Bosques urbanos: vertebradores de la infraestructura verde

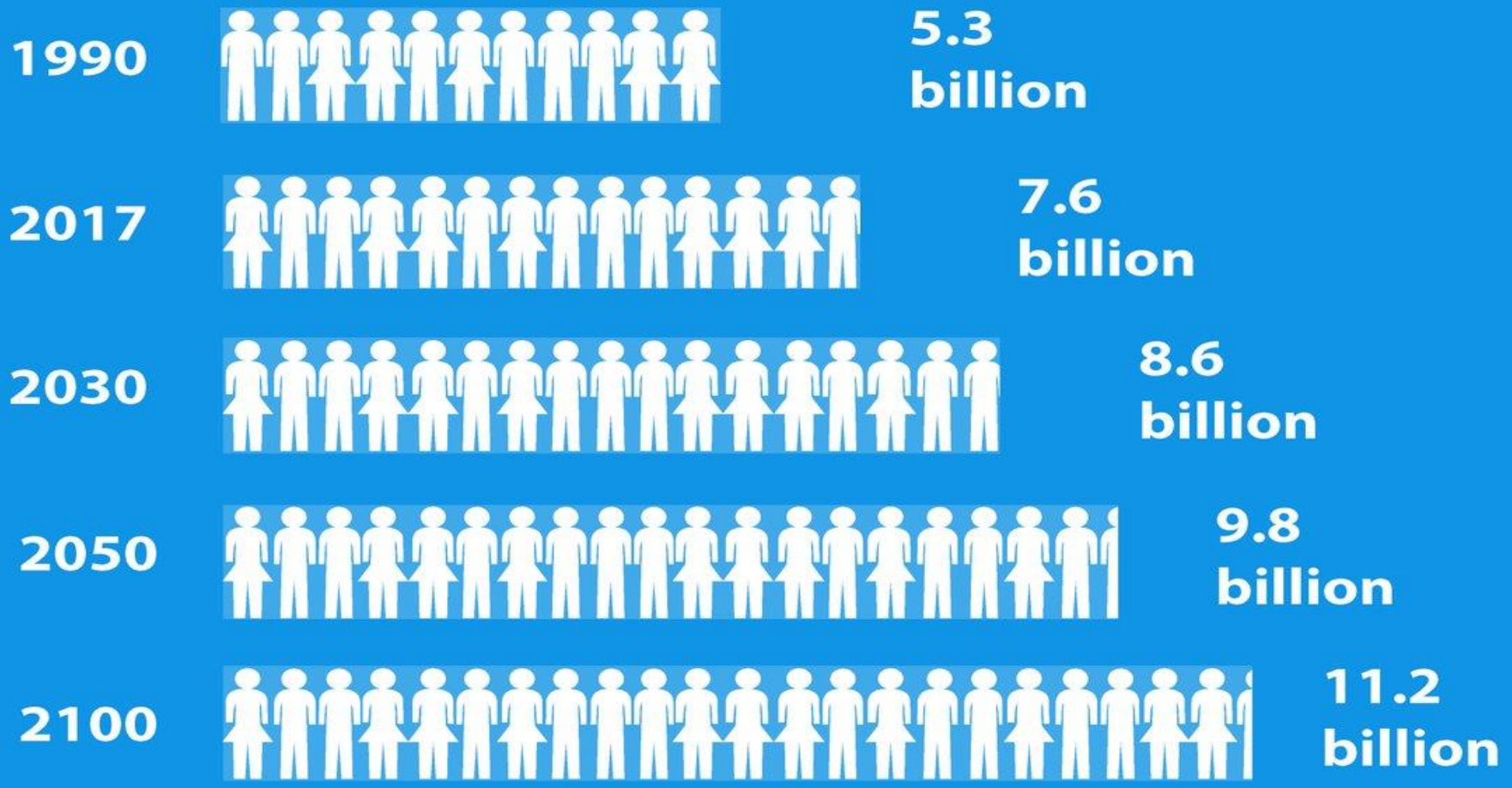
Madrid, 9 de octubre de 2019

Pedro Calaza Martínez
PhD-Eng. + PhD-L.A.


