDICATORS	VARIABLES	SCORE
Native Biodiversity	**INDICATOR 10: PROPORTION OF INVASIVE ALIEN SPECIES**		
	RATIONALE FOR SELECTION OF INDICATOR Invasive alien species out-compete native species and, thus, threaten the survival of native species and the integrity of ecosystems. As cities are very open to influx of alien species, this indicator measures the status of this threat. The definition of alien invasive species adopted follows that accepted by the SCBD, i.e.: An alien species whose introduction and/or spread threatens biological diversity (For the purposes of the present guiding principles, the term "invasive alien species" shall be deemed the same as "alien invasive species" in Decision V/8 of the Conference of the Parties to the Convention on Biological Diversity). It is inevitable for cities, which are open to external influences, to have alien species. Alien species which are not invasive or detrimental to native species are not considered in this indicator. In fact exotic or alien species enhance the diversity in many cities. Cities can decide on the taxonomic groups which are most problematic for their city or where most data are available.	HOW TO CALCULATE INDICATOR To ensure that the comparison of invasive alien species with that of native species is meaningful, it would have to be a comparison of identical taxonomic groups. (Number of invasive alien species) ÷ (Total number of species) × 100% WHERE TO GET DATA FOR CALCULATIONS Possible sources of data include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.	BASIS OF SCORING The scoring range is based on the premise that the more invasive alien species that are in the city; the more destructive impact will be to the native species. 0 points: > 30.0% 1 point: 20.1% - 30.0% 2 points: 11.1% - 20.0% 3 points: 1.0% - 11.0% 4 points: < 1.0%

Table 10.2: Cal-IPC WeedMapper invasive plant species present in USGS quads that overlap with the City of Los Angeles *(some species may occur in portions of quads that fall outside of the City boundary)*

Acacia dealbata	*Festuca myuros*
Acacia melanoxylon	*Festuca perennis*
Acroptilon repens	*Ficus carica*
Aegilops triuncialis	*Foeniculum vulgare*
Ageratina adenophora	*Gazania linearis*
Agrostis stolonifera	*Genista monspessulana*
Ailanthus altissima	*Geranium dissectum*
Albizia lophantha	*Glebionis coronaria*
Alternanthera philoxeroides	*Hedera helix* and *H. canariensis*
Anthemis cotula	*Helminthotheca echioides*
Arctotheca calendula	*Hirschfeldia incana*
Arctotheca prostrata	*Holcus lanatus*
Arundo donax	*Hordeum marinum*
Asparagus asparagoides	*Hordeum murinum*
Asphodelus fistulosus	*Hypochaeris glabra*
Atriplex semibaccata	*Hypochaeris radicata*
Avena barbata and *A. fatua*	*Iris pseudacorus*
Avena fatua	*Kochia scoparia*
Bassia hyssopifolia	*Lepidium chalepense*
Brachypodium distachyon	*Lepidium latifolium*
Brassica nigra	*Limonium ramosissimum*
Brassica rapa	*Lobularia maritima*
Brassica tournefortii	*Malephora crocea*
Bromus diandrus	*Marrubium vulgare*
Bromus hordeaceus	*Medicago polymorpha*
Bromus japonicus	*Mesembryanthemum crystallinum*
Bromus madritensis ssp. *rubens*	*Myoporum laetum*
Bromus tectorum	*Myriophyllum aquaticum*
Buddleja davidii	*Nicotiana glauca*
Cakile maritima	*Olea europaea*
Carduus pycnocephalus	*Oxalis pes-caprae*
Carduus tenuiflorus and *C. pycnocephalus*	*Pennisetum clandestinum*
Carpobrotus chilensis	*Pennisetum setaceum*
Carpobrotus edulis	*Phalaris aquatica*
Centaurea melitensis	*Phoenix canariensis*
Centaurea solstitialis	*Plantago lanceolata*
Chondrilla juncea	*Polypogon monspeliensis*
Cirsium vulgare	*Pyracantha angustifolia, crenulata, seratus,* etc.
Conium maculatum	*Raphanus sativus*
Cortaderia jubata	*Ricinus communis*

Cortaderia selloana	*Robinia pseudoacacia*
Cotoneaster franchetii	*Rubus armeniacus*
Cotoneaster lacteus	*Rumex acetosella*
Cotoneaster pannosus	*Rumex crispus*
Cotula coronopifolia	*Salsola paulsenii*
Cynara cardunculus	*Salsola tragus*
Cynodon dactylon	*Schinus molle*
Cytisus scoparius	*Schinus terebinthifolius*
Cytisus striatus	*Schismus arabicus* and *S. barbatus*
Dactylis glomerata	*Silybum marianum*
Delairea odorata	*Sisymbrium irio*
Descurainia sophia	*Spartium junceum*
Digitalis purpurea	*Stipa capensis*
Dittrichia graveolens	*Stipa miliacea* var. *miliacea*
Echium candicans	*Tamarix aphylla*
Ehrharta calycina	*Tamarix parviflora*
Ehrharta erecta	*Tamarix ramosissima*
Erodium cicutarium	*Tetragonia tetragonioides*
Eucalyptus camaldulensis	*Torilis arvensis*
Eucalyptus globulus	*Trifolium hirtum*
Euphorbia lathyris	*Verbascum thapsus*
Euphorbia terracina	*Vinca major*
Euphorbia virgata	*Washingtonia robusta*
Festuca arundinacea	*Zantedeschia aethiopica*

Appendix B11: Singapore Index Indicator 11

SI Indicator #11: Regulation of Quantity of Water – Pervious Surfaces

1. **Raw Datasets Used:**
    a. Dataset 1 Name: LA_City_Imperviousness
        i. Dataset Filename: LA_City_Imperviousness
        ii. Dataset LASAN Location: \\htpgis3\GIS_Users\WPD\Projects\Special_Requests\Singapore_Index_Biodiversity\SingaporeIndexBiodiversity_DataCollection.gdb\LA_City_Imperviousness
        iii. Source Data: N/A
        iv. Metadata: N/A
        v. Dataset Discussion: The LA City Imperviousness layer is constructed from two data sources. The 2005 SCAG (Southern California Association of Governments) landuse classification layer and the 2006 Los Angeles County Hydrology Manual which assigns runoff values for each landuse category. The runoff value in this dataset range between 0 and 1 indicating total retention and total runoff respectively.

            The cutoff value between pervious and impervious has traditionally been set to .42 as this is the runoff value for High Density Single Family Residential parcels of which most City areas are comprised off.

2. **Method**
    a. See Singapore Index Methods for Indicator #11 in Table 11.1
    b. Indicator ArcGIS Geodatabase file: LA City Imperiousness
    c. Data processing methods step 1 : Calculate the total area of the City using the above dataset = 300,664 Acres

        Data processing methods step 2 : Calculate the total area of the City with a impervious value equal to or less than .42 = 187,066 Acres
    d. (187,066 / 300,664)*100 = 62.22% = 2 Points

Table 11.1: Singapore Index User's Manual Instructions for Indicator 11

CBI	INDICATORS	VARIABLES	SCORE
Ecosystem Services	**INDICATOR 11: REGULATION OF QUANTITY OF WATER**		
	RATIONALE FOR SELECTION OF INDICATOR Climate change is in many places predicted to result in increased variability in precipitation which in urban landscapes may translate into high peaks in water flow and damage to construction, business and transport. Vegetation has a significant effect in reducing the rate of flow of water through the urban landscape, e.g. through presence of forest, parks, lawns, roadside greenery, streams, rivers, waterbodies, etc.	HOW TO CALCULATE INDICATOR Proportion of all permeable areas (including areas identified in indicator 1 plus other parks, roadside, etc. but excluding artificial permeable surfaces*, if applicable) to total terrestrial area of city (excluding marine areas under the city's jurisdiction). (Total permeable area) ÷ (Total terrestrial area of the city) × 100% WHERE TO GET DATA FOR CALCULATIONS Possible sources of data include government environmental agencies, city municipalities, urban planning, water and land agencies, satellite images, etc. *See http://en.wikipedia.org/wiki/Permeable_paving	BASIS OF SCORING The following points are awarded for the respective proportions of permeable areas in the city: 0 points: < 33.1% 1 point: 33.1% - 39.7% 2 points: 39.8% - 64.2% 3 points: 64.3% - 75.0% 4 points: > 75.0%

Appendix B12: Singapore Index Indicator 12

SI Indicator #12: Carbon Storage and Cooling Effects of Tree Canopy

1. **Raw Datasets Used:**
    a. Dataset 1 Name: TreeCanopyPoly2
        i. Dataset Filename: TreeCanopyPoly2
        ii. Dataset LASAN Location: \\htpgis3\GIS_Users\WPD\Projects\Special_Requests\Singapore_Index_Biodiversity\SingaporeIndexBiodiversity_DataCollection.gdb
        iii. Source Data: This dataset was compiled from the 2006 4-inch Color Infrared Orthophotography – LAR-IAC. The spectral band for tree vegetation was extracted and converted into a polygon layer on a desktop computer in 2007
        iv. Metadata: https://egis3.lacounty.gov/dataportal/2010/02/19/2006-4-inch-color-infrared-cir-orthophotography/
        v. Dataset Discussion: The dataset represents a mid-resolution level analysis of the tree canopy as seen in the above mentioned CIR layer.
    b. Dataset 2 Name: boelapoly.shp
        i. Dataset Filename: boelapoly.shp
        ii. Dataset LASAN Location: \\htpgis3\GIS_Data\BOUNDARY\boelapoly.shp
        iii. Source Data: This dataset is created and maintained by the Los Angeles Bureau of Engineering and represents a polygon of the City area.
        iv. Metadata: A public version of this dataset can be found at (http://geohub.laCity.org).
        v. Dataset Discussion: The resolution of the original grids had to be down sampled in order to process the hundreds of tiles on a desktop computer which has led to a ~-25% error. We have carried out a trothing exercise to come up with our degree of error by manually drawing out the tree canopy within 6 study areas around the City. The total area of tree canopy in the shapefile is ~46,000 Acres and by adding to it 25% we approximate a total area of 57,500 Acres of tree canopy or approximately 88 sq. miles.

2. Method

a. See Singapore Index Methods for Indicator #12 in Table 12.1

b. Indicator ESRI Geodatabase Name: TreeCanopyPoly2

c. Indicator ESRI Shapfile Name: boelapoly

d. Calculate Area of Tree Canopy in TreeCanopyPoly2 ~ 46,000 Acres

e. Manually calculate tree canopy area in 5 sample sites across City to find error in original dataset = ~25%

f. Arrive at new approximate tree canopy area for City = 57,500 Acres

g. Divide tree canopy area by total City area (302,993 / 57,500)*100 = 18.98 = 1 Point

Table 12.1: Singapore Index User's Manual Instructions for Indicator 12

CBI	INDICATORS	VARIABLES	SCORE
Ecosystem Services	**INDICATOR 12: CLIMATE REGULATION: CARBON STORAGE AND COOLING EFFECT OF VEGETATION**		
	RATIONALE FOR SELECTION OF INDICATOR Two important aspects of climate regulation services are carbon storage and cooling effects provided by vegetation, in particular tree canopy cover. Climate regulation services are affected by many factors, including the size of trees, the different characteristics of tree species, and other variables. With regards to carbon storage, plants capture carbon dioxide during photosynthesis, hence, capturing carbon that is emitted by anthropogenic activities. Canopy cover of trees, which includes those that are naturally occurring and planted in a city, is accepted here as an indirect measure of the carbon sequestration and storage services. Plants, through shading, evapotranspiration, and decreasing the proportion of reflective surfaces, reduce the ambient heat in the air and the surface temperature in the urban landscape. As a general rule, a 10% increase in vegetation cover reduces the temperature by about three degrees. The extent of tree canopy cover can also act as a proxy measure for filtering of air and numerous other biodiversity benefits. Planting of native trees to increase the canopy cover is encouraged. This indicator is optional for cities in the desert or arid zones or other ecological zones where extensive canopy cover in the city may not be feasible.	HOW TO CALCULATE INDICATOR Carbon storage and cooling effect of vegetation (Tree canopy cover) ÷ (Total terrestrial area of the city) × 100% WHERE TO GET DATA FOR CALCULATIONS City councils and satellite images.	BASIS OF SCORING The more trees there are in a city, the higher would be the carbon stock of ecosystem services value provided. Tree canopy cover is being used here as a proxy measurement of the number of trees in a city. The following points are awarded for the respective proportions of canopy cover within the city: 0 points: < 10.5% 1 point: 10.5% - 19.1% 2 points: 19.2% - 29.0% 3 points: 29.1% - 59.7% 4 points: > 59.7%

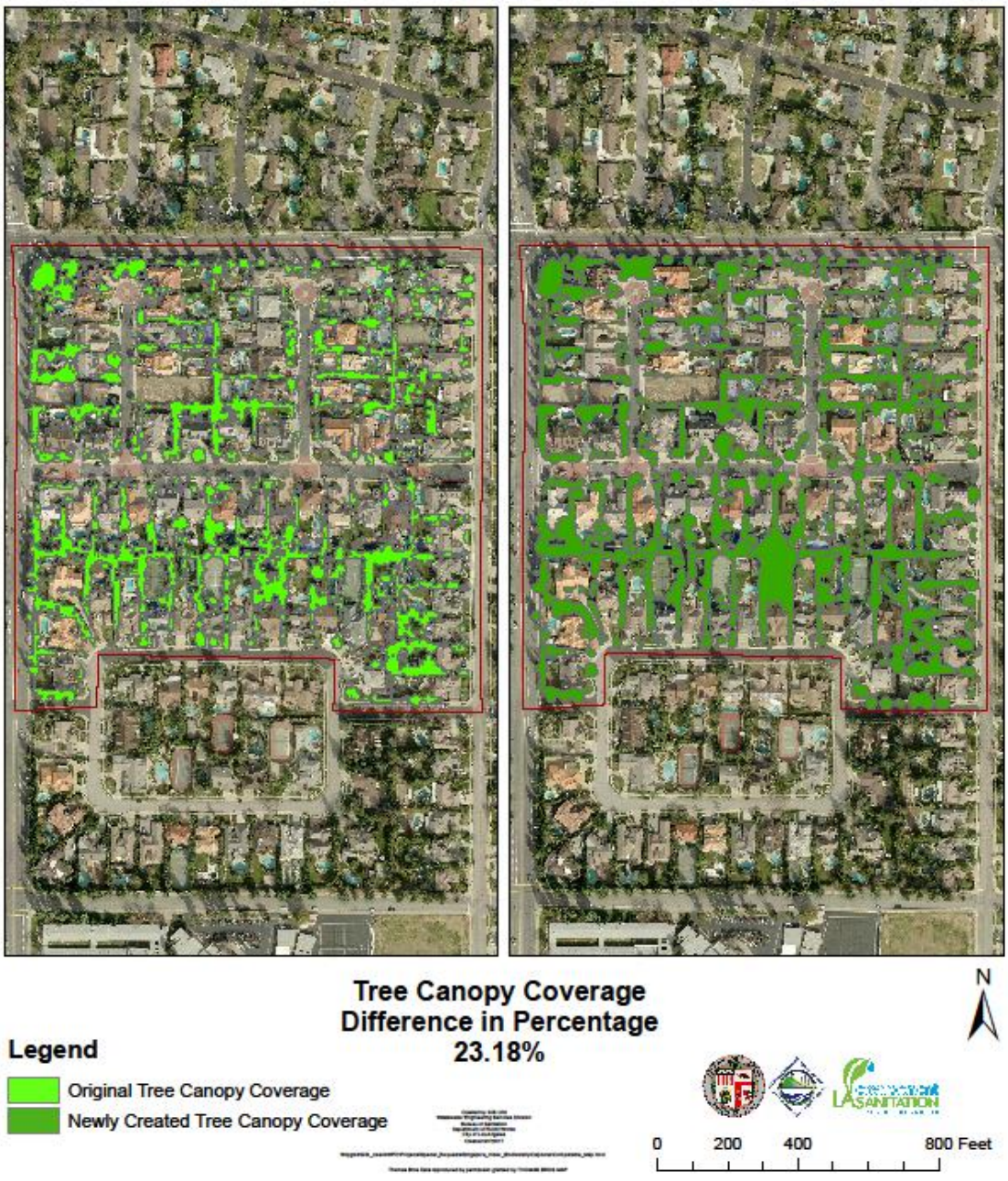

Figure 12.2: Tree Canopy Data Error Analysis Valley Area 4

Appendix B13: Singapore Index Indicator 13

SI Indicator 13: Accessible Natural Areas in the City

1. **Datasets Used:**
    a. Dataset 1 Name: California Protected Areas Database 2016
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: http://www.calands.org/data
        iii. Dataset Discussion: Includes all protected lands and can include parks, golf courses, cemeteries, habitat reserves, etc. Level of protection varies and most are owned by cites.

    b. Dataset 2 Name: California Conservation Easement Database 2016
        i. Dataset Location: \\htpgis3\General_Users\RAD
        ii. Original Source: http://www.calands.org/cced
        iii. Dataset Discussion: Includes all protected lands. High level of protection for all sites as most are managed by conservancies.

    c. Dataset 3 Name: CALVEG Southern Coast Section
        i. Dataset Filename: ExistingVegSouthCoast2002_2010_v2.gdb
        ii. Dataset Location: \\htpgis3\General_Users\RAD
        iii. Original Source: https://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192
        iv. Original Source Metadata:

            https://www.fs.fed.us/r5/rsl/projects/gis/data/vegcovs/scoast/ExistingVegSouthCoast2002_2010_v2.html

        v. Dataset Discussion: Only complete and uniform dataset of natural vegetation available for the entire City. Some level of error due to statewide extent and resolution. This dataset does not identify small natural, naturalized, or restoration areas well. Also, data was collected over 10 years starting approximately 1998 which will result in some error due to landcover change.

2. Other Datasets Considered

a. Public Lands Parks Score (TPL)

b. LA Co Parks and Open Space Dt Needs Assessment (2015)

c. Greenvisions

d. Other natural areas data sources per Indicator 1.

3. Method

a. Indicator #13 GIS Map File Location: \\htpgis3\General_Users\RAD

b. Select CPAD polygons in Los Angeles with “Access_Typ” field classification as “OpenAccess” or “Restricted Access”.

c. Select CCED polygons with “pubaccess” field as “Open” (Note all appear to be closed in Los Angeles)

d. Indicator guidelines direct users to measure the total area of parks that contain natural areas. However, given that many of the natural areas fall within very large national forest (parks), we instead measured the area of accessible natural area within the City. Identify selected CCED and CPAD polygons that contain natural areas per delineation from Indicator 1, calculate total areas of CCED and CPAD polygons (including non-natural areas within the polygons).

e. Divide total area in hectares by 3.98 million/1000.

4. Methods Notes

a. This will likely be an underestimate since CALVEG does not capture small natural areas, or “naturalized” or “restored” areas. There are many additional parks that include natural areas.

Table 13.1: Singapore Index User’s Manual Instructions for Indicator 13

CBI	INDICATORS	VARIABLES	SCORE
Ecosystem Services	**INDICATORS 13 –14: RECREATIONAL AND EDUCATIONAL SERVICES**		
	RATIONALE FOR SELECTION OF INDICATOR Biodiversity provides invaluable recreational, spiritual, cultural and educational services. It is essential for physical and psychological health.	HOW TO CALCULATE INDICATOR **Indicator 13:** (Area of parks with natural areas and protected or secured natural areas)*/1000 persons *Some cities refer to this as accessible green spaces **Indicator 14:** Average number of formal educational visits per child below 16 years to parks with natural areas or protected or secured natural areas per year WHERE TO GET DATA FOR CALCULATIONS Indicator 13: City councils Indicator 14: School records	BASIS OF SCORING **Indicator 13:** 0 points: < 0.1 ha/1000 persons 1 point: 0.1 - 0.3 ha/1000 persons 2 points: 0.4 - 0.6 ha/1000 persons 3 points: 0.7 - 0.9 ha/1000 persons 4 points: > 0.9 ha/1000 persons **Indicator 14:** 0 points: 0 formal educational visit/year 1 point: 1 formal educational visit/year 2 points: 2 formal educational visits/year 3 points: 3 formal educational visits/year 4 points: > 3 formal educational visits/year

Appendix B14: Singapore Index Indicator 14

SI Indicator 14: Recreation and Education: Number of Formal Education Visits per Child Below 16 Years to Parks with Natural Areas per Year

1. **Datasets Used:**
   LAUSD Student Population by grade. Only 5th graders participate in formal visits to natural areas annually, as part of the LAUSD Outdoor Education program.

2. **Other Datasets Considered**
   a. LAUSD Outdoor Education and Sustainability Initiatives Programs Data
   b. Nature Center, Zoo, Natural History Museum, and Aquarium Group Visits Data
   c. Schoolyard Habitat Data

3. **Method**
   a. See Singapore Index Methods for Table 14-1.
   b. Collect data from Los Angeles Unified School District (LAUSD) for total student population under 16 years old and 5th grade cohort.
   c. Assume 1 visit per 5th grader. While some 5th graders do not participate for various reasons, other students from different grades may visit natural areas as part of individual class or school programs that are not well tracked, so we assume these factors offset.
   d. Divide 5th grade population by total student population to produce average visits per year.

4. **Methods Notes**
   a. While data is available on school visits to nature centers, aquaria and museums, and zoos, since the formal educational visit to a natural area is not a standard experience across and within age groups annually and our City parks don't typically log visitors, it was determined that we could not measure these visits in a meaningful way, especially because it was per child. It was also assumed that because there is no requirement for formal education visits to natural areas, that on average children under 16 in Los Angeles have 0 average formal educational visits/year to a natural area. The only grade that has a required natural area visit is 5th grade. For that particular cohort, we could assume on average 1-3 or more formal educational visits/year in their 5th grade year only, and data would be available from the LAUSD Outdoor Education program.
   b. With this indicator, the SI measures the educational services provided by biodiversity to people by calculating the average number of formal educational visits per child below 16 years to parks with natural areas or protected or secured natural areas per year from school records. The suggested method of measurement is "average # of formal education visits per child below 16 years to parks with natural areas per year." In Los Angeles, there is no requirement for or precedent for monitoring annual formal education visits to parks with natural areas per child below 16 years. Furthermore, it is not a standard experience for

students to go to natural areas on formal educational visits every year. Therefore, no dataset exists for this suggested calculation for this indicator.

c. Meaningful data could be collected once a standardized requirement affecting all children is in place and is being implemented; or when LAUSD begins to track student visits to natural areas by age. This may happen as a result of this index measurement effort.

Table 14-1: Singapore Index User's Manual Instructions for Indicator 14

CBI	INDICATORS	VARIABLES	SCORE
Ecosystem Services	**INDICATORS 13 –14: RECREATIONAL AND EDUCATIONAL SERVICES**		
	RATIONALE FOR SELECTION OF INDICATOR Biodiversity provides invaluable recreational, spiritual, cultural and educational services. It is essential for physical and psychological health.	HOW TO CALCULATE INDICATOR **Indicator 13:** (Area of parks with natural areas and protected or secured natural areas)*/1000 persons *Some cities refer to this as accessible green spaces **Indicator 14:** Average number of formal educational visits per child below 16 years to parks with natural areas or protected or secured natural areas per year WHERE TO GET DATA FOR CALCULATIONS Indicator 13: City councils Indicator 14: School records	BASIS OF SCORING **Indicator 13:** 0 points: < 0.1 ha/1000 persons 1 point: 0.1 - 0.3 ha/1000 persons 2 points: 0.4 - 0.6 ha/1000 persons 3 points: 0.7 - 0.9 ha/1000 persons 4 points: > 0.9 ha/1000 persons **Indicator 14:** 0 points: 0 formal educational visit/year 1 point: 1 formal educational visit/year 2 points: 2 formal educational visits/year 3 points: 3 formal educational visits/year 4 points: > 3 formal educational visits/year

Appendix B15: Singapore Index Indicator 15

SI Indicator 15: Budget Allocated to Biodiversity

1. **Datasets Used:**
    a. Individual Department administration division budgets (biodiversity project tracking is unprecedented).
    b. Dataset Discussion: This indicator evaluates the financial commitment of the City government toward the maintenance and enhancement of biodiversity. Biodiversity is protected, maintained, and enhanced through the implementation and maintenance of projects, programs and facilities/land that protect, maintain, and enhance biodiversity. Examples are: CEQA and NEPA review on projects, and the implementation of biological conservation/avoidance measures such as construction/project biological monitoring and endangered species protection/avoidance measures, preserve and habitat management, maintenance and enhancement activities, native landscaping and natural lands restoration projects. Actual budget allocated to such activities may be obtained from the Chief Administrative Office which could coordinate with departmental administration divisions to obtain the budget allocation information. Biodiversity expenditure tracking and allocation is unprecedented in the City; biodiversity expenditures would need to be estimated as a fraction of any current expenses and allocations documented; values obtained by this method may not be meaningful. The Expert Council did not want mitigation expenses/allocations to be counted, and wanted only specifically projects/programs/environmental and planning processes with biodiversity as an explicit purpose/objective to be counted including biodiversity components of capital improvement projects. It would be very difficult to parse out acceptable expenses/allocations based on these parameters, without establishing a protocol for future reporting. City department data was solicited with poor response/results and in a form that could not be parsed out to meet the parameters outlined by the Expert Council.

2. **Other Datasets Considered**
    a. Departmental projects/programs with biodiversity components allocated budgets.
    b. Departmental CEQA/NEPA division budgets
    c. Departmental preserve/natural lands management and endangered species habitat management and enhancement budgets.

3. **Method**
    a. See Singapore Index Methods for Indicator 15 (Table 15-1).
    b. Collect data from individual departments on biodiversity-related expenses that are not related to regulatory compliance, and legally-required mitigation or environmental commitment project/measure (request $ amounts spent on projects listed for Indicator 16 that meet the guidelines).
    c. Sum amount spent on biodiversity related administration for all City departments, and divide total by total budget of City x 100%

d. Use Singapore Index Methods Indicator 15 Basis of Scoring to determine scoring.
e. During this baseline assessment, it was assumed that most expenses/allocations for biodiversity-related work incurred/made by the City were for regulatory compliance and fulfillment of legal mitigation and environmental commitment requirements, any eligible expenses would fall short of the $36M (0.4% of total City budget) threshold per annum for 0 vs. 1 points. For these reasons, it was assumed that the baseline score for Indicator 15 is “0”.

4. Methods Notes

a. Most effective method recommended moving forward: formal request made by City Council motion for an annual report from the CAO 1) that would contain the information needed for this indicator and performs Steps “a-d”, and 2) in order to facilitate integration of biodiversity-related budgeting, allocation, and expenditure tracking into the current project planning, budgeting, capital improvement program planning, and annual reporting processes.
b. Additional recommendations can be found in Aug. 30-31 Workshop summary.