Abducius

World Population

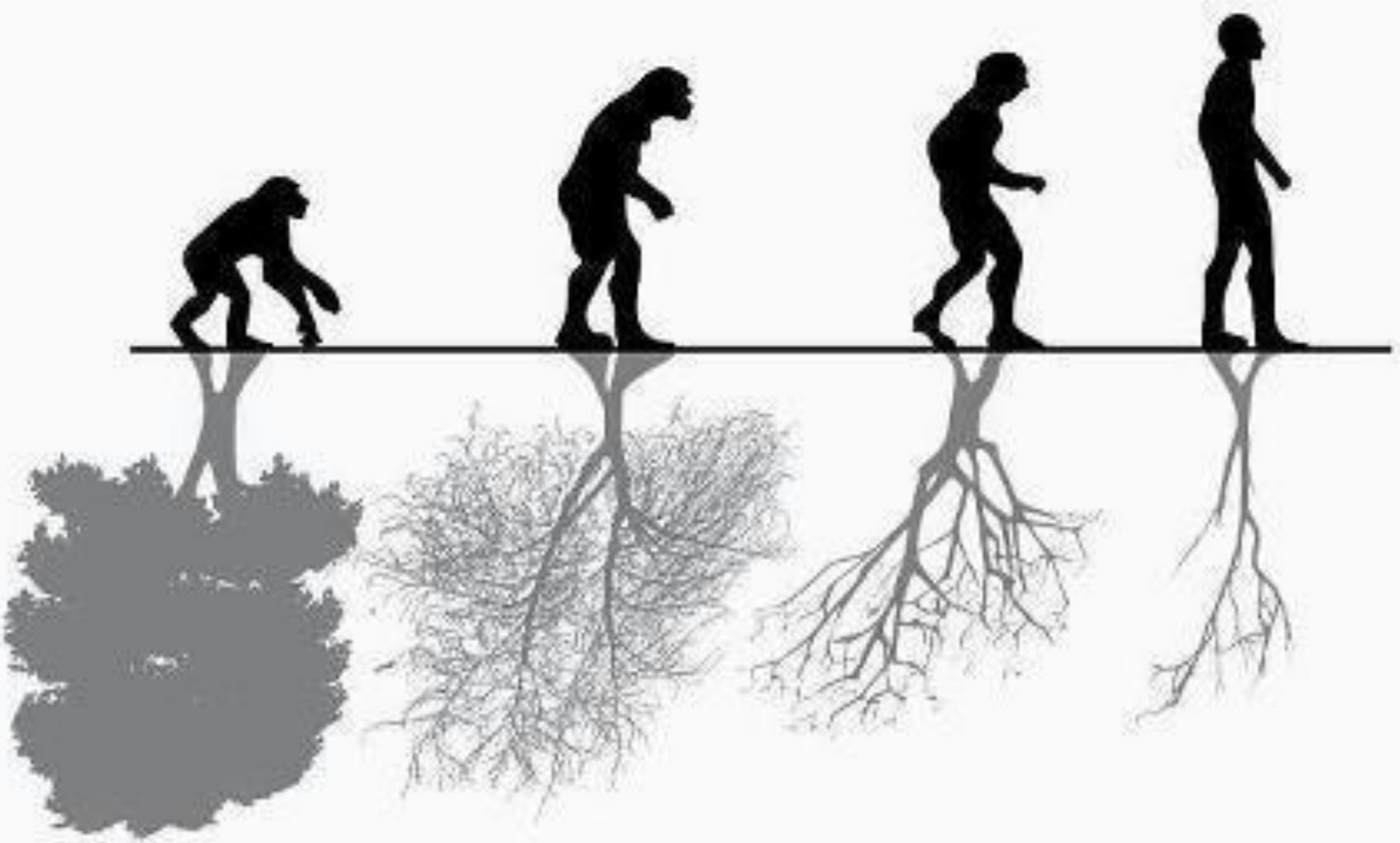
Projected world population until 2100

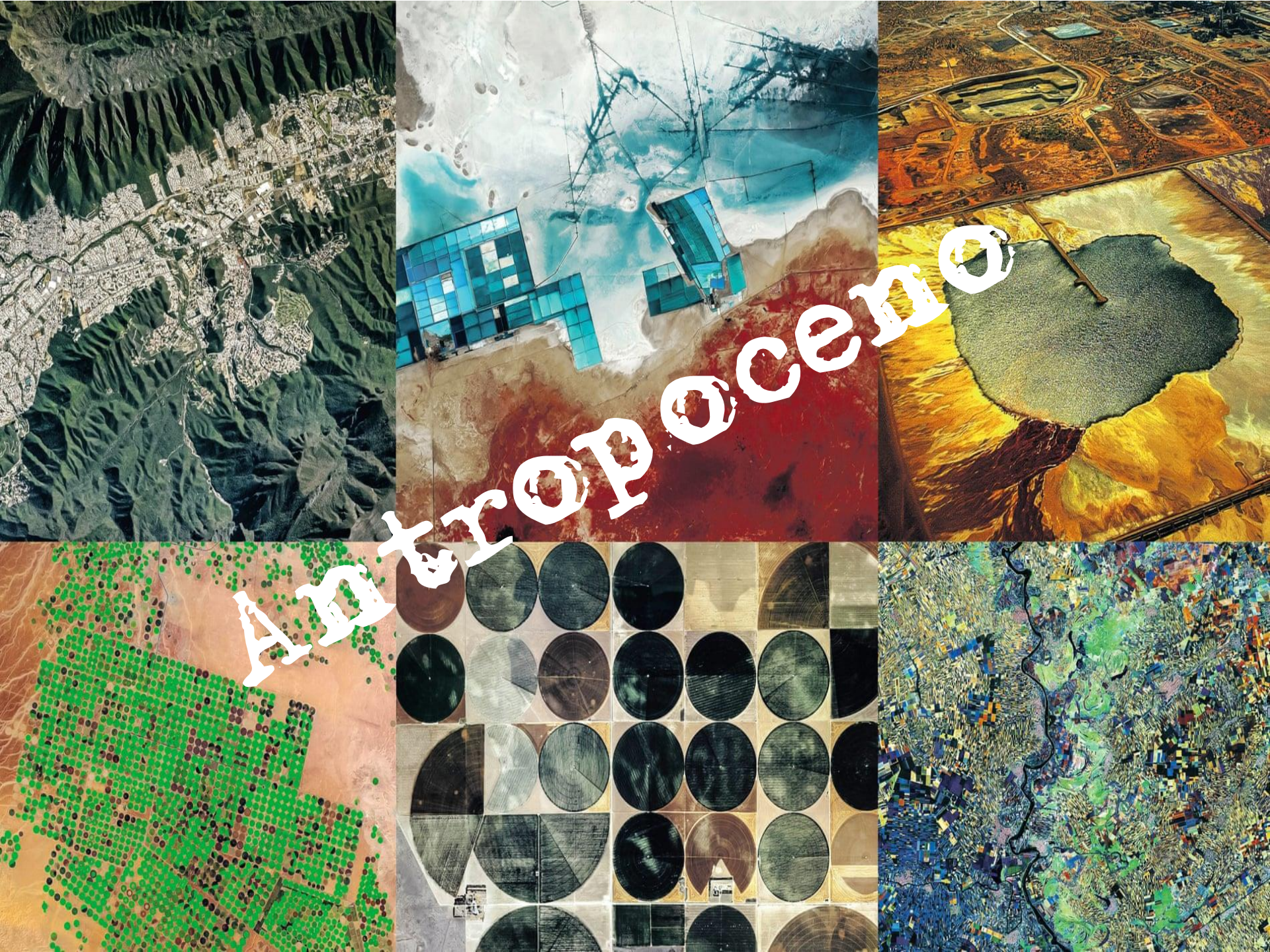


Source: United Nations Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2017 Revision*
Produced by: United Nations Department of Public Information

SUSTAINABLE DEVELOPMENT GOALS

De un mundo vac o a un mundo lleno

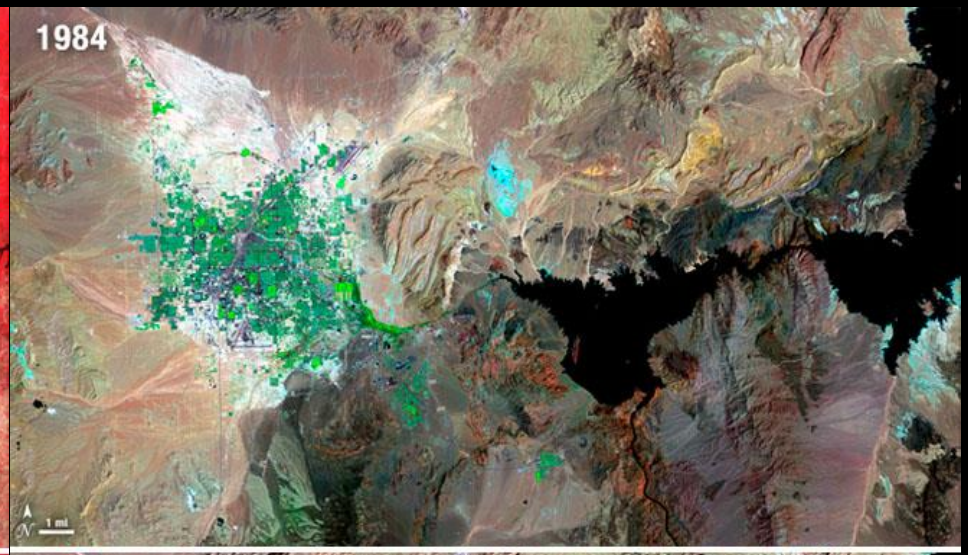


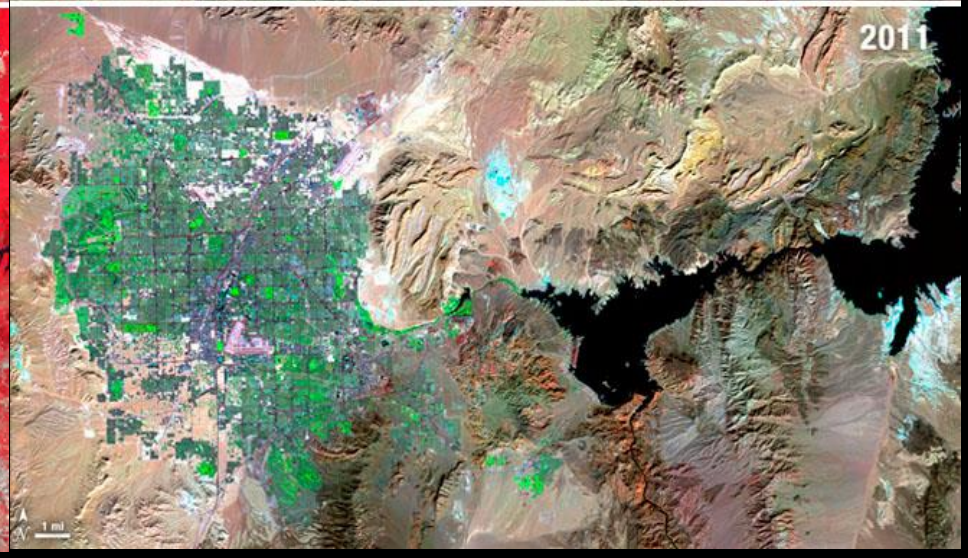

Antropoceno

(UN DESA, 2012)

Primer siglo urbano

Stewart Pickett



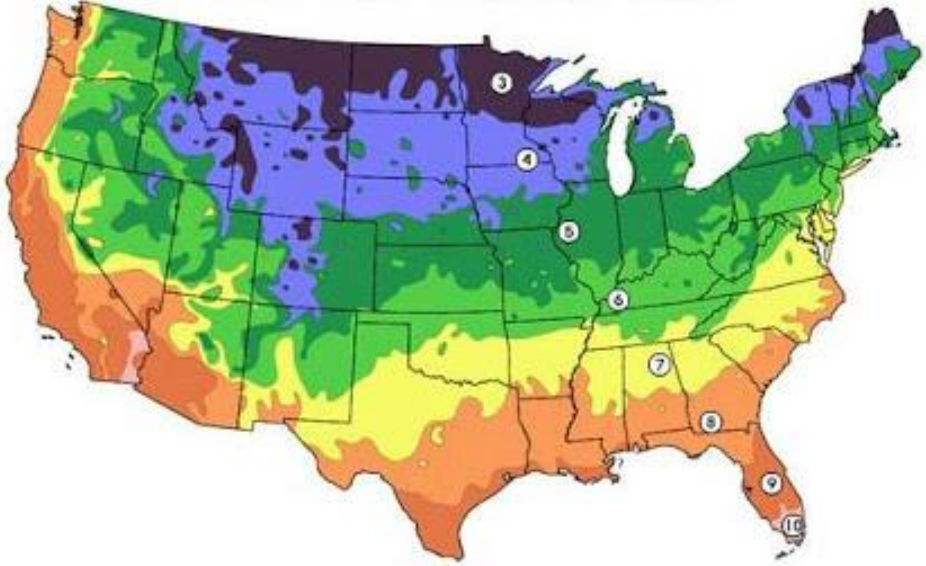


Estambul (Turquía)

Las Vegas (EEUU)