Table 15-1: Singapore Index User's Manual Instructions for Indicator 15

CBI	INDICATORS	VARIABLES	SCORE
Governance and Management	**INDICATOR 15: BUDGET ALLOCATED TO BIODIVERSITY**		
	RATIONALE FOR SELECTION OF INDICATOR This indicator evaluates the financial commitment of city governments towards the maintenance and enhancement of biodiversity. The relative amount spent on biodiversity related administration by a city can be seen as a representation of the city's commitment towards environmental stewardship. It is recognised that there are numerous other factors affecting the amount allocated towards biodiversity, but in general the greater the proportion of the total city's budget allocated, the greater the level of commitment by the city. In cities where the functions of maintaining greenery and biodiversity conservation are also assigned to the private sector or government linked corporations, the budget for these government linked companies or the amount of government funds paid to the private sector may also be included in the calculations.	HOW TO CALCULATE INDICATOR (Amount spent on biodiversity related administration) ÷ (Total budget of city) × 100% Computation should include the city's or municipality's manpower budget as well as its operational and biodiversity related project expenditures. The calculation may also include the figures of government linked corporations that have a component spent on biodiversity, and the amount of government funds paid to private companies for biodiversity related administration where such figures are available. WHERE TO GET DATA FOR CALCULATIONS Possible sources of data include government agencies responsible for biodiversity conservation and finance departments. For cities where the budgets of government linked companies are included, annual reports of those companies can provide relevant data.	BASIS OF SCORING The following points are awarded for the respective proportions of the city budget allocated to biodiversity: 0 points: < 0.4% 1 point: 0.4% - 2.2% 2 points: 2.3% - 2.7% 3 points: 2.8% - 3.7% 4 points: > 3.7%

Table 15-2: Allocated Biodiversity Budget

(Functions based on Biodiversity-Related Functions Identified in the City of LA General Plan Conservation Element) (http://planning.laCity.org/cwd/gnlpln/ConsvElt.pdf)

Functional Unit	Allocated Annual Budget	Comments/Notes
Biodiversity Conservation/Education Institutions		
Cabrillo Marine Aquarium	$3,000,000	From Administration.
Friends of Cabrillo Marine Aquarium		
Greater Los Angeles Zoo Association	$15,232,000	Total operational expenditures ($15,661,000) From 2015-2016 annual report less $137,800 spent on endangered species recovery field work listed below.
Harbor Community Benefit Foundation (Habitat component)	$171,000	HCBF Community Benefits Grants (assume 30%) from 2014 HCBF annual report
Inyo County Eastern Sierra Interagency Visitor Center (DWP)		
LA Parks Foundation (Natural parks component)		
LA Zoo and Botanical Gardens	$18,688,678	Includes cost of housing/transferring the 121+ species that are managed under Species Survival Programs under the Association of Zoos & Aquariums and/or are endangered. Total operational expenditures ($19,202,000) from 2015-2016 annual report less $513,322 spent on endangered species recovery field work.
Park Rangers (Natural parks interpretive component)		
Subtotal	**$38,034,000**	
Departmental Environmental Planning /Approvals Divisions		
Airports	$	
Bureau of Street Services Tree Removal Permit Support (For mitigation-based and development-based (dead/hazard)). Includes info about avoiding nesting/breeding season.		
Building and Safety		
City Planning		
Environmental Affairs Division		No Longer Exists
General Services Division		
Harbor		
Housing		
Public Works – Bureau of Engineering		

Functional Unit	Allocated Annual Budget	Comments/Notes
Public Works - LA Sanitation	$170,000	Regulatory Affairs Division Staff working on CEQA. No contract work last year.
Recreation and Parks		
Transportation		
Water and Power	$6,800,000	Based on environmental contractor budgets used for CEQA/NEPA work. Staff budget not included.
Other Lead Agencies City Development Project Implementation		
Other City Agencies That Own or Manage Properties Identified		
Subtotal	**$7,970,000**	
Departmental Biological Resources/Biodiversity Management/Conservation Divisions		
Los Angeles World Airports LAX Dunes Butterfly Preserve SEA/ Endangered Species Protection, Propagation and Survival Enhancement and Habitat Management Programs	$	
Department of Water and Power Endangered Species Conservation Program		
Harbor Department Endangered Species Butterfly Preserve/ Endangered Species Protection, Propagation and Survival Enhancement Conservation Program		
LASAN Facilities/Properties Habitat Conservation/ Environmental Stewardship Program	$900,000	Environmental Services Group (Regulatory Affairs Division) ($500K grant); staff and contracts
Department of Public Works Facilities/Properties Habitat Conservation/Environmental Stewardship Program		
Public Works BOSS Urban Forestry/Tree Ordinance Enforcement Program (Ordinances 153,500 and 177,404)		
City of LA Legislative Program for the Protection of Endangered, Threatened, Sensitive and Rare Species and Their Habitats and Habitat Corridors City Legislative Program (Mayor, City Council, CLA)		
LARAP Endangered Species Conservation Program		
Other Agencies Responsible for Property Management; Endangered Species Conservation Program		
LA Zoo Endangered Species Protection, Propagation and Survival Enhancement Programs	$496,502 (Zoo) (US Species) $2,000 (GLAZA) (US Species) $135,800 (GLAZA) (Intl Species) $16,820 (Zoo) (Int'l Species)	Cost of housing/transferring the 121+ species that are managed under Species Survival Programs under the Association of Zoos & Aquariums and/or are endangered are captured in the operational costs listed above. Full CA condor recovery costs are included here.

Functional Unit	Allocated Annual Budget	Comments/Notes
Subtotal	**$1,651,122**	
Departmental Biological Resources/Biodiversity Management/Conservation Divisions		
Citywide Protection, restoration and enhancement of habitat areas, linkages and corridor segments Program	$	
Department of Water and Power Stocking or Management of Fisheries at Lake Crowley and Other City-Owned or Managed Lakes and Fisheries Outside the City Boundaries		
Dept of City Planning Forest Conservation Program		Does not exist yet.
Dept of City Planning Habitat Conservation Program		
Dept of Recreation and Parks Development of parklands adjoining, in proximity to or which link with the Angeles Forest and Santa Clarita woodlands with uses compatible with Forest Habitat Protection, Trail and Corridor Systems and Forest Facilities		
Dept of Water and Power Chatsworth Reservoir Nature Reserve SEA Habitat Management Program		
LARAP and City Legislative Program - City Habitat Area and Corridor Acquisition for Habitat Recovery Efforts for Species Protection and Recreational Uses Program		
LARAP Lake Fish Stocking or Enhancement Program		
Subtotal	$ 0	
Departmental Biological Resources/Biodiversity Management/Conservation Divisions (continued)		
City Legislative Program Endangered Species and Habitat Conservation, and Bay and Coastal Protection, Enhancement and Habitat Restoration Program	$	
LADWP Facilities/Properties Habitat Conservation/Environmental Stewardship Program		
LAWA Facilities/Properties Habitat Conservation/Environmental Stewardship Program		
Subtotal	**$ 0**	
Departmental Mitigation and Environmental Commitment, Monitoring and Reporting Units		
Airports	$	
Building and Safety		
City Planning		
Environmental Affairs Division		No longer exists.
General Services Division		

Functional Unit	Allocated Annual Budget	Comments/Notes
Harbor		
Housing		
Public Works – Bureau of Engineering		
Public Works - LA Sanitation	$51,700,000	Environmental Monitoring and Watershed Protection Divisions
Recreation and Parks		
Transportation		
Water and Power		
Other Lead Agencies City Development Project Implementation		
Other City Agencies That Own or Manage Properties Identified		
Subtotal	**$51,700,000**	
NPDES Permit Implementation		
Coordinating Agency LASAN NPDES Permit Implementation	$600,000.00	NPDES Permit Section (Regulatory Affairs Division)
Harbor Department Harbor Ecosystem Management		
Enforcement of NPDES Permits and Laws Prohibiting Discharge of Contaminants into the Bays and their Tributaries : LASAN Monitoring and Enforcement Divisions	$9,290,467.00	$3.3M TMDL/MS4 permit monitoring (WPD); $5,990,467 NPDES Receiving Water, Watershed (MS4, CIMP, BMP), and Landfill Monitoring
LASAN Research and Experimentation Division for Improvement of Efficiency of Wastewater Processing Facilities in Maintaining High Water Quality Standards	$2,567,343.00	Regulatory & Process Control Monitoring at LASAN's four Water Reclamation Plants, Influent & Effluent Monitoring, AWPF/AOP Monitoring Support (at TIWRP & DCTWRP), QA/QC, LIMS, and Special Studies for compliance & continuous improvement.
Subtotal	**$12,457,810**	
Total	**$111,161,810**	

Appendix B16: Singapore Index Indicator 16

SI Indicator 16: Number of Biodiversity Projects Implemented by the City Annually

1. **Datasets Used:**
    a. Expert Council Workshop - List of projects generated by workshop participants
    b. Departmental lists of projects (not all available)

2. **Other Datasets Considered**
    a. Departmental lists of projects
    b. Projects completed in partnership with non-profits

3. **Method**
    a. See Singapore Index Methods for Indicator 16 in Table 16-1.
    b. Obtain lists of biodiversity projects from City Departments. Ask respondents to indicate whether projects are voluntary or legally required, and whether they benefit ecosystem services and/or biodiversity.
    c. Tally the number of projects. All projects were counted without consideration as to whether they were mitigation measures, environmental commitments or regulatory compliance projects.
    d. Use Singapore Index Methods Indicator 16 Basis of Scoring to determine scoring.

4. **Methods Notes**
    a. Most cost-effective method may be to make a formal request for a report from the CAO made by the City Council motion. The report should contain a multi-year list of City biodiversity activities (projects, programs, staff etc.) and budget amounts allocated (Indicator 15) for those activities.

5. **Results**

    4 points – An estimated 114 programs/projects were tallied (see Table 16-2 for details).

Table 16-1: Singapore Index User's Manual Instructions for Indicator 16

CBI	INDICATORS	VARIABLES	SCORE
Governance and Management	**INDICATOR 16: NUMBER OF BIODIVERSITY PROJECTS IMPLEMENTED BY THE CITY ANNUALLY**		
	RATIONALE FOR SELECTION OF INDICATOR This indicator measures the number of biodiversity related projects and programmes that the city authorities are involved in, either as the main player or in partnerships with other entities where the city is a key collaborator. Programmes and projects are not limited to the conservation of protected areas but could include those pertaining to species conservation (e.g. plants, birds and butterflies), species recovery, biodiversity surveys, biodiversity enhancement projects, restoration projects, procurement of green services, etc. For a project or a programme to be included in this indicator, biodiversity must be an important consideration in the stated objectives. A programme designed to conserve species that are non-native to the city, but threatened elsewhere (e.g. zoo species conservation projects) can be considered as well.	HOW TO CALCULATE INDICATOR Number of programmes and projects that are being implemented by the city authorities, possibly in partnership with private sector, NGOs, etc. per year. In addition to submitting the total number of projects and programmes carried out, cities are encouraged to provide a listing of the projects and to categorise the list into projects that are: 1. Biodiversity related 2. Ecosystems services related WHERE TO GET DATA FOR CALCULATIONS Possible sources of data include city authorities, private corporations and NGOs that conduct such activities, etc.	BASIS OF SCORING The following points are awarded for the respective numbers of biodiversity related programmes or projects in the city: 0 points: < 12 programmes/projects 1 point: 12 - 21 programmes/projects 2 points: 22 - 39 programmes/projects 3 points: 40 - 71 programmes/projects 4 points: > 71 programmes/projects

Table 16-2: Current City Biodiversity and Ecosystem Service Projects

	City Dept	Biodiversity Project/Program Name (can be in pre-design, design, implementation or completed stages)	Voluntary Action (Y/N)	Required Mitigation or Compliance Action? (Y/N)	Ecosystem Services Project (Y/N)	Biodiversity Project (Y/N)
1	RAP	Aliso Canyon Park	Y	N		
2	DWP	Analysis of Air Photos to detect possible changes in plant communities, prior to and since the completion of the Second Los Angeles Aqueduct				
3	DWP	Analysis of habitat conditions for the threatened Yellow-billed Cuckoo along Baker and Hogback Creeks.				
4	ZOO	Anti-Bushmeat Education	Y	N	N	Y
5	ZOO	Armenian Viper	Y	N	N	Y
6		Arroyo Secco/LAR Confluence Restoration				
7	ZOO	Asian Elephant Education/Protection	Y	N	N	Y
8	ZOO	Asian Vulture	Y	N	N	Y
9	LARAP	Baldwin Hills Nature Conservancy				
10		Ballona Wetlands Restoration				
11	LASAN/ RAP	Bee Canyon Park	Y	N		
12	DWP	Big Pine Regreening				
13	DWP	Big Pine Tree Planting				
14	ZOO	Black-wing Starling	Y	N	N	Y
15	ZOO	Bushmaster Survey	Y	N	N	Y
16	ZOO	California Condor Breeding & Reintroduction	Y	N	N	Y
17		Common Ground Mountains to Sea Watershed and Open Space Plan				
18		Compton Creek Wetlands				
19	ZOO	Consultation on Creation of Ndogo Chimpanzee Sanctuary	Y	N	N	Y
20	DWP	Continuation of payments by DWP to the Inyo County General Fund				
21	DWP	Continuation of payments by DWP to the Inyo County Water Department				
22	DWP	Detailed inventory of flora and fauna at Owens Valley springs and seeps				
23	DWP	Develop mitigation plans for impacts identified in the EIR and Inyo/Los Angeles Agreement		Y		
24	DWP	Development of a GIS program for Owens Valley				
25	DWP	Development of a Land Management Plan for DWP lands				
26	DWP	Development of a Livestock Grazing Management Plan				
27	DWP	Development of a Recreation Plan for Haiwee Reservoir				
28	LASAN	Drain Multi-use Enhancement Project/ Multi-species Habitat Restoration/LBV Recovery Actions, Arroyo chub				
29	ZOO	Drill Conservation	Y	N	N	Y
30	ZOO	Drill Reintroduction	Y	N	N	Y
31	DWP	DWP biologist conducts first field studies to determine the extent of saltcedar (Tamarisk) infestation in the Owens Valley, and prepares report documenting the most effective control methods.				
32	DWP	DWP Lawn Rebate Program				

	City Dept	Biodiversity Project/Program Name (can be in pre-design, design, implementation or completed stages)	Voluntary Action (Y/N)	Required Mitigation or Compliance Action? (Y/N)	Ecosystem Services Project (Y/N)	Biodiversity Project (Y/N)
33	DWP	DWP Public Affairs Office establishes Public Information Officer position in Bishop Administrative Office, to improve public contact in Northern District (Inyo & Mono Counties)				
34	DWP	DWP to accomplish on-site mitigation efforts at Hines Spring				
35	DWP	DWP to fund a saltcedar control program				
36	DWP	DWP to provide funds for County Parks Rehabilitation, Development, and Maintenance				
37	DWP	DWP to provide funds to City of Bishop for Parks and Environmental Assistance				
38	DWP	DWP to re-vegetate impacted acreage as identified in the EIR on Groundwater Pumping		Y		
39	Eagle Scouts/ LAWA	Eagle Scout Projects (e.g., picnic tables, coastal dune restoration project, storage bin, starling trap, nursery bird netting structures)	Y		Y	Y
40	DWP	Eastern California Museum				
41	DWP	Eastern Sierra Environmental Capital - Mono Basin Restoration				
42	DWP	Eastern Sierra Environmental O&M - Mono Basin Restoration				
43	LASAN	Ed P. Reyes Greenway	Y			
44	DWP	Evaluate feasibility of establishing waterfowl habitat east of highway 395 at Diaz Lake				
45	ZOO	Fiji Crested Iguana Survey	Y	N	N	Y
46	ZOO	Free-flying Bats monitored in Zoo	Y	N	N	Y
47	ZOO	Gharial survey	Y	N	N	Y
48	ZOO	Giant Otter/Local Awareness & protection	Y	N	N	Y
49	ZOO	Giant Salamander	Y	N	N	Y
50	Girl Scouts/ FOLD/ LAWA	Girl Scout and California Native Plant Society (CNPS) projects: Adopt-a-Dune, Friends of the LAX Dunes, Gold Award project	Y		Y	Y
51	ZOO	Grauer's gorilla rescue & rehabilitation	Y	N	N	Y
52		Hansen Dam Basin Arundo Control				
53	ZOO	Harpy Eagle release	Y	N	N	Y
54		Headworks LAR Ecosystem Restoration				
55	DWP	In 1987, property at the site of a seldom used primitive campsite at Benton Crossing, on the Owens River north of Crowley Lake, leased to a concessionaire for use as a modern campground facility.				
56	DWP	In 1988, property adjacent to the Mono County Museum in Lee Vining leased for a day-use park and picnic area				
57	DWP	In 1989, DWP installs fencing around Layton Spring, on the east shore of Crowley Lake, to protect the site from impacts caused by indiscriminant camping and by large numbers of livestock driven through the area on public-participation cattle drives.				
58	DWP	Independence Ditch System				
59	DWP	Independence Pasturelands				
60	DWP	Independence Regreening				
61	DWP	Independence Rest Area				

62	DWP	Independence Springfield				
	City Dept	Biodiversity Project/Program Name (can be in pre-design, design, implementation or completed stages)	Voluntary Action (Y/N)	Required Mitigation or Compliance Action? (Y/N)	Ecosystem Services Project (Y/N)	Biodiversity Project (Y/N)
63	DWP	Independence Wood Lot				
64	LASAN/ LADWP	IRWMP/IRP OneWaterLA	Y	Y		Y
65	ZOO	Jaguar Conservation & Protection	Y	N	N	Y
66	ZOO	Javian Warty Pig - Development of in-situ breeding protocol	Y	N	N	Y
67	DWP	Klondike Lake				
68	ZOO	Komodo Dragon monitoring	Y	N	N	Y
69	DWP	LA Aqueduct Biodiversity and Habitat Management, Protection, Preservation, and Restoration of Habitat that Enhances and Maintains Biodiversity				
70	LASAN	LA River Restoration				
71	DWP	Laws Museum				
72	DWP	Laws-Poleta Native Pasturelands				
73	LAWA	LAX Dunes Long-Term Habitat Management Plan Implementation			Y	Y
74	DWP	Lone Pine Regreening				
75	DWP	Lone Pine Riparian Park				
76	DWP	Lone Pine Sports Complex				
77	DWP	Lone Pine Wood Lot				
78		Lopez Canyon Equestrian	Y	N	N	N
79	DWP	Lower Owens River O&M - Lower Owens River Restoration				
80	DWP	Lower Owens River Project				
81	LASAN	Machado Lake Ecosystem Rehabilitation				
82	DWP	Manzanar Clean-up				
83	DWP	McNally Ponds and Pasturelands				
84	DWP	Millpond Recreation Area				
85	ZOO	Monitoring of local Polillo Island fauna	Y	N	N	Y
87	ZOO	Mountain Yellow-legged Frog breeding and reintroduction	Y	N	N	Y
88	LASAN/ RAP	North Atwater Park Stormwater Treatment Native Plantings	Y			
89	DWP	North Lond Pine Clean-up				
90	RAP	Oro Vista Park	Y	N		
91	ZOO	Peninsular Pronghorn Recovery	Y	N	N	Y
92	DWP	Potential expansion of some elements of the City of Los Angeles' Water Conservation Program				
93	DWP	Range Management O&M - Livestock Grazing Management				
94	DWP	Release of DWP properties to Inyo County				
95	DWP	Resource Management O&M - LADWP Land Management				
96	DWP	Richards and Van Norman Fields				
97	RAP	Riverside Park	Y			

	City Dept	Biodiversity Project/Program Name (can be in pre-design, design, implementation or completed stages)	Voluntary Action (Y/N)	Required Mitigation or Compliance Action? (Y/N)	Ecosystem Services Project (Y/N)	Biodiversity Project (Y/N)
98	ZOO	Saiga Anti-Poaching Program	Y	N	N	Y
99	ZOO	Saola Conservation	Y	N	N	Y
100	LASAN/ RAP/ USACE	Sepulveda Basin Wildlife Area and Projects Fish, Birds, Wildlife				
101	LASAN/ RAP	Sepulveda Basin Wildlife Reserve				
102	DWP	Shepherd Creek Alfalfa Field				
103	ZOO	Sonoran Pronghorn recovery	Y	N	N	Y
104	SAN	Southern California Coastal Water Research Project				
105		State of the River				
106	ZOO	Tadjik Markhor & Dukhara Urial	Y	N	N	Y
107	ZOO	Tagua in-situ breeding for reintroduction	Y	N	N	Y
108	LASAN/ LA RIVER Office	Taylor Yard				
109	DWP	Transfer of Town Water Systems from DWP to local control				
110	DWP	Tree Planting along Roads				
111		Tujunga Wash Native Fish Restoration				
112	ZOO	Uakari habitat assessment/monitoring	Y	N	N	Y
113	BOSS	Urban Forestry Protected Tree Ordinance 177404 Revision and Amendment	Y	N	Y	Y
114	RAP	Via Dolce Park	Y	N		

Appendix B17: Singapore Index Indicator 17

SI Indicator 17: Policies, Rules and Regulations - Existence of Local Biodiversity Strategy and Action Plan

1. **Datasets Used:**
   City Biodiversity Policies/Plans, Rules and Regulations
   State Biodiversity Policies/Plans, Rules and Regulations
   Federal Biodiversity Policies/Plans, Rules and Regulations

2. **Other Datasets Considered**
   Project and Program Plans

3. **Method**
   a. See Singapore Index Methods for Indicator 17 in Table 17-1.
   b. Met with City Planning and Building and Safety to determine what the existing biodiversity policies, rules and regulations are, and what the status of the local biodiversity strategy and action plan is.
   c. Compare City action plan initiatives with CBD initiatives per Singapore Index Methods per Indicator 17 Basis of Scoring.
   d. Determine score per Indicator 17 Basis of Scoring.

Table 17-1: Singapore Index User's Manual Instructions for Indicator 17

CBI	INDICATORS	VARIABLES	SCORE
Governance and Management	**INDICATOR 17: POLICIES, RULES AND REGULATIONS – EXISTENCE OF LOCAL BIODIVERSITY STRATEGY AND ACTION PLAN**		
	RATIONALE FOR SELECTION OF INDICATOR To ensure that there is good governance, sound policies must be formulated. To facilitate the implementation of biodiversity management policies, rules and regulations must be put in place. This section evaluates the existence of policies, rules and regulations relevant to biodiversity, in particular if they are aligned with the national agenda and CBD's initiatives, like the National Biodiversity Strategy and Action Plan (NBSAP) and/or the correspondent subnational strategies. Some of the CBD initiatives include plant conservation, forest biodiversity, global taxonomy initiative, invasive species programme, marine biodiversity conservation, protected areas, etc. The initiatives might not be termed "Local Biodiversity Strategy and Action Plan" (LBSAP) as long as the city can justify that a similar plan exists.	HOW TO CALCULATE INDICATOR Status of LBSAP (or any equivalent plan); number of associated CBD initiatives. WHERE TO GET DATA FOR CALCULATIONS Possible sources of data include city councils, CBD national focal points, ICLEI-Local Governments for Sustainability LAB Initiative, United Nations University and IUCN or CBD websites and publications.	BASIS OF SCORING To ensure that biodiversity is conserved in a city, it is advisable to formulate and implement an LBSAP (or any equivalent plan). This needs to be aligned with the NBSAP so that biodiversity conservation efforts are synchronised and synergised. 0 points: No LBSAP* 1 point: LBSAP not aligned with NBSAP 2 points: LBSAP incorporates elements of NBSAP, but does not include any CBD initiatives** 3 points: LBSAP incorporates elements of NBSAP, and includes one to three CBD initiatives 4 points: LBSAP incorporates elements of NBSAP, and includes four or more CBD initiatives * LBSAP or equivalent. ** The thematic programmes of work and cross-cutting issues of the CBD are listed in http://www.cbd.int/programmes/. The Strategic Plan for Biodiversity (2011-2020), including the Aichi Biodiversity Targets can also be used as a reference framework (http://www.cbd.int/sp/default.shtml).

4. Methods Notes

a. The City pLAn includes high level objectives for urban biodiversity, and the City General Plan Conservation Element contains high level objectives for habitat and biodiversity. An action plan is needed to achieve and go beyond “no-net-loss of biodiversity” per the Sustainable City pLAn, and the biodiversity Council Motion.

5. Results

0 points – In summary, no unified strategy and action plan exists that is aligned with existing state and federal biodiversity and climate change adaptation policies and programmatic and funding priorities). Identified state and federal biodiversity policies and guidances are described in further detail below.

The City has an outdated General Plan Conservation Element (2001) that needs to be updated. When the Conservation Element is updated to include biodiversity objectives and current science, all community and specific plans that make up the General Plan will need to be updated to include updated conservation elements, and more specifically coastal elements in the coastal zone. The General Plan Conservation Element contains objectives related to biodiversity and habitat management, as does the more up-to-date Health and Wellness Element. Aside from these planning documents, there are vision and implementation plans that have biodiversity/habitat restoration and enhancement action elements for different sites in the City. Because they are outdated, they are not fully in alignment with the more updated state, federal and international biodiversity strategies that take climate change impacts into account. These are described further below. The proprietary departments have some biodiversity efforts taking place, but most are not voluntary or pro-active. No unified biodiversity strategy or implementation unit exists in the City. Biodiversity management is not integrated/mainstream, but plans are in place to develop a Citywide Biodiversity Strategy. The evolution of biodiversity conservation planning efforts in the City of Los Angeles and the various milestone policy documents created along this path to the future biodiversity strategyare depicted in Figure 17.1.

Figure 17.1 – Evolution of City of Los Angeles Biodiversity Conservation Planning

The City of Los Angeles has a high-level general City wide policy, the General Plan, the Conservation Element of that plan, and more specific local sub-policy documents, Community and Specific Plans that sometimes contain conservation elements that include elements for conserving and enhancing biodiversity. The City also has more detailed plans with action elements that include biodiversity components, such as the LA River Restoration Plan and the Health and Wellness Element of the General Plan. These plans are not named “Local Biodiversity Strategy and Action Plan (LBSAP)”, but they are partly equivalent in that they include some strategy elements and some action elements.