Zonas USDA PHZM

Calentamiento global



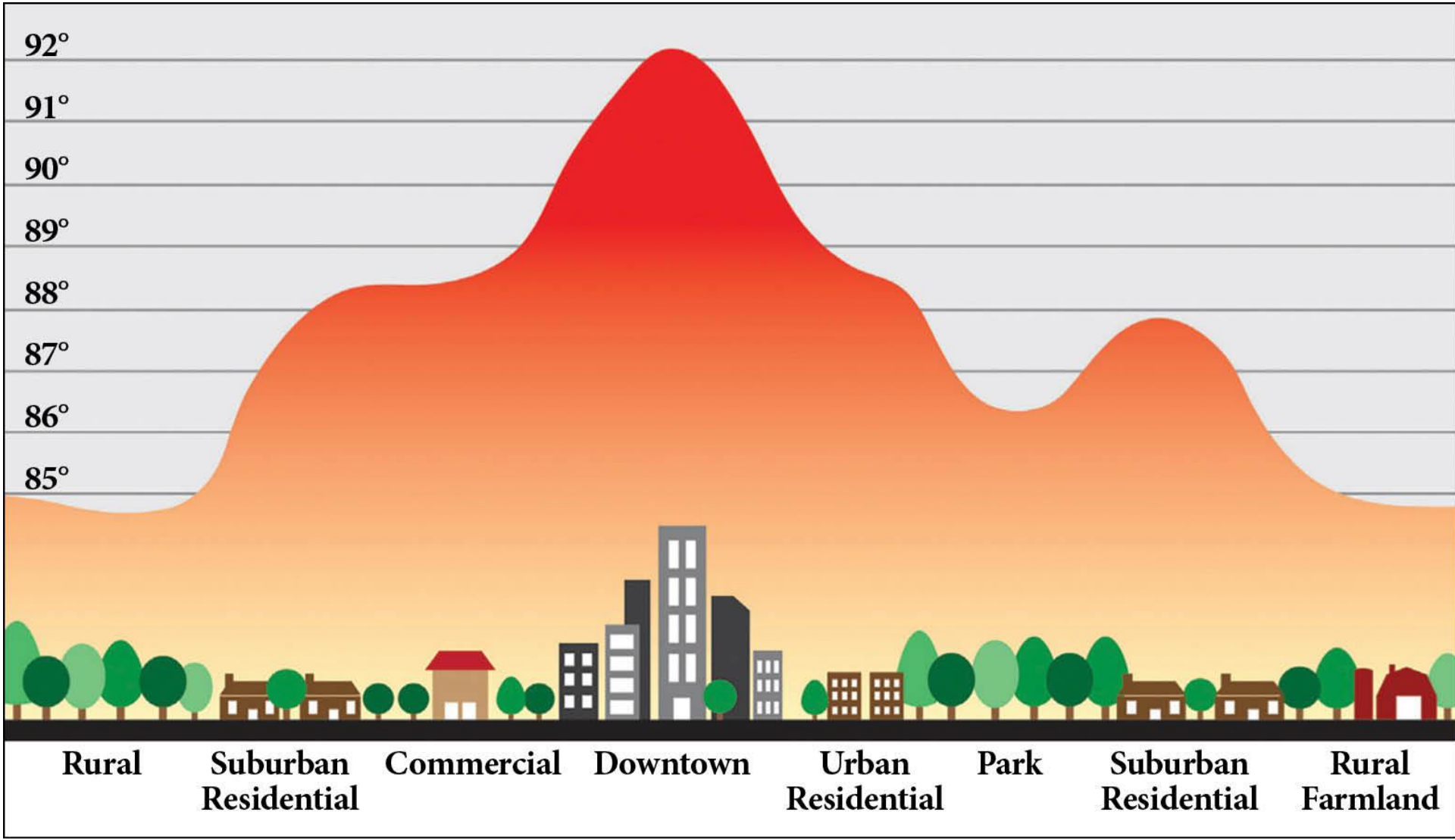
1990

2012

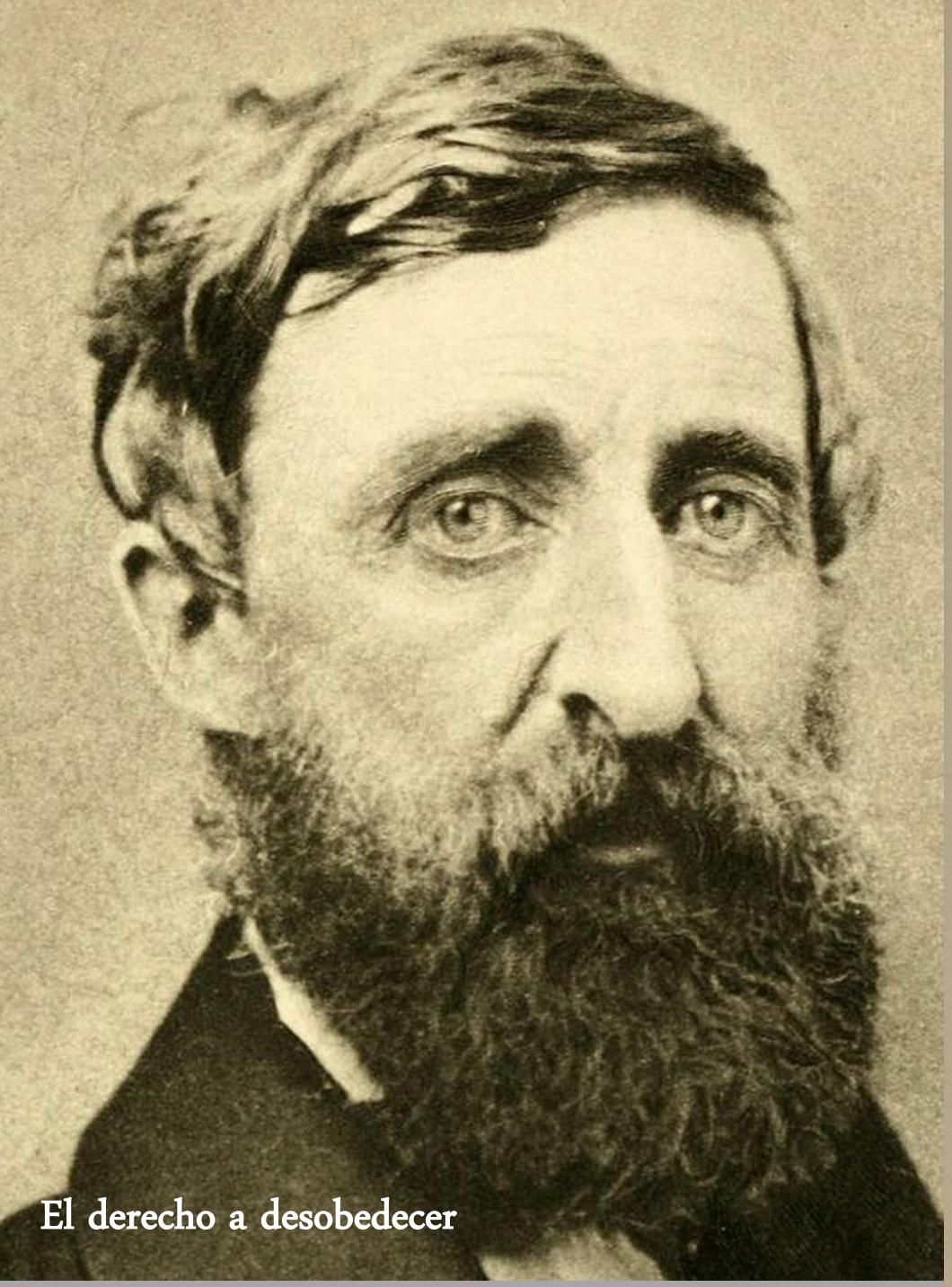
Zones

2 3 4 5 6 7 8 9 10

Efecto isla de calor




MURCIA
ALICANTE



El derecho a desobedecer

WALDEN;

OR,

LIFE IN THE WOODS.