The City’s LBSAP, less the action plan component, is the City’s General Plan, with the Conservation and Open Space Elements, the Framework Element Open Space and Conservation Chapter, and the related elements of the more Community and Specific Plans being the most relevant. Many of these plan elements are outdated and in need of an update. Community and Specific Plans will need to be updated to include Conservation Elements, as well. Communities in coastal areas need Coastal elements added to their Community and Specific Plans, as well that align their plans with the Coastal Act and enable adoption as local coastal plans.

In addition, some City of LA protected ecosystems have local conservation and/or habitat management plans, and many CEQA Environmental Impact

Report and NEPA Environmental Impact Assessment Documents and their related Mitigation Monitoring and Reporting and Implementation Plans contain measures related to biodiversity conservation and enhancement. Other additional non-General Plan and non-CEQA/NEPA[1] plans, policies, rules, regulations and procedures have been developed that also contain biodiversity conservation and enhancement measures. These elements align with national wildlife (and habitat) protection, management and enhancement policies, rules and regulations under the jurisdiction of the US Fish and Wildlife Service, and with some of the Convention on Biological Diversity (CBD) Aichi Targets as shown in Table 17-1. In addition, the City implementation of the CEQA and NEPA environmental review processes and environmental regulatory agency permitting procedures at the local level ensures that biodiversity and other environmental protection policies and regulations implemented through these procedures are considered in decisions regarding project design and implementation.

On a national level, biodiversity management is lead by the US Department of Fish and Wildlife (FWS). In 2010, FWS released a climate change strategy entitled "Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change" which establishes a basic framework within which the Service will work as part of the larger conservation community to help ensure the sustainability of fish, wildlife, plants and habitats in the face of accelerating climate change. The three key strategies of the plan are adaptation, mitigation, and engagement including a focus on wildlife linkages. FWS's Wildlife and Sport Fish Restoration Program State Wildlife Grant (SWG) Program "provides Federal grant funds to State fish and wildlife agencies for developing and implementing programs that benefit wildlife and their habitats, including species that are not hunted or fished. Grant funds may be used to address a variety of conservation needs–such as research, fish and wildlife surveys, species restoration, habitat management, and monitoring—that are identified within a State's Wildlife Action Plan. These funds may also be used to update, revise, or modify a State's Plan" which usually includes specific biodiversity protection and enhancement activities throughout the State that CDFW issues grant monies to local organizations to implement.

Written under the direction of the California Department of Fish and Wildlife (CDFW), the State of California's Wildlife Action Plan (SWAP) received its first update in 2015. The SWAP and its companion plans are not regulatory documents; they provide a collaborative "vision and framework for conserving the state's natural heritage by prescribing, prioritizing and recommending actions to serve these resources before they become more costly to protect" (Webpage:https://www.wildlife.ca.gov/SWAP). Companion plans were prepared in the following 9 sectors identified as having significant influences on sensitive ecosystems within the state, and a recognized opportunity to partner with others toward a common goal of safeguarding natural and cultural heritages of the state": "agriculture, consumptive and recreational uses, energy development,

[1] CEQA - California Environmental Quality Act; NEPA - National Environmental Policy Act

forests and rangeland, land-use planning, transportation planning, tribal lands, water management and marine resources".

In addition to the recent SWAP Update, the state also released in 2016, "A Climate Change Vulnerability Assessment of California's Terrestrial Vegetation", and in 2014 the "Safeguarding California Plan – California's Climate Adaptation Strategy" with a section specifically on Biodiversity and Habitats. The Safeguarding California Plan is currently undergoing its mandated 2017 update. These documents guide conservation efforts within the context of accelerating climate change, much like the 2010 FWS strategic plan did. The City of Los Angeles' Sustainable City pLAn includes strategies and initiatives for climate adaptation including the development of a no-net-loss biodiversity strategy, and a climate adaptation plan. City biodiversity strategy planning efforts and climate adaptation planning are not yet aligned with one another and with these state and federal policies with respect to biodiversity.

FWS also coauthored the 2012 2nd Edition of the National Fish Habitat Action Plan with the National Fish Habitat Action Partnership. "The National Fish Habitat Action Plan (Action Plan) is a non-regulatory, voluntary plan designed to protect, restore, and enhance the nation's fish and aquatic communities through regional Fish Habitat Partnerships. The Action Plan is a strategy to help maximize the impact of federal conservation dollars on the ground." In alignment with the National Fish Habitat Action Plan, the State CA Water Action Plan includes measures for the protection and enhancement of anadromous fish habitat.

CDFW issues grants for local projects that meet the goals of the CA Water Action Plan, the State Wildlife Action Plan and the Safeguarding California Plan Climate Adaptation Strategy for Biodiversity and Habitats through its various grant programs.

Written over a decade before these recent state and federally-approved publications became available and were recently updated, the City's General Plan Open Space, and Biodiversity and Habitat Conservation elements and frameworks and other plan documents are outdated and/or do not provide adequate detail regarding biodiversity management. As such, an update is needed to ensure alignment with current federal, state, regional and local biodiversity and related natural resource management efforts, current scientific knowledge and paradigms, and current planning efforts and paradigms. An up-to-date biodiversity strategy and action plan would optimize the City's ability to obtain CDFW, FWS and other funding for biodiversity projects.

Table 17-2 shows "biodiversity" policies identified by City project managers that they align their projects with, and how these policies fulfill international Convention on Biological Diversity (CBD) targets. As shown, none of these previously discussed guidelines are currently being used by City project managers to incorporate biodiversity and ecosystem services enhancement into project designs.

Table 17-2: Alignment of City of Los Angeles Biodiversity Policies with Federal Policies and CBD Aichi Targets

CBD Aichi Targets
Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society
Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use
Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity
Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services
Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capaCity building

Name of City Agency Responding	**Plans/Guiding Documents/ Policies/ Procedures/ Regulations that Conserve and Enhance Biodiversity**	**State and Federal Policies/Regulations**	**CBD Target(s) (A-E)**
City Planning	General Plan, Community Plans, Specific Plans, Conservation Element	CA Office of Planning and Research (State)	A, B, C, E
All Project Implementation Agencies/Property Managers, Building and Safety, City Planning	CEQA Mitigation Plans	CEQA (State)	E
All Project Implementation Agencies/Property Managers, Building and Safety, City Planning	NEPA Environmental Commitments	NEPA (Federal)	E
BOE Architectural Division	LID Ordinance (Local)		D
BOE Architectural Division	Protected Trees Ordinances (Local)		B, C
BOE Architectural Division	Green Building Ordinance (LEED) (Local)		
BOE Architectural Division	Landscape Ordinance (Local) and WUCOLS		
BOE Architectural Division	SWPPP	General construction permit - Clean Water Act (Federal)	B

Appendix B18: Singapore Index Indicator 18

SI Indicator 18: Institutional CapaCity: Essential Biodiversity Functions

1. **Datasets Used:**
    a. Directory/List of Institutions Named by Biodiversity Experts

2. **Method**
    a. See Singapore Index Methods for Indicator 18 in Table 18-1.
    b. Obtain list of essential biodiversity-related institutions that the City uses from City Departments and from biodiversity experts. Measure whether the functions of these institutions exist rather than the physical existence of the institution. Two functions may exist in the City under one institution.
    c. Tally the number of functions.
    d. Use Singapore Index Methods Indicator 18 Basis of Scoring to determine scoring.

3. **Results**

    4 points (20 biodiversity functions tallied). Table 18-2 contains a list of function/institutions identified by this measurement and their biodiversity functions. In total, 20 were tallied. This list is not exhaustive.

Table 18-1: Singapore Index User's Manual Instructions for Indicator 18

CBI	INDICATORS	VARIABLES	SCORE
Governance and Management	**INDICATORS 18 – 19: INSTITUTIONAL CAPACITY**		
	RATIONALE FOR SELECTION OF INDICATOR Institutions are necessary for the effective implementation of projects and programmes. Hence, the existence of biodiversity focussed and biodiversity related institutions will greatly enhance biodiversity conservation in a city. Some of the essential institutions include a well managed biodiversity centre, herbarium, zoological garden or museum, botanical garden, insectarium, etc. It is more important to measure whether the functions of these institutions exist rather than the physical existence of these institutions. Hence, if a herbarium is situated in a botanical garden, then two functions exist in the city under one institution. Many biodiversity issues are cross-sectoral and, hence, involve inter-agency efforts. The evaluation of inter-agency coordination is an important indicator of the success of biodiversity conservation, more so in a city where it is so compact. This indicator promotes mainstreaming of biodiversity.	HOW TO CALCULATE INDICATOR **Indicator 18:** Number of essential biodiversity related functions* that the city uses. * The functions could include the following: biodiversity centre, botanical garden, herbarium, zoological garden or museum, insectarium, etc. **Indicator 19:** Number of city or local government agencies involved in inter-agency co-operation pertaining to biodiversity matters. WHERE TO GET DATA FOR CALCULATIONS City councils	BASIS OF SCORING **Indicator 18:** 0 points: No functions 1 point: 1 function 2 points: 2 functions 3 points: 3 functions 4 points: > 3 functions **Indicator 19:** 0 points: one or two agencies* cooperate on biodiversity matters 1 point: three agencies cooperate on biodiversity matters 2 points: four agencies cooperate on biodiversity matters 3 points: five agencies cooperate on biodiversity matters 4 points: More than five agencies cooperate on biodiversity matters * Agencies could include departments or authorities responsible for biodiversity, planning, water, transport, development, finance, infrastructure, etc.

Table 18.1 – Essential Biodiversity-Related Functions Used by the City of Los Angeles

Institution	Biodiversity Function
Bureau of Engineering Herbarium/Environmental Management Group	Supports City Departments in CEQA/NEPA environmental review of projects, including assessing potential biological impacts; assist in the development of mitigation measures or integration of biodiversity protection measures into project design.
Cabrillo Marine Aquarium	Marine aquarium; Educational exhibits; Interpretive program; Biodiversity education with focus on southern California ocean life; Citizen science; Student research mentoring; Popular field trip destination for school-aged children; Off-site teaching visits; Annual island boat trips.
Center for Biological Diversity	Biological diversity research, advocacy, and education/outreach.
City Watershed Protection Division	Watershed enhancement planning for stormwater and receiving water bodies water quality and recapture and reuse; integrated landscape and stormwater infrastructure (streams, rivers, drainages, street drains/bioswales, wetlands etc.) conceptual design and project implementation; hydrological studies; water quality regulatory enforcement.
CSULA Zoological Museum and Herbarium Collections	Natural history collections: extant and fossil plants, birds and their eggs and nests, insects, marine invertebrates, mammals and fish. Extensive entomological and vascular plant holdings.
Inyo County Eastern Sierra Interagency Visitor Center	Provides visitor, wilderness, and highway information for the Eastern Sierra. Staffed by US Forest Service, National Park Service, Bureau of Land Management, and Eastern Sierra Interpretive Association employees, information is available on public lands in Inyo and Mono Counties and beyond. The Eastern Sierra Interpretive Association (ESIA) operates a **bookstore** at the visitor center, with a comprehensive selection of books and maps of the region, and bear resistant food containers for rent or sale.
LA Zoo and Botanical Garden	Plant collection; education and outreach/public awareness; native plant gardens; botanical gardens; international conservation projects; CA Condor and Peninsular Pronghorn Recovery Plans; cooperative species survival plans; research; endangered species recovery.
LASAN Environmental Monitoring Division	Monitors the environment for specific pollutants, pathogens, and native indicator and invasive species.
LAUSD Office of Outdoor and Environmental Education	Provide outdoor and environmental education experiences for students at Clear Creek and Point Fermin Outdoor Education Centers.
Mayor's Office of Sustainability	Provides roadmap and leadership for City implementation of sustainability strategies and initiatives.
National Park Service	Ecosystem/natural resource management advising; interpretive programming/field experiences; nature center operation; teacher training; classroom materials.
Natural History Museum	Archival collections and exhibits, citizen science programs, scientific data collection, field trips, mobile museums, teacher/classroom curriculum, research, research library and tools, education and outreach.
Occidental College Moore Laboratory of Zoology	World-renowned bird collection.

Institution	Biodiversity Function
Santa Monica Mountains Conservancy/ Mountains Recreation and Conservation Authority	Preserves and manages local open space and parkland, watershed lands, trails and wildlife habitat; manages and provides ranger services for almost 73,000 acres of public lands and parks that it owns and that are owned by SMMC or other agencies; provides comprehensive education and interpretation programs for the public; acquires parkland, participates in vital planning processes; completes major park improvement projects; provides natural resources and scientific expertise, critical regional planning services, park construction services, park operations, fire prevention, ranger services, educational leadership programs; one of lead agencies providing for LA River Revitalization. Works with counties and cities within the greater LA area to acquire land and coordinate efforts to create a continuous necklace of public parks, habitat corridors and trails which will link the entire mountain system around the San Fernando and La Crescenta Valleys for the Rim of the Valley Trail Corridor plan which features the creation of permanent habitat corridors to protect endangered and threatened native plant and animal species.
Trust for Public Land	Fundraise for land conservation and parks; protecting and restoring natural spaces; collaborate with communities to plan, design, and create parks, playgrounds, gardens, and trails.
UCLA Donald R. Dickey Bird and Mammal Collection	Collection of birds and mammals of southern California.
Los Nogales Nursery, Audubon Center at Debs Park	Collaborative effort between Audubon Center at Debs Park and the National Park Service. Engages the community and educates people of all ages in environmental stewardship; Grows native plant species from seed collected in Debs Park that are used to restore native habitat throughout the park. Citizen science and conservation.
White Point Nature Preserve and Education Center	102 acres of restored coastal sage scrub habitat, hiking and accessible trails overlooking the ocean and Catalina Island. Nature Education Center serves as a resource for students, families and community groups and a hub for environmental stewardship/volunteering activities. (Managed by PVPLC under agreement with owner (City of LA)).
Sepulveda Basin Wildlife Reserve at the Sepulveda Basin Recreation Area	225-acre site set aside by City of Los Angeles to protect native plants and animals. Over 200 species of birds have been seen in the basin. Many birds attracted by the water, gather here in the fall and winter. A joint project of the US Army Corps of Engineers and LARAP, partnering with community groups.
Los Angeles Airport El Segundo Blue Butterfly Preserve (LAX Dunes Preserve)	Approximately 300 acres set aside by the City of Los Angeles to protect a Fish and Wildlife Service recovery area for the endangered El Segundo blue butterfly. There is an interpretive native plant trail on the northern edge that can be used to access Dockweiler State Beach. Owned by City of Los Angeles World Airports (City of LA).
Ballona Wetlands Ecological Reserve	600 remaining acres of 2,000-acre expanse of marshes, mud flats, salt pans and sand dunes that stretched form Playa del Rey to Venice and inland to Baldwin Hills. Managed by CDFW, owned by state.
Griffith Park (GP)	A biodiversity hot spot with over 4,210 acres of both natural chaparral-covered terrain and landscaped parkland and picnic areas: http://www.laparks.org/griffithpark. Ranger Station: http://www.laparks.org/events for nature walks, and a guided interpretive tour of the nature park discovery center. Camp Hollywoodland for Girls and Griffith Park Boys' Camp. Hiking, horseback riding, picnicking. Natural history

Institution	Biodiversity Function
	survey and additional info/resources at Friends of Griffith Park website: https://www.friendsofgriffithpark.org/.
William O. Douglas Outdoor Classroom (WODOC) and Sooky Goldman Nature Center	WODOC was formed in order to connect inner City youth with California's natural resources. WODOC and the Sooky Goldman Nature Center are located in Franklin Canyon Park, surrounded by 605 acres of natural open space. Franklin Canyon Park serves over 10,000 LAUSD children yearly. The Park is jointly managed by the Santa Monica Mounts Conservancy through the Mountains Recreation and Conservation Authority, the National Park Service, Department of Water and Power, City of LA and City of Beverly Hills.
LA River	LA River attracts over 300 species of migratory birds and supports fish, reptiles, mammals and amphibians, and insects (http://www.theriverproject.org/learn/habitat/wildlife). LA River Cooperation Committee (http://boe.laCity.org/lariver/rcc/River_Cooperation_Committee_Fact_Sheet_rev_03102011.pdf) is a joint working group of the County and City of Los Angeles, with the Army Corps of Engineers serving in an advisory capaCity. See http://lariver.org/ for projects and resources such as the LA River Revitalization Master Plan http://lariver.org/City-contacts. http://boe.laCity.org/lariver/rcc/. LA River Ecosystem Restoration Project: http://www.lariver.org/blog/la-river-ecosystem-restoration.
Ken Malloy Harbor Regional Park/ Machado Lake	Ken Malloy Harbor Regional Park Machado Lake is home to over 300 separate species of migratory birds. The lake is part of the natural water habitat of Southern California for native animals and plants, nature walks, birdwatching, boating, monthly lake-cleanup, Machado Youth camp.
Mildred E. Mathias Botanical Garden @ UCLA	Over 3,000 types of plants grow at the garden and a wide range of environments are found within its borders, from the sunny, dry desert and Mediterranean sections on the eastern edge to the shady verdant interior. A stream and series of ponds run through the center of the garden, home to koi and turtles.
Theodore Payne Foundation for Wildflowers and Native Plants	Seed and bulb program, local source initiative, education and outreach, nursery, plant sales, plant guides, native plant database, living collection, garden share network, classes, garden tours, speakers bureau, reference library, hotline, public projects (gardens in school and public spaces), exhibitions, arts program.
Wayne Lab (UCLA)	A long-standing collaboration with the National Park Service to study carnivore genetics and behavioral ecology in Santa Monica Mountains National Recreational Area (SMMNRA) which extends from Ventura County to just a few miles from downtown Los Angeles adjacent to Griffith Park.

Appendix B19: Singapore Index Indicator 19

SI Indicator 19: Institutional CapaCity: City or Local Government Agency Inter-agency Co-operation Pertaining to Biodiversity Matters

1. **Datasets Used:**
    a. List of biodiversity projects with multiple project agencies involved as identified by City agencies.

2. **No Other Datasets Considered**

3. **Method**
    a. See Singapore Index Methods for Indicator 19 in Table 19-1.
    b. Obtain list of City or local government agencies involved inter-agency co-operation pertaining to biodiversity matters from City departments and from biodiversity experts. This includes cooperation for CEQA/NEPA compliance related to a project. Divide list into ecosystem services projects, and biodiversity enhancement projects.
    c. Use Singapore Index Methods Indicator 19 Basis of Scoring to determine scoring.

Table 19-1: Singapore Index User's Manual Instructions for Indicator 19

CBI	INDICATORS	VARIABLES	SCORE
Governance and Management	**INDICATORS 18 – 19: INSTITUTIONAL CAPACITY**		
	RATIONALE FOR SELECTION OF INDICATOR Institutions are necessary for the effective implementation of projects and programmes. Hence, the existence of biodiversity focussed and biodiversity related institutions will greatly enhance biodiversity conservation in a city. Some of the essential institutions include a well managed biodiversity centre, herbarium, zoological garden or museum, botanical garden, insectarium, etc. It is more important to measure whether the functions of these institutions exist rather than the physical existence of these institutions. Hence, if a herbarium is situated in a botanical garden, then two functions exist in the city under one institution. Many biodiversity issues are cross-sectoral and, hence, involve inter-agency efforts. The evaluation of inter-agency coordination is an important indicator of the success of biodiversity conservation, more so in a city where it is so compact. This indicator promotes mainstreaming of biodiversity.	HOW TO CALCULATE INDICATOR **Indicator 18:** Number of essential biodiversity related functions* that the city uses. * The functions could include the following: biodiversity centre, botanical garden, herbarium, zoological garden or museum, insectarium, etc. **Indicator 19:** Number of city or local government agencies involved in inter-agency co-operation pertaining to biodiversity matters. WHERE TO GET DATA FOR CALCULATIONS City councils	BASIS OF SCORING **Indicator 18:** 0 points: No functions 1 point: 1 function 2 points: 2 functions 3 points: 3 functions 4 points: > 3 functions **Indicator 19:** 0 points: one or two agencies* cooperate on biodiversity matters 1 point: three agencies cooperate on biodiversity matters 2 points: four agencies cooperate on biodiversity matters 3 points: five agencies cooperate on biodiversity matters 4 points: More than five agencies cooperate on biodiversity matters * Agencies could include departments or authorities responsible for biodiversity, planning, water, transport, development, finance, infrastructure, etc.

4. Methods Notes

a. Most cost-effective method may be to make a formal request for a report from the CAO made by City Council motion. The report should contain a multi-year list of City biodiversity activities (projects, programs, staff etc.) (Indicator 16), budget amounts allocated (Indicator 15) for those activities, and names of project agencies leading activity (Indicators 19 and 20).

5. Results

3 points – Five agencies (RAP, LASAN, BOE, BOSS, DWP) cooperate on biodiversity matters Biodiversity is not mainstreamed. The following long-term interdepartmental collaborations that benefit ecosystem services and biodiversity were identified.

1) Santa Monica Bay Restoration/TMDLs: City/local government interagency collaboration for ocean water quality/bay health is spearheaded locally by a state organization, the Santa Monica Bay Restoration Commission (SMBRC). SMBRC has worked with local government agencies to coordinate improvement of water quality and bay health over the last decade, laying the foundation for successful marine ecosystem recovery efforts by SMBRC and partnering cities, agencies, and organizations.

2) Integrated (Water) Resource Plan: The City also has long-term internal interdepartmental cooperative relationships that have helped to lay the foundation for biodiversity health by increasingly moving toward better wastewater treatment and reclamation, stormwater recapture and reuse, and water quality monitoring to ensure the health of LA's water bodies. This partnership between the Departments of Water and Power, LASAN, and other City Departments has resulted in the OneWaterLA Plan.

3) LA River Ecosystem Restoration/Revitalization: An important interagency partnership is embodied in the LA River Office with the Mayor's Office and Bureau of Engineering, Department of Recreation and Parks, LASAN, coordinating with other non-City of LA municipal river restoration partners for the revitalization of the river and development of parklands alongside it. The Los Angeles River Watershed Monitoring Program is another long-standing partnership between the City and the Council for Watershed Health to promote ecological heath of the watershed and community well-being.

4) Prop O Program Multi-Benefit Projects: A partnership between LASAN, City Planning, Bureau of Engineering, Department of Water and Power, and Recreation and Parks also exists for the implementation of multi-benefit projects that improve water quality, increase reuse of treated recycled water, and increase stormwater recapture while restoring drainage systems, wetlands, and other native landscapes, and improving park access.

5) Biodiversity Interdepartmental Team: Recently, for this biodiversity indexing effort, a Biodiversity Interdepartmental Team was formed under the direction of the City Council and with the assistance of Council District 5 and the Mayor's Sustainability Office who have been convening a citizen biodiversity stakeholder group for the last two years. The Interdepartmental Team consists of ten City Departments, Offices, or Bureaus (Los Angeles World Airports, Street Services, Recreation and Parks, Port of LA, Department of Water and Power, LASAN, City Planning, Chief Legislative Office, Council District 5, and the Mayor's Office of Sustainability).

Appendix B20: Singapore Index Indicator 20

SI Indicator 20: Participation and Partnership: Formal or Informal Public Consultation Process Pertaining to Biodiversity

1. **Datasets Used:**
    a. Formal and informal public consultation process pertaining to biodiversity related matters (see multiple agency websites for procedures/policies - Department of Fish and Wildlife, Coastal Commission, City Building and Safety).

2. **No Other Datasets Considered**

3. **Method**
    a. See Singapore Index Methods for Indicator 20 in Table 20-1.
    b. Name and describe formal or informal public consultation processes pertaining to biodiversity matters. Formal processes include, among others, CEQA/NEPA environmental review, and permit applications and approvals. Informal processes include, among others, stakeholder meetings and informal consultations with regulators often during the pre-design/design phase of a construction project or of a maintenance plan.
    c. Use Singapore Index Methods Indicator 20 Basis of Scoring to determine scoring.

Table 20-1: Singapore Index User's Manual Instructions for Indicator 20

CBI	INDICATORS	VARIABLES	SCORE
Governance and Management	**INDICATORS 20 – 21: PARTICIPATION AND PARTNERSHIP**		
	RATIONALE FOR SELECTION OF INDICATOR Indicator 20 evaluates the existence and the state of formal or informal public consultation process pertaining to biodiversity related matters. Indicator 21 measures the extent of informal and/or formal partnerships, or collaboration with other entities. As it is impossible for any single agency to carry out all the activities, responsibilities, projects and programmes that have biodiversity implications, hence, it is inevitable that engagement of all levels of the population must be facilitated. These include the city officials in various departments, other spheres of government, the public, private sector, NGOs, etc. Such partnerships should have substantial and long term involvement on the part of the city officials, such as programmes like Payments for Ecosystem Services (PES).	HOW TO CALCULATE INDICATOR **Indicator 20:** Existence and state of formal or informal public consultation process pertaining to biodiversity related matters. **Indicator 21:** Number of agencies/private companies/NGOs/academic institutions/international organisations with which the city is partnering in biodiversity activities, projects and programmes. Instances of inter-agency co-operation listed in IND19 should not be listed here again. WHERE TO GET DATA FOR CALCULATIONS City councils	BASIS OF SCORING **Indicator 20:** 0 points: No routine formal or informal process 1 point: Formal or informal process being considered as part of the routine process 2 points: Formal or informal process being planned as part of the routine process 3 points: Formal or informal process in the process of being implemented as part of the routine process 4 points: Formal or informal process exists as part of the routine process **Indicator 21:** 0 points: No formal or informal partnerships 1 point: City in partnership with 1-6 other national or subnational agencies/private companies/NGOs/academic institutions/international organisations 2 points: City in partnership with 7-12 other national or subnational agencies/private companies/NGOs/academic institutions/international organisations 3 points: City in partnership with 13-19 other national or subnational agencies/private companies/NGOs/academic institutions/international organisations 4 points: City in partnership with 20 or more other national or subnational agencies/private companies/NGOs/academic institutions/international organisations

4. Results

2 points – Formal or informal process in the process of being implemented as part of the routine process. Biodiversity not specifically included in process. Formal processes include CEQA/NEPA environmental review which may include biodiversity-related analyses, regulatory agency, and City permitting division applications and approvals that involve public hearings and stakeholder engagement. Such formal processes are routine. There are also informal processes in the process of being implemented, such as the formation of a biodiversity Expert Council for the development of a unified biodiversity strategy and action plan for the City.

Routine Formal Process for Public Consultation

a. City Planning
At a high level, the Department of City Planning engages with stakeholders during planning document updates, using a variety of public engagement strategies including multimedia, social media, workshops/meetings, charrettes, etc. During these processes, DCP develops high-level strategy policy goals and objectives and planning documents that guide more specific area and implementation plans closer to the ground.

b. Environmental Planning: Environmental Review and Permitting for Projects

Permits
Project managers must conduct consultations with the following agencies, as applicable, to determine approvals needed for their projects. As part of the consultation and permit/approval/certification application process, solicitations for public comment may be distributed, and public hearings may be held to hear comments on the proposed project depending on the requirements of the agency providing the approvals.