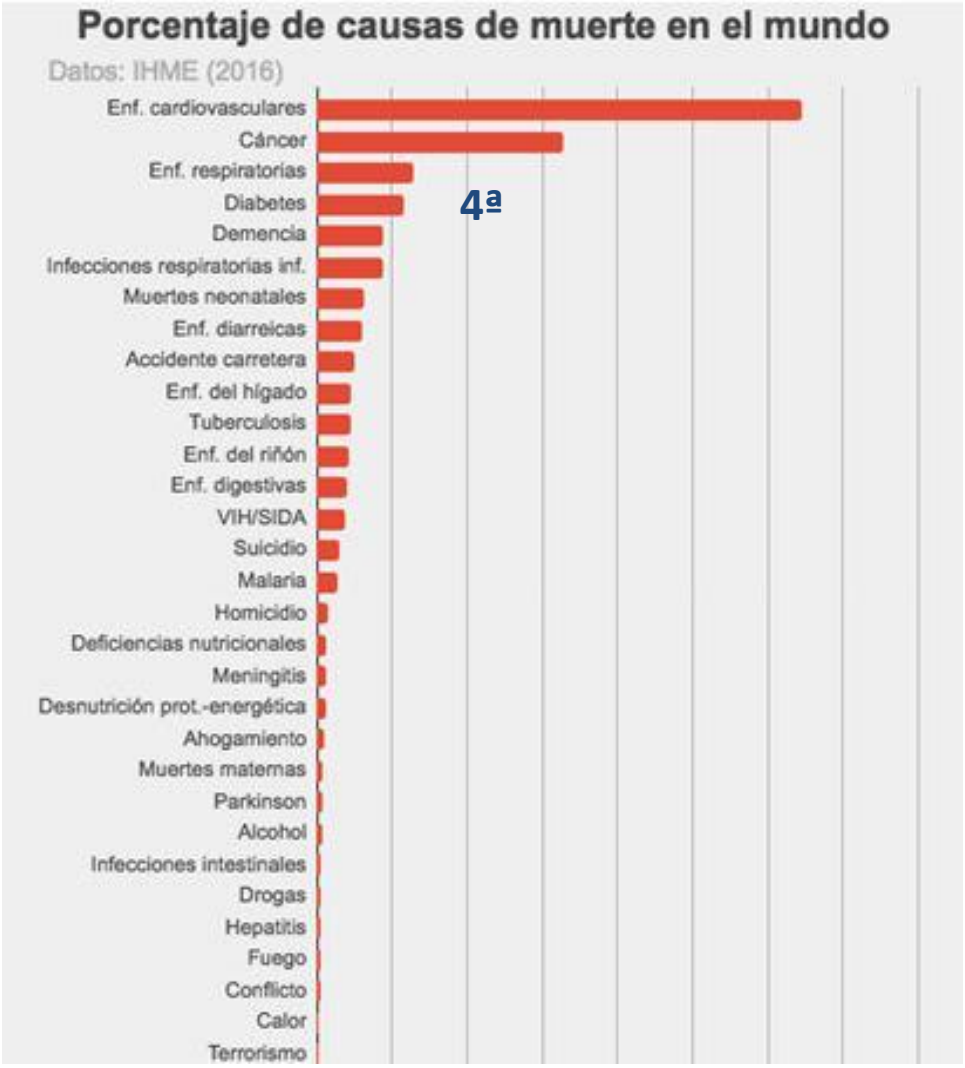
By HENRY D. THOREAU,

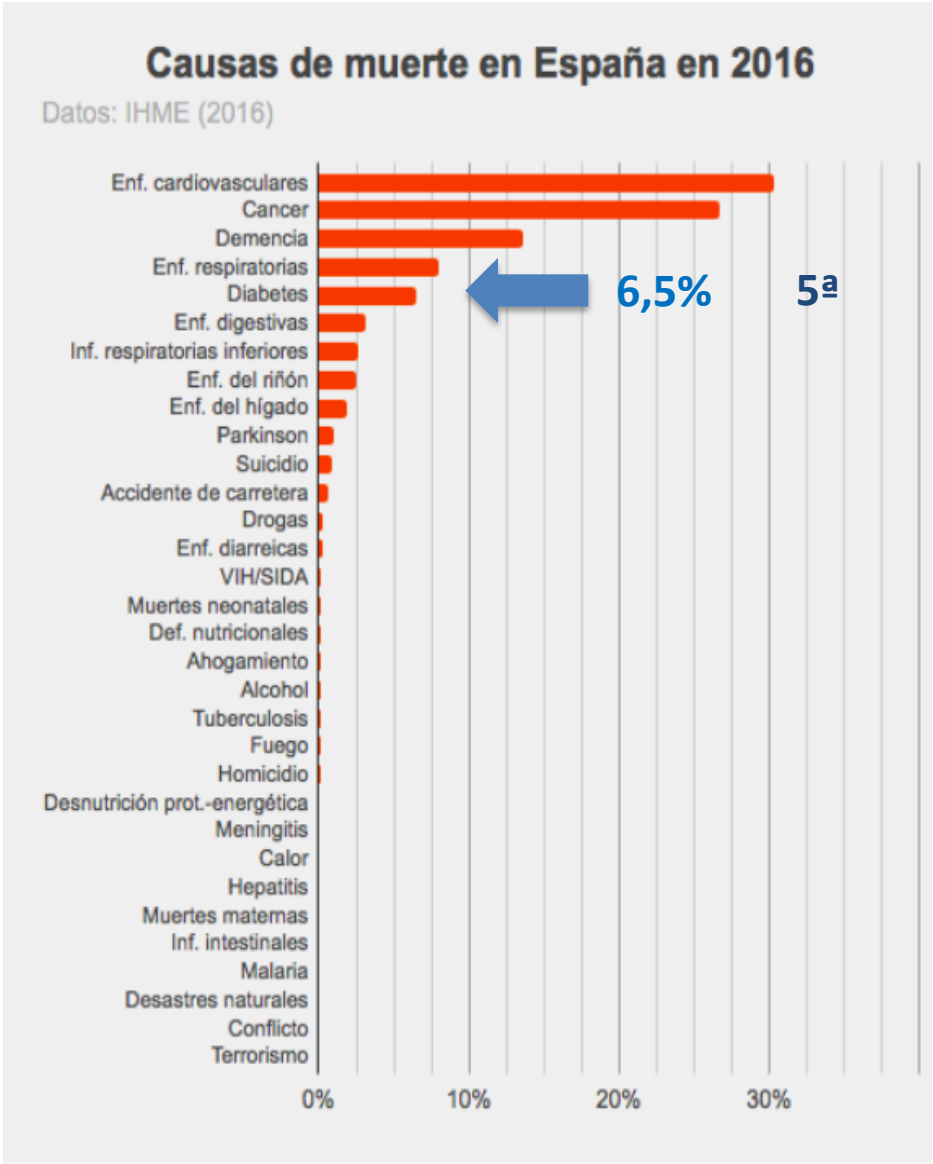
AUTHOR OF "A WEEK ON THE CONCORD AND MERRIMACK RIVERS."

I do not propose to write an ode to dejection, but to brag as lustily as chanticleer in the morning, standing on his roost, if only to wake my neighbors up. — Page 92.

BOSTON:
TICKNOR AND FIELDS.
M DCCC LIV.

Causas de muerte en el mundo 2016





ENT

WHO (2014)

Urbanización
Envejecimiento poblacional
Globalización.

España 92% (64,7%-2011)

El 92% de las muertes en España se deben a enfermedades no transmisibles, según la OMS

- Abarcan las dolencias de tipo cardiovascular, respiratoria, diabetes o distintos tipos de cánceres

Un equipo especializado para abordar distintos tipos de cáncer - EFE

María Teresa Benítez de Lugo
@mt237

Actualizado: 18/09/2017 18:48h

De acuerdo con el último estudio sobre enfermedades no transmisibles publicado hoy por la Organización Mundial de la Salud (OMS), **363.000 personas mueren a causa de una enfermedad no transmisible** (ENT), ya sea de tipo cardiovascular, respiratoria, diabetes o distintos tipos de cánceres, un 92% del total.

NOTICIAS RELACIONADAS

«Tener cáncer no es una sentencia de muerte»

La OMS propone aumentar el precio de los refrescos con azúcar para reducir la obesidad

LO MÁS LEÍDO EN ABC

Sociedad | ABC

1 
Cobra fuerza la hipótesis de que la muerte a tiros de los dos jóvenes en Granada pudo ser un accidente

2 
Condena sin precedentes para 'La Manada' marroquí que agredió a una niña

3 
La nueva esclavitud del siglo XXI

4 
El Gobierno considerará familias numerosas

El problema….

Ordenadores/Consolas/Actividades en interior/Poco tiempo

Ocasionan desconocimiento de la naturaleza… Síntoma de una desconexión total…

Nature déficit disorder

Richar Louv…

Last child in the Woods

Problemas Urbanos???

Vandalismo

Enfermedades de corazón

Regeneración económica

Enfermedades Respiratorias

Stress

Incohesión Social

Cambio Climático

Biodiversidad.


Que sentido queremos?
o
cual necesitamos?
No hay mayor signo de
demencia que hacer la misma
cosa una y otra vez y esperar
que los resultados sean
distintos.
Albert Einstein


Paley park

Ciudades…

La gran promesa: un lugar mejor… oportunidades… bienestar, equidad… sí, pero…

Polarización económica, transporte, enfermedades…

+

Cambio climático, desigualdad social, organización social, estilos de vida…

Incremento de vulnerabilidad…

Ciudad saludable

”aquella que crea y mejora continuamente los entornos físicos y sociales y amplía los recursos de la comunidad que permiten a las personas apoyarse mutuamente para realizar todas las funciones de la vida y desarrollarse a su máximo potencial” (OMS, 2016)


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
THE GLOBAL GOALS
For Sustainable Development
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE AND JUSTICE STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

SUSTAINABLE DEVELOPMENT GOALS

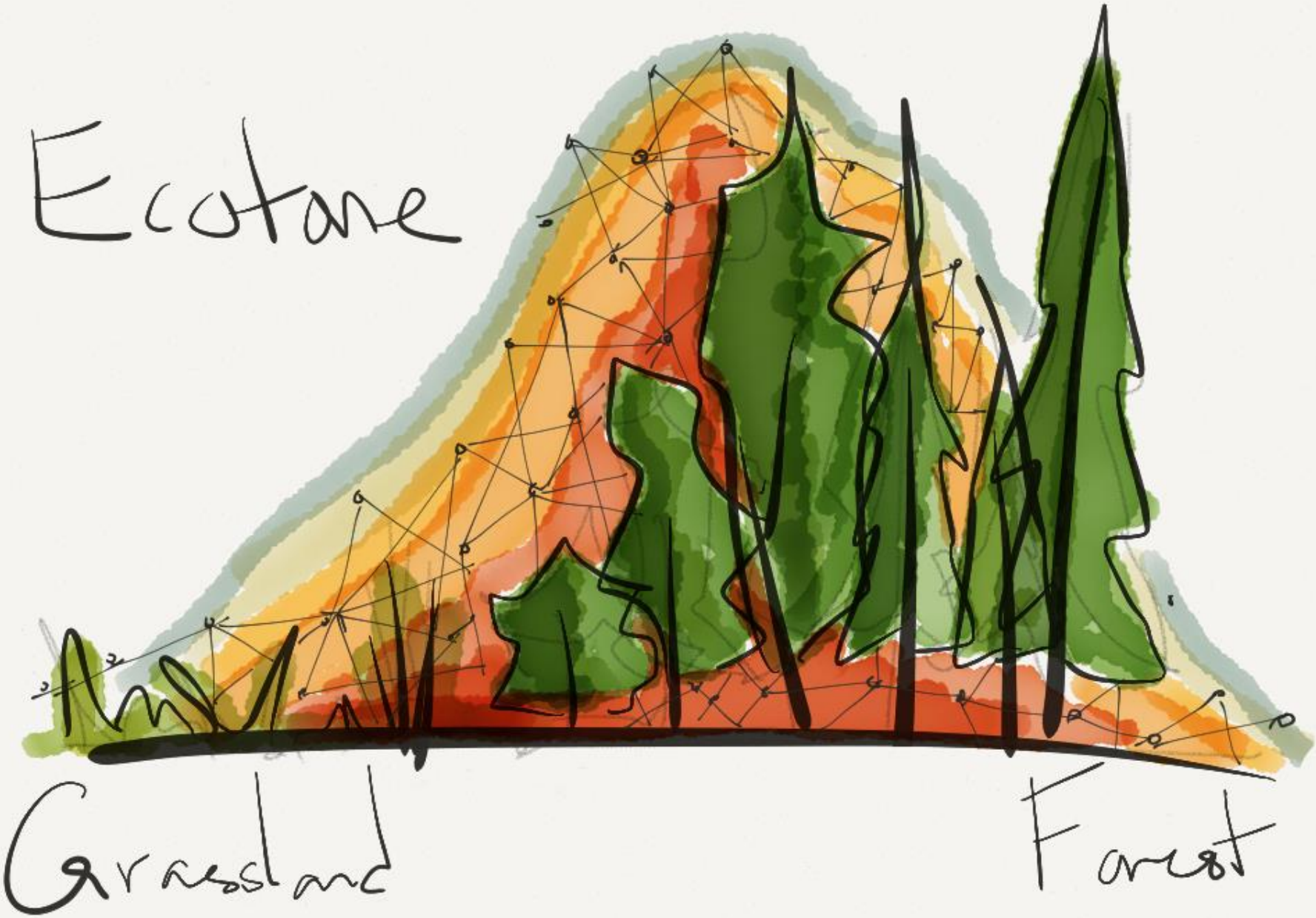
Meta 11.7: De aquí a 2030, proporcionar acceso universal a zonas verdes y espacios públicos seguros, inclusivos y accesibles, en particular para las mujeres y los niños, las personas de edad y las personas con discapacidad.