- California Department of Fish and Wildlife Consultation/Permit Application
- CalTrans Consultation/Preliminary Environmental Study/Natural Environment Study
- CEQA Lead Agency Initial Study and Environmental Review
- City of Los Angeles Building and Safety Division Consultation/Plan Check and Permit Applications (Additional City of Los Angeles Departmental Approvals May be Required from the Departments of Planning, Fire, Public Works, Transportation, CRA LA, Housing, DWP, Cultural Affairs) and from the following agencies: Health, AQMD, LAUSD, Oil and Gas, Cal OSHA)) (See Figure 20-1) (http://www.ladbs.org/services/core-services/plan-check-permit) .
- Coastal Commission Coastal Development Permit Consultation/Application
- NEPA Lead Agency Environmental Assessment and Environmental Review
- Regional Water Quality Control Board Consultation/Permit Application
- U.S. Army Corps of Engineers Consultation/Permit Application

- U.S. Fish and Wildlife Service Consultation/Permit/Application

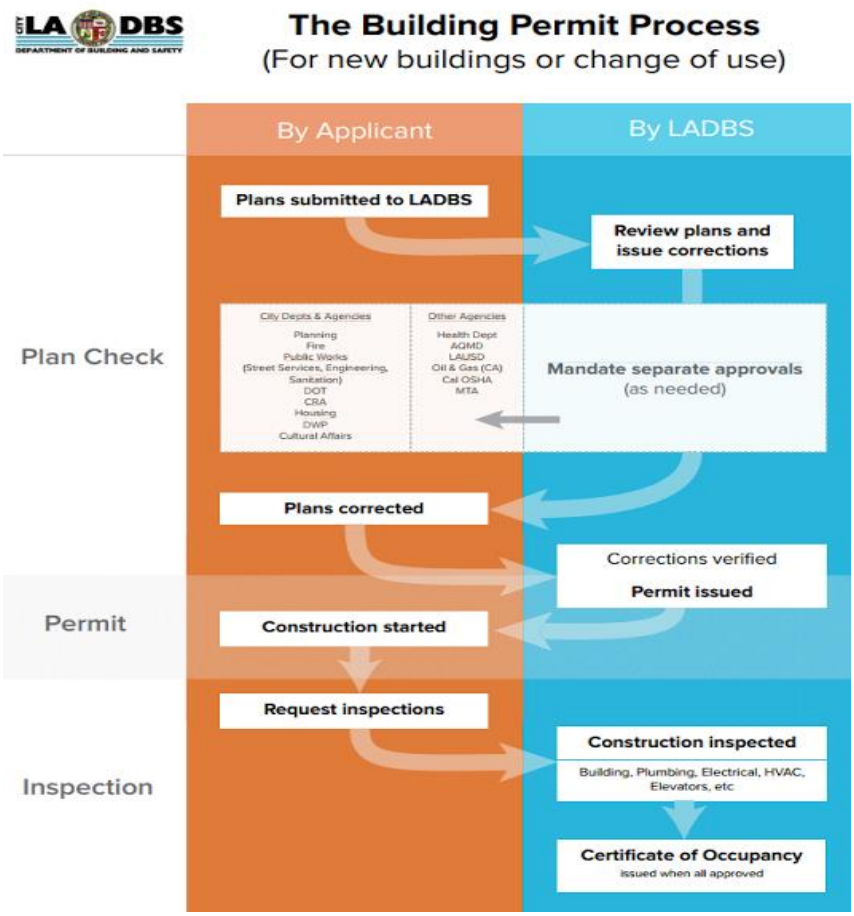

Figure 20-1 The City of Los Angeles Department of Building and Safety Building Permit Process

c. *Environmental Review*

In addition, California Environmental Quality Act (CEQA) environmental review is required for City activities that 1) have a potential for a direct physical change or a reasonably foreseeable indirect physical change in the environment; 2) involves a discretionary approval requiring the exercise of judgement or deliberation; 3) are directly undertaken by a public agency, which include public works construction activities, clearing or grading of land, improvements to existing public structures, enactment and amendment of zoning ordinances, and adoption and amendment of local general plans; 4) are supported (in whole or in part) by public agency, which include contracts, grants, subsidies, loans, or other assistance from a public agency; and 5) involve the public agency issuance of a lease, permit, license, certificate or other entitlement for use by a public agency. National Environmental Policy Act (NEPA) environmental review is required when a federal action is taken (such as permit application reviews/approvals) that may have impacts on the human and natural environment. Federal actions are

those that require Federal funding, permits, policy decisions, facilities, equipment, or employees. CEQA and NEPA environmental reviews include assessments of potential impacts on biological resources such as native habitats, ecosystems including wetlands, migration corridors including fish ladders, and special status species including locally-protected tree species; and potential conflicts with adopted habitat conservation plans.

Informal Public Consultations

In addition to the formal public consultation processes described above, the follo wing consultation activities are also being performed:

- Council District 5 Biodiversity Working Group/Biodiversity Stakeholders Meetings - Stakeholder group that provides input to elected officials on City biodiversity needs and concerns.
- Biodiversity Expert Council - Council of biodiversity experts who are assisting the City with the measurement of the City's biodiversity index.
- LAWA LAX Dunes Advisory Committee - Committee of regulatory agency representatives and two citizens responsible for guiding biodiversity conservation and enhancement activities in LAWA's LAX Dunes nature preserve.
- Neighborhood Council Stakeholder Meetings.

Appendix B21: Singapore Index Indicator 21

SI Indicator 21: Participation and Partnership: Agencies/Private Companies/NGOs/Academic Institutions/International Organizations Partnering in Biodiversity Activities, Projects and Programmes

1. **Datasets Used:**
    - **a.** List of Biodiversity Projects with Project Agencies Identified by City Agencies (not listed in Indicator 19)

2. **Other Datasets Considered**
    - **a.** USFS/LMU Los Angeles STEW map. http://cures.lmu.edu/our-programs/research/urban-stewardship-and-governance/la-stew-map/

3. **Method**
    a. See Singapore Index Methods for Indicator 21 in Table 21-1.
    b. Obtain list of biodiversity projects (not listed in Indicator 19) with project agencies identified from City Departments/Expert Council/stakeholders. Divide list into ecosystem services projects, and biodiversity enhancement projects.
    c. List agencies/private companies/NGOs/academic institutions/international organizations with which the City is partnering in biodiversity activities, projects and programs.
    d. Utilize the Indicator 21 Scoring Guide to determine score.

Table 21-1: Singapore Index User's Manual Instructions for Indicator 21

CBI	INDICATORS	VARIABLES	SCORE
Governance and Management	**INDICATORS 20 – 21: PARTICIPATION AND PARTNERSHIP**		
	RATIONALE FOR SELECTION OF INDICATOR Indicator 20 evaluates the existence and the state of formal or informal public consultation process pertaining to biodiversity related matters. Indicator 21 measures the extent of informal and/or formal partnerships, or collaboration with other entities. As it is impossible for any single agency to carry out all the activities, responsibilities, projects and programmes that have biodiversity implications, hence, it is inevitable that engagement of all levels of the population must be facilitated. These include the city officials in various departments, other spheres of government, the public, private sector, NGOs, etc. Such partnerships should have substantial and long term involvement on the part of the city officials, such as programmes like Payments for Ecosystem Services (PES).	HOW TO CALCULATE INDICATOR **Indicator 20:** Existence and state of formal or informal public consultation process pertaining to biodiversity related matters. **Indicator 21:** Number of agencies/private companies/NGOs/academic institutions/international organisations with which the city is partnering in biodiversity activities, projects and programmes. Instances of inter-agency co-operation listed in IND19 should not be listed here again. WHERE TO GET DATA FOR CALCULATIONS City councils	BASIS OF SCORING **Indicator 20:** 0 points: No routine formal or informal process 1 point: Formal or informal process being considered as part of the routine process 2 points: Formal or informal process being planned as part of the routine process 3 points: Formal or informal process in the process of being implemented as part of the routine process 4 points: Formal or informal process exists as part of the routine process **Indicator 21:** 0 points: No formal or informal partnerships 1 point: City in partnership with 1-6 other national or subnational agencies/private companies/NGOs/academic institutions/international organisations 2 points: City in partnership with 7-12 other national or subnational agencies/private companies/NGOs/academic institutions/international organisations 3 points: City in partnership with 13-19 other national or subnational agencies/private companies/NGOs/academic institutions/international organisations 4 points: City in partnership with 20 or more other national or subnational agencies/private companies/NGOs/academic institutions/international organisations

Table 21-2: Zoo Biodiversity Field Conservation Partnerships (2016-2017)

City Dept	Biodiversity Project/Program Name (can be in pre-design, design, implementation or completed stages)	Approximate Average Annual Budget Allocation ($)	Names of Agencies/ Organizations Leading Project	Names of Agency/ Organization Collaborators and Partners
ZOO	Tadjik Markhor & Dukhara Urial	$5,000.00 (GLAZA)	Nature & Biodiversity Conservation Union of Tajikistan	
ZOO	Asian Vulture	$5,000.00 (GLAZA)	Bombay Natural History Society	Royal Society for the Protection of Birds
ZOO	Black-wing Starling	$2,000.00 (GLAZA)	Zoologische Gesellschaft fuer Artenu.Populationsschutz.V	Cikananga Wildlife Center
ZOO	Bushmaster Survey	$1,500.00 (GLAZA)	The Orianne Society	
ZOO	anti-Bushmeat Education	$2,000.00 (GLAZA)	Pandrillus	
ZOO	Komodo Dragon monitoring	$8,000.00 (GLAZA)	University of Melbourne	
ZOO	Armenian Viper	$2,000.00 (GLAZA)	St. Louis Zoo	
ZOO	Giant Salamander Reintroduction	$2,000.00 (GLAZA)	Shaanxi Institute of Zoology	
ZOO	Drill Conservation	$3,000.00 (GLAZA)	Bioko Biodiversity Protection Program/Drexel University	Universidad Nacional de Guinea
ZOO	Drill Reintroduction	$5,000.00 (GLAZA)	Pandrillus	
ZOO	Monitoring of local Polillo Island fauna	$2,000.00 (GLAZA)	Virginia Zoological Park	
ZOO	Fiji Crested Iguana Survey	$3,500.00 (GLAZA)	U.S. Geological Survey	
ZOO	Giant Otter/Local Awareness & protection	$8,300.00 (GLAZA)	University of Stirling	

City Dept	Biodiversity Project/Program Name (can be in pre-design, design, implementation or completed stages)	Approximate Average Annual Budget Allocation ($)	Names of Agencies/ Organizations Leading Project	Names of Agency/ Organization Collaborators and Partners
ZOO	Grauer's gorilla rescue & rehabilitation	$12,500.00 (GLAZA) $5,000 (ZOO)	Diane Fossey Gorilla Fund International	Institut Congolais pour la Conservation de la nature
ZOO	Harpy Eagle release	$4,000.00 (GLAZA)	The Peregrine Fund	Disney's Animal Kingdom
ZOO	Asian Elephant Education/Protection	$10,000.00 (GLAZA)	Wild Earth Allies	
ZOO	Gharial survey	$8,000.00 (GLAZA)	Ministry of Environments & Forests	Utter Pradesh, Madhya Pradesh & Rajasthan Forests Departments
ZOO	Javian Warty Pig - Development of in-situ breeding protocol	$5,000.00 (GLAZA)	Zoological Society for the Conservation of Species and Populations	
ZOO	Asian Elephant Education/Protection	$5,000.00 (GLAZA)	Biodiversity & Elephant Conservation Trust	Oregon Zoo
ZOO	Consultation on Creation of Ndogo Chimpanzee Sanctuary	$10,000.00 (ZOO)	Centre International de Reshereches Medicales de Franceville	
ZOO	Jaguar Conservation & Protection	$8,000.00 (GLAZA)	Paso Pacifica	
ZOO	Peninsular Pronghorn Recovery	$5,000.00 (GLAZA) $1,820 (ZOO)	Espacias Naturles	The Living Desert Zoo & Gardens
ZOO	Tagua in-situ breeding for reintroduction	$8,000.00 (GLAZA)	Proyecto Tagua	Chaco Center for Conservation & Research
ZOO	Uakari habitat assessment/monitoring	$10,000.00 (GLAZA)	San Diego Zoo Institute for Conservation Research	
ZOO	Saiga anti-poaching program	$3,000.00 (GLAZA)	Siaga Conservation Alliance	Wildlife Conservation Network
ZOO	Saola conservation	$8,000.00 (GLAZA)	Saola Working Group	

City Dept	Biodiversity Project/Program Name (can be in pre-design, design, implementation or completed stages)	Approximate Average Annual Budget Allocation ($)	Names of Agencies/ Organizations Leading Project	Names of Agency/ Organization Collaborators and Partners
ZOO	Free-flying Bats monitored in Zoo	$500.00 (ZOO)	Museum of Natural History/Los Angeles	
ZOO	Mountain Yellow-legged Frog breeding and reintroduction	$2,000.00 (GLAZA) $5,000.00 (ZOO)	California Dept of Fish & Wildlife	
ZOO	California Condor Breeding & Reintroduction	$489,000.00 (ZOO)	USFWS	Peregrine Fund
ZOO	Sonoran Pronghorn recovery	$2,002.00 (ZOO)	USFWS	Arizona Fish & Game Dept

Appendix B22: Singapore Index Indicator 22

SI Indicator 22: Education and Awareness: In School Curriculum

1. **Datasets Used:**
    a. State Science Education Standards (Next Generation Science Standards)
    b. LAUSD programs (Schoolyard habitat, 5th Grade Outdoor Education program)

2. **No Other Datasets Considered**

3. **Method**
    a. See Singapore Index Methods for Indicator 22 in Table 22-1.
    c. Gather copies of standards and highlight biodiversity in curriculum
    d. Use Indicator 22 Scoring guide to determine score for Indicator 22.