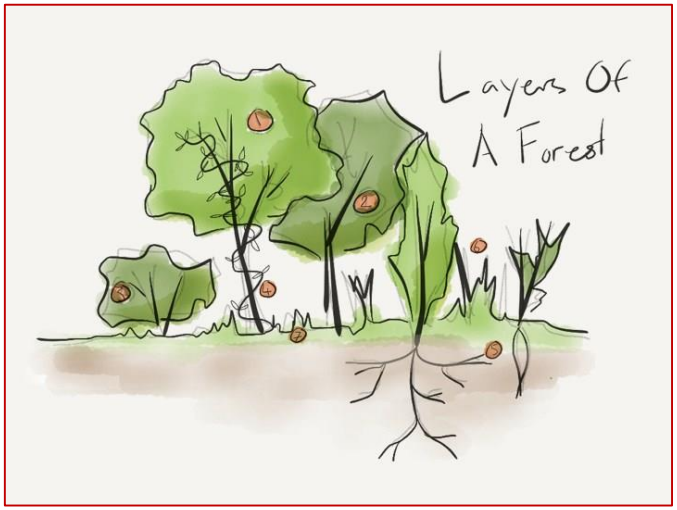
Habitat III: *conference on sustainable urban development*. Quito, 2016.

New Urban Agenda:

referencias *explícitas* a la salud mental y física, construcción de la comunidad realizando tareas ecológicas urgentes…

Los políticos, planificadores y desarrolladores urbanos deben implicarse con el uso del arbolado.


Ecotone
Grassland
Forest


Layers Of
A Forest

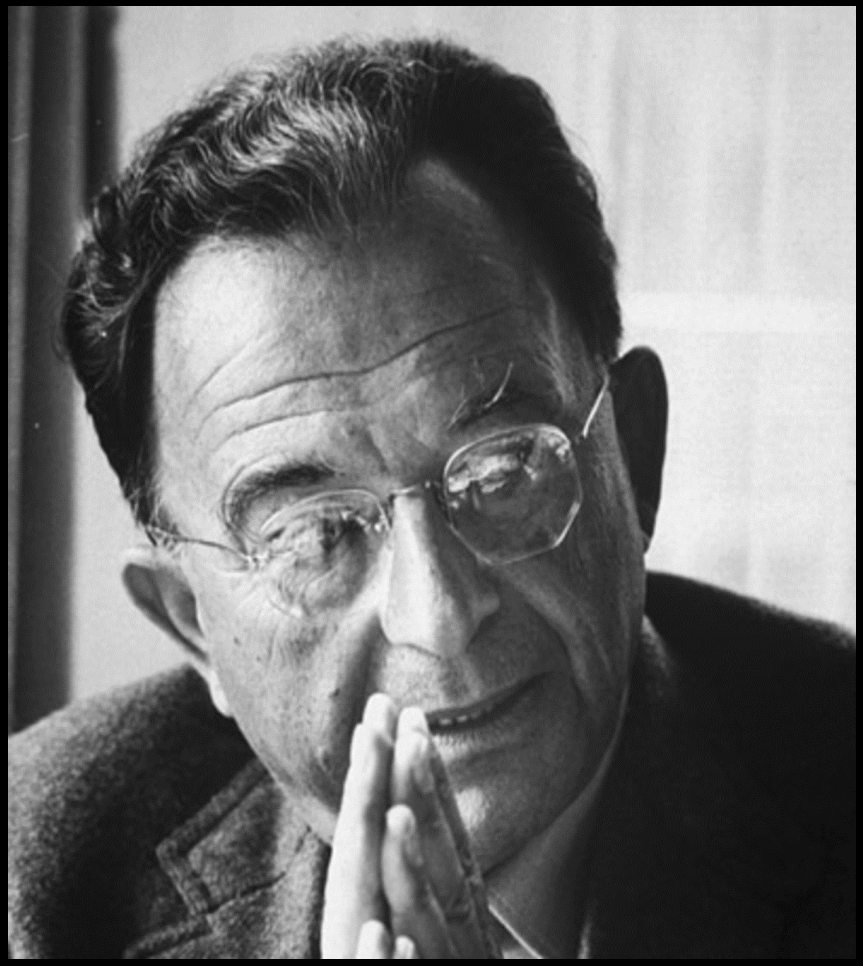

Layers of
A City?

bio•phil•ia

(bahy-oh-fil-ee-uh) noun

an innate and
genetically determined
love for the natural world
felt universally by humankind.

Biofilia



El corazón del hombre (Fromm, 1964),

The anatomy of Human Destructiveness (Fromm, 1973).

Biofilia (Edward Wilson, 1984)

afiliaci n emocional innata de los seres humanos a otros organismos vivos (Wilson, 1993, p. 31).

Exposición a la naturaleza???

Eco-planificación:

"estrategias y técnicas que combinan el urbanismo y la naturaleza para crear lugares para vivir enriquecedores sanos y civilizados“
(Williams, 2000)

Ciudades biofílicas

Biofilia representa el hilo conductor conceptual de un diseño y la gestión de ciudades que potencia la *gobernanza, la información y formación, los estilos de vida sanos, y sobre todo la naturación de las ciudades, a diferentes escalas y morfologías* (Beatley, 2010).

La presencia de naturaleza es necesaria pero …
no es una condición suficiente…

filia

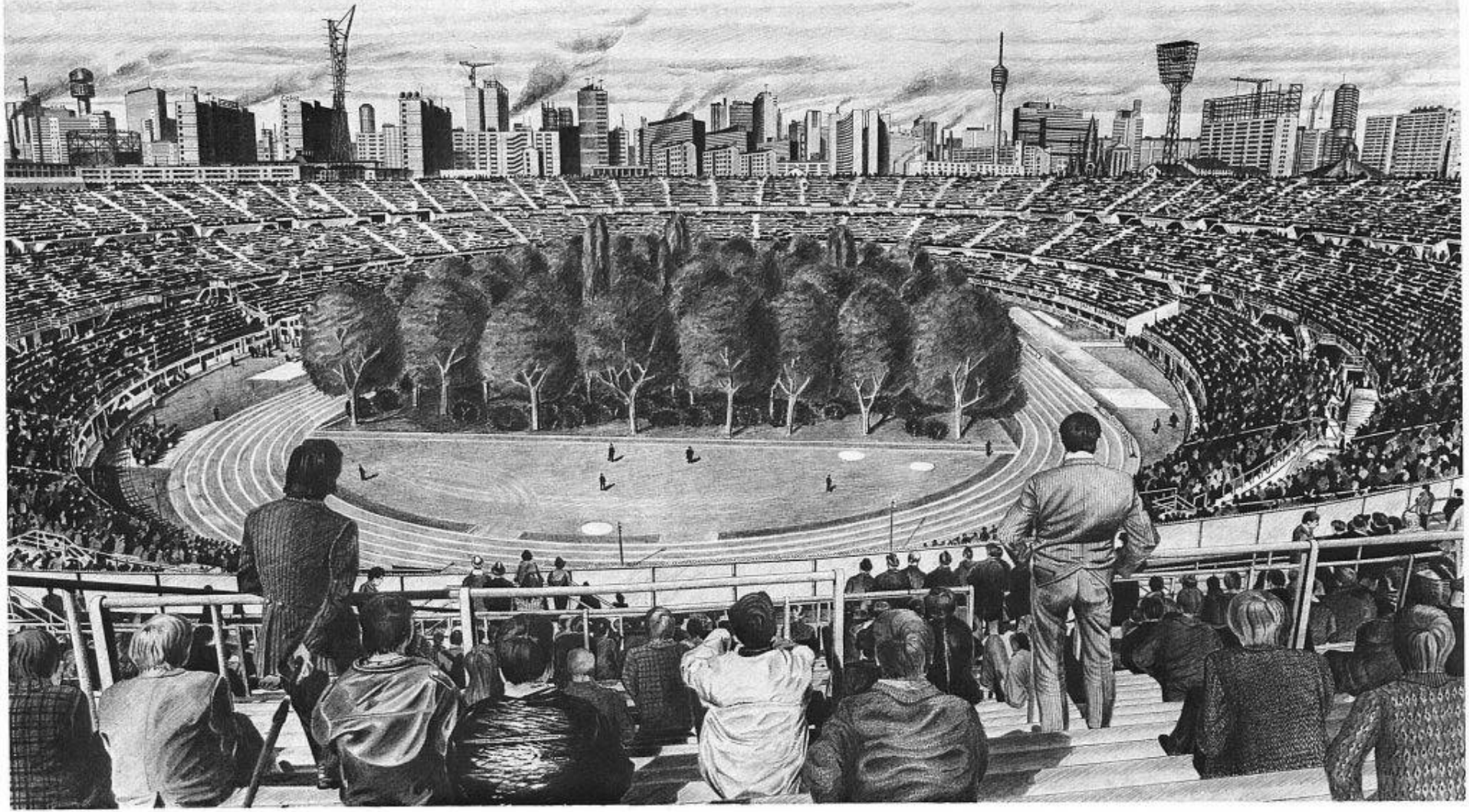
es tan importante como

bio-

En ciudades biofílicas los residentes están directa y activamente involucrados en el aprendizaje y cuidado de la naturaleza y han desarrollado importantes conexiones emocionales con ella.