Table 22-1: Singapore Index User's Manual Instructions for Indicator 22

CBI	INDICATORS	VARIABLES	SCORE
Governance and Management	**INDICATORS 22 - 23: EDUCATION AND AWARENESS**		
	RATIONALE FOR SELECTION OF INDICATOR Education can be divided into two categories, formal through the school curriculum or informal. Two aspects will be evaluated, i.e., formal education and public awareness. While indicator 14 gives an indication of school children's use of recreational services provided by ecosystems, indicators 22 and 23 highlight: (i) if biodiversity is included in the school curriculum; and (ii) the number of outreach or public awareness events are held per year For indicator 22, most cities have no jurisdiction over school curricula. The incorporation of this indicator creates the opportunity for city officials to liaise with education officers so that biodiversity courses are taught at pre-school, primary, secondary and tertiary levels. For indicator 23, the event should either be organised entirely by the city authorities, or there should be a heavy involvement of the authorities before the event can be considered for inclusion in the indicator. Events that just take place within the city are not considered, as they are not representative of the governance exerted by the city authorities.	HOW TO CALCULATE INDICATOR **Indicator 22:** Is biodiversity or nature awareness included in the school curriculum (e.g. biology, geography, etc.)? **Indicator 23:** Number of outreach or public awareness events held in the city per year. WHERE TO GET DATA FOR CALCULATIONS Education department, city councils, NGOs	BASIS OF SCORING **Indicator 22:** 0 points: Biodiversity or elements of it are not covered in the school curriculum 1 point: Biodiversity or elements of it are being considered for inclusion in the school curriculum 2 points: Biodiversity or elements of it are being planned for inclusion in the school curriculum 3 points: Biodiversity or elements of it are in the process of being implemented in the school curriculum 4 points: Biodiversity or elements of it are included in the school curriculum **Indicator 23:** 0 points: 0 outreach events/year 1 point: 1 - 59 outreach events/year 2 points: 60 -149 outreach events/year 3 points: 150-300 outreach events/year 4 points: > 300 outreach events/year Cities are requested to include a full list of the events included in the calculation for indicator 23, as well as information on how many people attended the event or were targeted where available.

4. Results

4 points – Elements of biodiversity are included in the school curriculum. Biodiversity is included in the California state science standards that govern what is taught in California public schools. Biodiversity is in the biology curriculum at the elementary, middle and high school levels, therefore, a score of 4 was given.

Los Angeles Unified School District (LAUSD), the second largest school district in the nation, is the Local Education Agency for the City of Los Angeles. LAUSD enrolls over 645,000 students from over 720 square miles in the greater Los Angeles area including the City of Los Angeles as well as all or parts of 31 smaller municipalities plus several unincorporated sections of Southern California. In addition to the LAUSD schools, nearly 300 charter schools operate in LAUSD, serving over 150,000 students. 1,000 private schools also call Los Angeles home.

California State educational content standards describe what students should know and be able to do in each subject at each grade. The Next Generation Science Standards for California Public Schools, Kindergarten Through Grade Twelve (CA NGSS) educational content standards were adopted in 2013, and the current Science Framework which was based on the CA NGSS was adopted in 2016 (http://www.cde.ca.gov/ci/sc/cf/scifwprepubversion.asp) by the State Board of Education. Biodiversity awareness is included in the 2016 California Science Framework in Grades 3-8, and in high school biology as shown in Table 22-3. These standards may be taught in public schools in the classroom and/or in outdoor education and experiential education settings. Examples of LAUSD non-classroom curricular experiences that can increase biodiversity awareness, such as field trips and experiential education through schoolyard wildlife habitats are shown in Table 22-3 and Figure 22-2.

Table 22-2 2016 Science Framework: Biodiversity Awareness Content Standards

Elementary School

- **Grade 3:** 3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
- **Grade 4:** 4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
- **Grade 4:** 4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. 5-ESS3-1 Earth and Human Activity
- **Grade 5:** 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Middle School

- **Grade 6:** MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
- **Grade 7:** MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- **Grade 7:** MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

  Grade 7: MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services. [Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]
- **Grade 7:** MS-LS2-C. Ecosystem Dynamics, Functioning, and Resilience - § Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4) § Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)****Supplemental DCI PS1.B, ESS3.A, ESS3.C*
- **Grade 7:** ETS1.B: Developing Possible Solutions - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary to MS-LS2-5)
- **Grade 7:** LS4.D: Biodiversity and Humans - Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to MS-LS2-5)
- **Grade 8:** MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- **Grade 8:** MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

High School

- **Biology:** HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
- **Biology:** HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
- **Biology:** HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- **Biology:** HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capaCity of ecosystems at different scales.

  Biology: LS4.D: Biodiversity and Humans - Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7) Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained

is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7), (HS-LS4-6)

Biology: ETS1.B: Developing Possible Solutions - When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-LS2-7),(secondary to HS-LS4-6)

Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (secondary to HS-LS4-6)

Biology: ESS3.C: Human Impacts on Earth Systems -The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3) Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

Biology: HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. [Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [Assessment Boundary: Assessment is limited to provided data.]

Biology: HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.* [Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

Biology: HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.* [Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

Biology: HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]

Sources:
CA Science Education Standards – Next Generation Science Standards
Heinrich Sartin LAUSD Local District Northeast Science, Technology, Engineering, Art and Mathematics (STEAM) Coordinator

Table 22-3 Non-classroom Biodiversity Curricular Experiences in LAUSD Service Area

Outdoor Education (Day and Overnight Camp Nature Exploration/Experiential Learning Experiences)
Botanic Garden and Theodore Payne Foundation Education Center Field Trips
Los Angeles Marine Institute Tall Ship Marine Investigation Field Trips
Schoolyard Habitats (Campus Ecology Projects)
School Gardens (Campus Ecology Projects)
Los Angeles River Rover Mobile Visitor and Education Center

Additional LAUSD Biodiversity Programs and Assets:

LAUSD Outdoor and Environmental Education Program
http://www.outdooreducation.org/

LAUSD Clear Creek Outdoor Education Center
http://btb.lausd.net/News/itemid/192/Clear-Creek-Outdoor-Education-Center-begins-it%E2%80%99s-90th-year

LAUSD Point Fermin Outdoor Education Center
http://www.outdooreducation.org/pfoec/

LAUSD Field Trips and Outdoor Education
http://learninggreen.laschools.org/field-trips--outdoor-education.html

LAUSD Campus Ecology Initiatives/Schoolyard Habitats
http://learninggreen.laschools.org/campus-ecology.html

LAUSD Sustainability Curriculum Resources for Teachers
http://learninggreen.laschools.org/curriculum-guides--references.html

Source: LAUSD Office of Outdoor and Environmental Education and LAUSD Sustainability Initiatives Unit

Appendix B23: Singapore Index Indicator 23

SI Indicator 23: Education and Awareness: Outreach or Public Awareness Events

1. **Datasets Used:**
    a. LA Zoo and Botanical Garden Docent Department Log of Events
    b. Cabrillo Marine Aquarium Log of Events

2. **Other Datasets Considered**
    a. Nature Center/Natural Park Log of Events
    b. Natural History Museum Biodiversity Exhibits and Citizen Science Log of Events

3. **Method**
    a. See Singapore Index Methods for Indicator 23 in Table 23-1.
    b. Obtain list of biodiversity outreach or public awareness events held in the City per year from each City Department.
    c. Tally the number of events.
    d. Use Indicator 23 Scoring Guide to determine score.

Table 23-1: Singapore Index User's Manual Instructions for Indicator 23

CBI	INDICATORS	VARIABLES	SCORE
Governance and Management	**INDICATORS 22 - 23: EDUCATION AND AWARENESS**		
	RATIONALE FOR SELECTION OF INDICATOR Education can be divided into two categories, formal through the school curriculum or informal. Two aspects will be evaluated, i.e., formal education and public awareness. While indicator 14 gives an indication of school children's use of recreational services provided by ecosystems, indicators 22 and 23 highlight: (i) if biodiversity is included in the school curriculum; and (ii) the number of outreach or public awareness events are held per year For indicator 22, most cities have no jurisdiction over school curricula. The incorporation of this indicator creates the opportunity for city officials to liaise with education officers so that biodiversity courses are taught at pre-school, primary, secondary and tertiary levels. For indicator 23, the event should either be organised entirely by the city authorities, or there should be a heavy involvement of the authorities before the event can be considered for inclusion in the indicator. Events that just take place within the city are not considered, as they are not representative of the governance exerted by the city authorities.	HOW TO CALCULATE INDICATOR **Indicator 22:** Is biodiversity or nature awareness included in the school curriculum (e.g. biology, geography, etc.)? **Indicator 23:** Number of outreach or public awareness events held in the city per year. WHERE TO GET DATA FOR CALCULATIONS Education department, city councils, NGOs	BASIS OF SCORING **Indicator 22:** 0 points: Biodiversity or elements of it are not covered in the school curriculum 1 point: Biodiversity or elements of it are being considered for inclusion in the school curriculum 2 points: Biodiversity or elements of it are being planned for inclusion in the school curriculum 3 points: Biodiversity or elements of it are in the process of being implemented in the school curriculum 4 points: Biodiversity or elements of it are included in the school curriculum **Indicator 23:** 0 points: 0 outreach events/year 1 point: 1 - 59 outreach events/year 2 points: 60 -149 outreach events/year 3 points: 150-300 outreach events/year 4 points: > 300 outreach events/year Cities are requested to include a full list of the events included in the calculation for indicator 23, as well as information on how many people attended the event or were targeted where available.

4. Results

4 points – The City organizes over 550 biodiversity outreach events/year.

The primary City agencies that were identified by the Expert Council as organizers of biodiversity outreach or public awareness events were the LA Zoo and Botanical Garden and the Cabrillo Marine Aquarium. The LA Zoo and Botanical Garden organizes 200-260 biodiversity-related outreach events per year in the City. In addition to their daily biodiversity conservation and education operations at their facility, Cabrillo Marine Aquarium organizes 200-260 biodiversity-related outreach events per year, some of them off-site. A score of 4 was given, because the City organizes over 550 such events per year, and has biodiversity educational exhibits available to the public, year-round.Table 23-2 contains a list of the tallied events for this indicator.

Table 23-2: Biodiversity Outreach Events Held by City in City Per Year

Name of Biodiversity Outreach or Public Awareness Event	Event Organizer	Participating Agencies/Organizations	Average # of Events Held in City Annually
Special Needs Outreach (2-3/week)	LA Zoo and Botanical Gardens		80-100 trips per year
Community Outreach (4-6/month during academic year)	LA Zoo and Botanical Gardens		30-50 trips per year
Classroom Safari (4-6/month during the academic year)	LA Zoo and Botanical Gardens		40-50 per year
Conservation Outreach Committee	LA Zoo and Botanical Gardens		12 per year
Botanical Tours on Zoo Grounds	LA Zoo and Botanical Gardens		4 per year
Bird Walks on Zoo Grounds	LA Zoo and Botanical Gardens		4 per year
Watershed Stormwater Project Opening (Machado Lake)	LA Sanitation (LASAN)		1-3 per year?
Arbor Day/Ocean Day	LA Recreation and Parks (LARAP)	LASAN	1 per year
Job Shadow Day	City	Los Angeles World Airports (LAWA)	1 per year
LAX Dunes Butterfly Preserve Tour	LAWA		1 per year (2 days)
Earth Day	LASAN	LAWA	1 per year
ZooLABration (Wild for the Planet)	LA Zoo and Botanical Gardens	LAWA	1 per year

Name of Biodiversity Outreach or Public Awareness Event	Event Organizer	Participating Agencies/Organizations	Average # of Events Held in City Annually
Ocean Outreach Program	Cabrillo Marine Aquarium (LARAP)		150 per year (25,000 students/year)
Whalewatching Training	Cabrillo Marine Aquarium (LARAP)	American Cetacean Society	100 per year (10,000 students/year)
LA Zoo and Botanical Gardens	LA Zoo and Botanical Gardens		1.8 visitors per year
LA River Clean-Up	FOLAR, RiverLA	DWP	2-4/year
P-22 Day	National Wildlife Federation		
Cabrillo Marine Aquarium (exhibits, classes)	Cabrillo Marine Aquarium (LARAP)		Open to the public 311 days per year (300,000 visitors/year including estimated 150,000 school-aged) (free admission)
Nature Walks (Native Plants, Bird Walks – 4x/month)	Audubon	Audubon Center at Deb's Park (LA RAP)	48 per year
Nature Arts and Crafts (every Saturday)	Audubon	Audubon Center at Deb's Park (LA RAP	48 per year
Griffith Park Ranger Walks	LARAP Griffith Park Rangers		
Griffith Park Nature Discovery Center Tours	LARAP Griffith Park Rangers		
		Total:	**556-620 events/year plus biodiversity facilities open to the public for free year-round**

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Ecology Studio