En 1971, Max Peinter realizó un dibujo distópico y surrealista, en el cual un bosque crecía en el césped de un gran estadio:

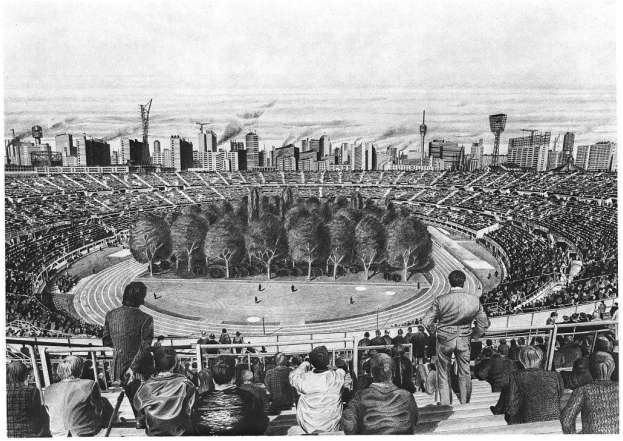
The Unending Attraction of Nature (*La Atracción Interminable de la Naturaleza*): un auténtico icono del arte.



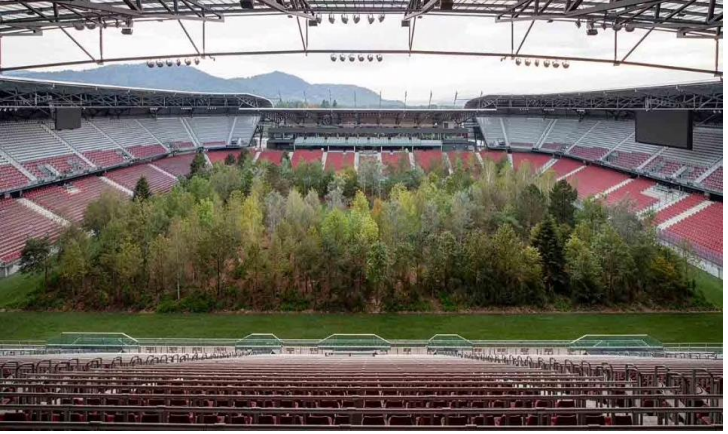
El artista sueco Klaus Littmann descubrió el diseño hace 30 años…

30 000 espectadores, Klagenfurt, en Lake Wörthersee: “FOR FOREST”

“a través de esta instalación monumental, Littmann pretende nuestra percepción sobre la naturaleza y cuestionar su futuro”.



forforest.net,




Parque natural Arseny Meschersky

Parque natural Arseny Meschersky

Urbanismo biofilico

Objetivo clave: la naturaleza en el centro de la planificación y diseño urbano.

UB requiere la acción a múltiples escalas geográficas en un ***enfoque macro y micro***.

El acceso a la naturaleza puede ocurrir de diferentes formas y a través de un rango muy variado de elementos vegetales.

Región y ciudad	Barrio y vecindario	Edificios
Urbanismo y planificación territorial	Jardines comunitarios. Espacios privados…	Cubiertas ajardinadas Jardines verticales Diseño interior biofílico


Infraestructura verde

OXÍMORON

Es hielo abrasador, es fuego helado,
es herida, que duele y no se siente,…
Francisco de Quevedo

TR

Estrategia de Biodiversidad de la UE

OBJETIVO 2:

Mantenimiento y mejora de los ecosistemas y **servicios ecosistémicos** antes de 2020 mediante la creación de **Infraestructura Verde** y la **Restauración** de al menos el **15 % de** los ecosistemas degradados.

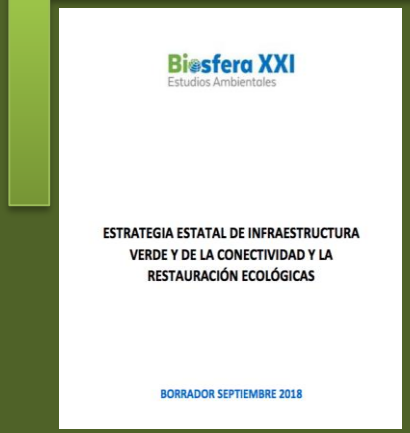
Estrategia Europea de Infraestructura Verde

Antecedentes conceptuales

Comunicación CE 2013

Ley 33/2015 del Patrimonio Natural y de la Biodiversidad

Normativa/iniciativas

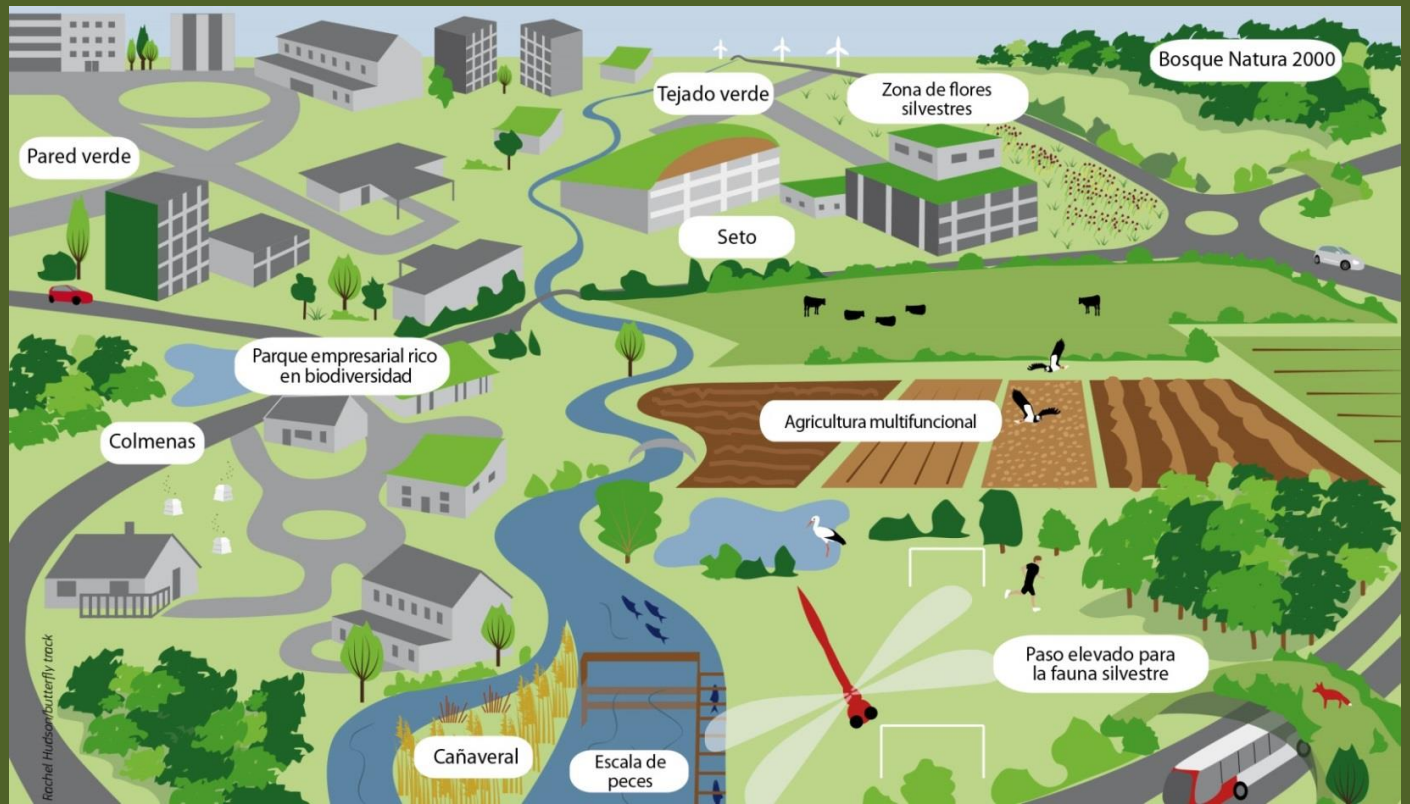


La Ley 33/2015, por la que se modifica la Ley 42/2007, **incorpora el concepto de Infraestructura Verde** en nuestro ordenamiento jurídico.

En su art. 15 determina la **obligación** de elaborar una **Estrategia Estatal de IV y de la CyR Ecológica** con la participación de las CCAA. Esta Ley pretende dar cumplimiento a la Comunicación de la Comisión Europea y también a incorporar algunos de los objetivos de la **Estrategia**

Plan estratégico PN y B
Ley de Montes
Ley de aguas
Ley de costas/litoral
Ley protección marino
Ley desarrollo rural
Ley vías pecuarias
Ley de suelo
Ley de Evaluación A

"La infraestructura verde puede definirse, en términos generales, como una red estratégicamente planificada de zonas naturales y seminaturales de alta calidad con otros elementos medioambientales, diseñada y gestionada para proporcionar un amplio abanico de servicios ecosistémicos y proteger la biodiversidad tanto de los asentamientos rurales como urbanos (UE, 2014).."



Multi

Sémica

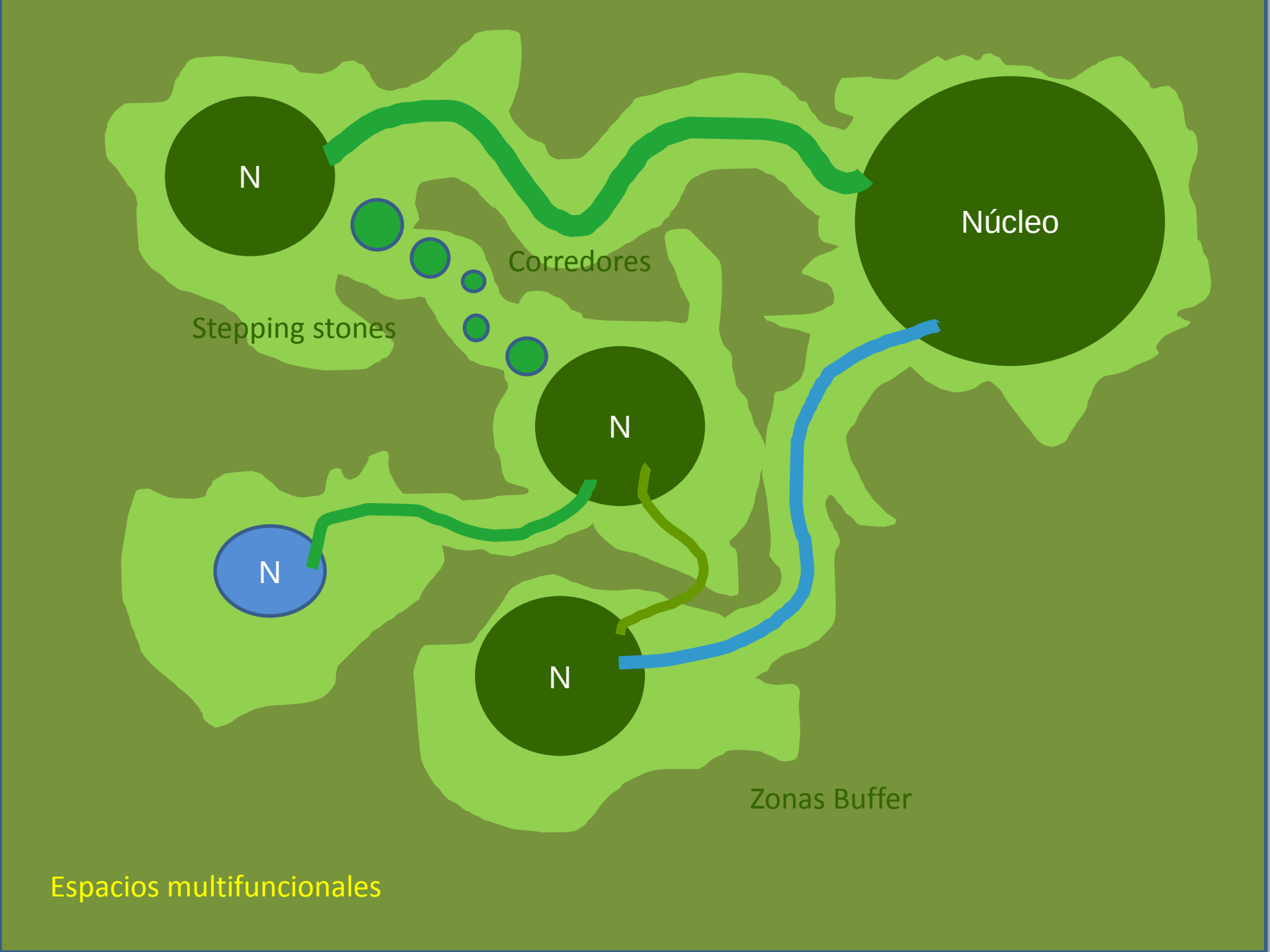
Escalar

Funcional

Objetivo

Temporal

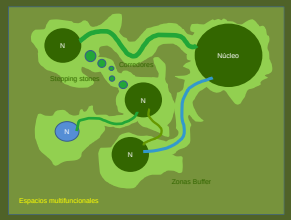
Disciplinar



Espacios multifuncionales

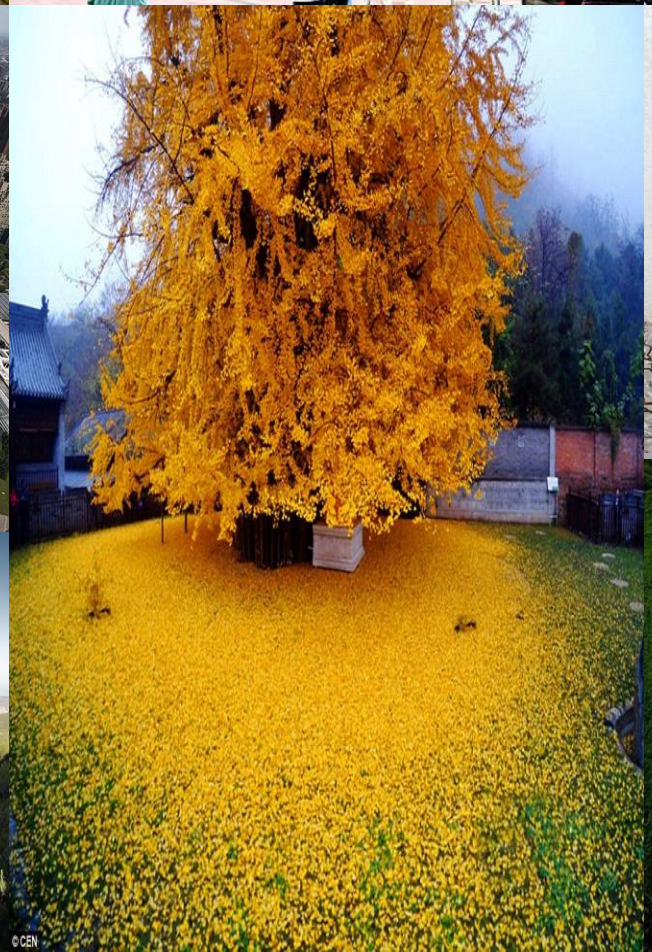

Terra
Fluxus

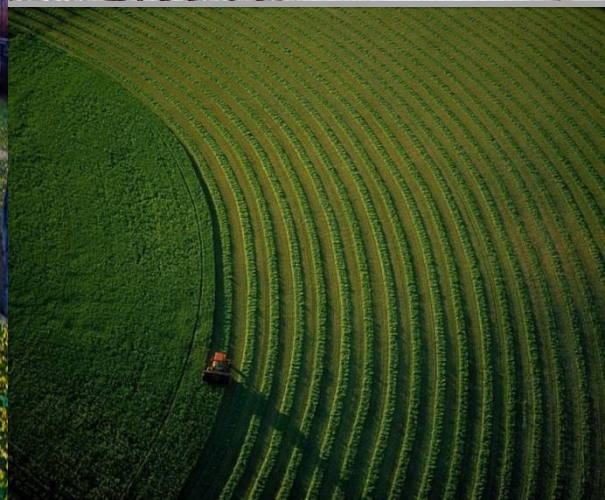
Elementos urbanos y periurbanos



- Arbolado urbano.
- Parques y zonas verdes públicas
- Espacios abiertos urbanos: plazas y bulevares
- Zonas verdes privadas y patios interiores
- Zonas verdes deportivas
- Estanques y balsas de inundación
- Ríos, arroyos, canales y sistemas de drenaje urbanos
- Abrevaderos y fuentes
- Jardines y huertos comunitarios
- Cementerios
- Cubiertas, muros y fachadas verdes
- Áreas agrícolas periurbanas
- Alineaciones de árboles, setos vivos, arbustos y linderos
- Vías verdes
- Parques periurbanos y parques forestales
- Paseos marítimos arbolados
- Tapias, muros verdes, fuentes y cubiertas verdes (paredes y techos verdes)
- Anillos verdes
- Sistemas de regadíos tradicionales (acequias, balsas, charcas)
- Hileras arboladas de caminos rurales
- Setos, sotos, y linderos con vegetación natural
- Áreas inundables
- Vegetación que acompaña a infraestructuras de la movilidad
- Canteras y graveras abandonadas
- Suelos no urbanizables protegidos por sus valores ambientales
- Sistemas de espacios libres y zonas verdes urbanas contempladas en la planificación urbanística


LES
HALLES

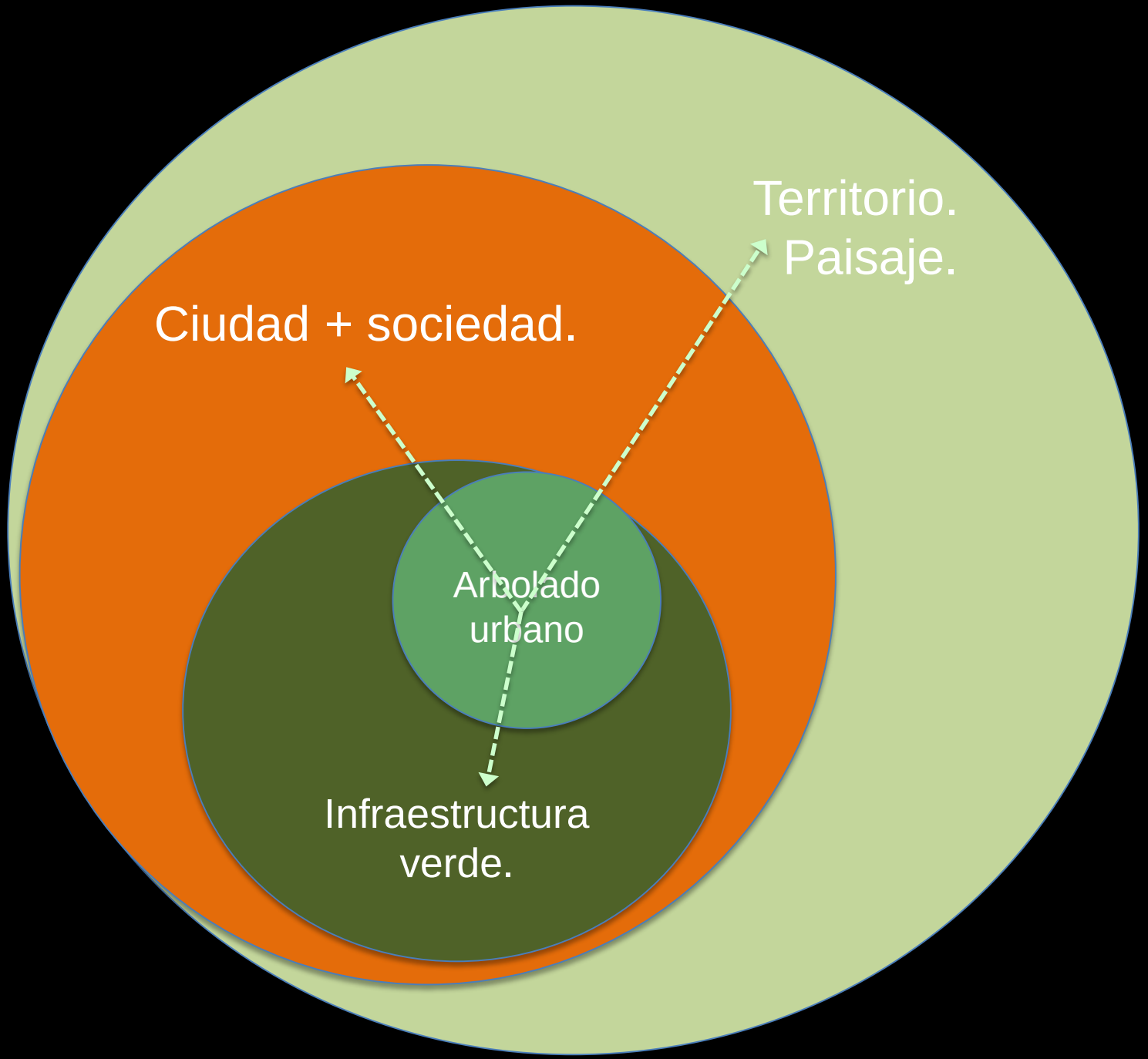




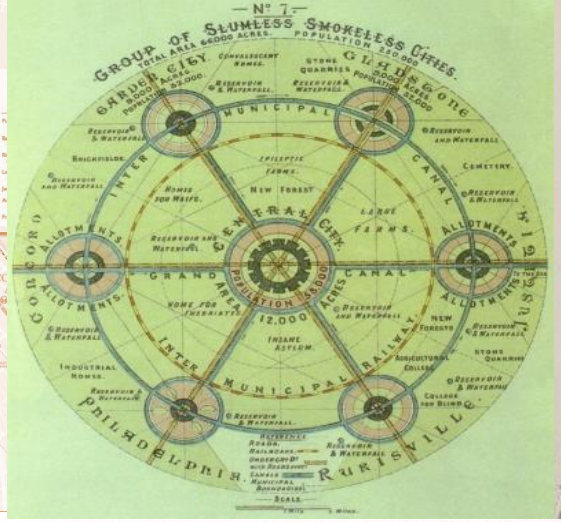

¿Qué vertebra más?

Haagsche Bosch, The Hague Netherlands

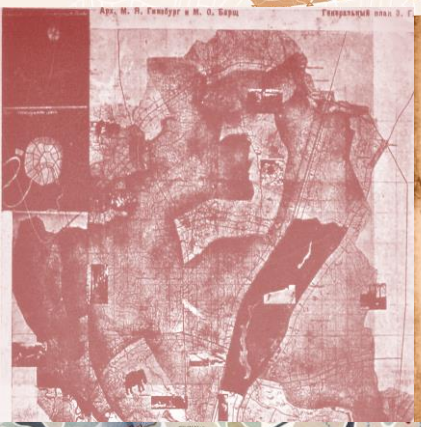
Pictures: historical material, city of The Hague


Territorio.
Paisaje.
Ciudad + sociedad.
Arbolado
urbano
Infraestructura
verde.


Emerald Necklace
JAMAICA POND
OLMSTED PARK
RIVERWAY
NORTH
ARNOLD ARBORETUM
BACK BAY FENS
FRANKLIN PARK
LEGEND


GROUP OF SLUMLESS SMOKELESS CITIES.
GARDEN CITY
GLASGOW
CENTRAL CITY
POPULATION 58,000
GRAND AREA
POPULATION 12,000
HOME FOR INEBRIATES
INSANE ASYLUM
INDUSTRIAL HOMES
PHILADELPHIA
RUSSIA


SKITSEFORSLAG TIL EGNSPLAN FOR
STORKØBENHAVN
UDARBEJDET 1947 AF EGNSPLANKONTORET




CITY
PORT


Lo que hoy ha sido probado,
fue una vez imaginado

Arboricultura urbana

El arte, ciencia y tecnología de gestionar árboles y recursos forestales en y alrededor de ecosistemas urbanos comunitarios para los beneficios psicológicos, sociológicos, económicos y estéticos que los árboles proporcionan a la sociedad.

(Helms 1998, después de Miller 1997)

Bosques urbanos (*Urban forests*):

Redes o sistemas que comprenden todos los bosques, grupos de árboles y árboles individuales localizados en áreas urbanas y periurbanas, incluyen, entre otros, bosques, árboles de calle, en parques y jardines y árboles en áreas abandonadas.

(FAO, 2016)

Peri-urban forests and woodlands.

City parks and urban forests (>0.5 has)

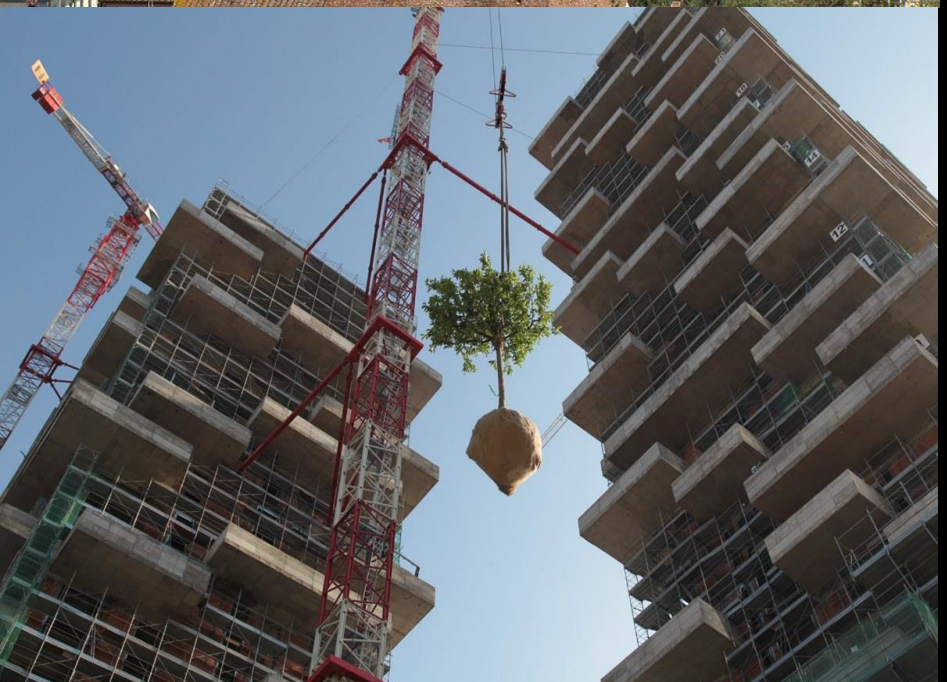
Pocket parks and gardens with trees (<0,5 has)

Trees on streets or in public squares.

Other green spaces with trees (agricultural, sport grounds, river banks, cemeteries or botanical gardens).

MACQUARIE UNIVERSITY CENTRAL COURTYARD

Hassell



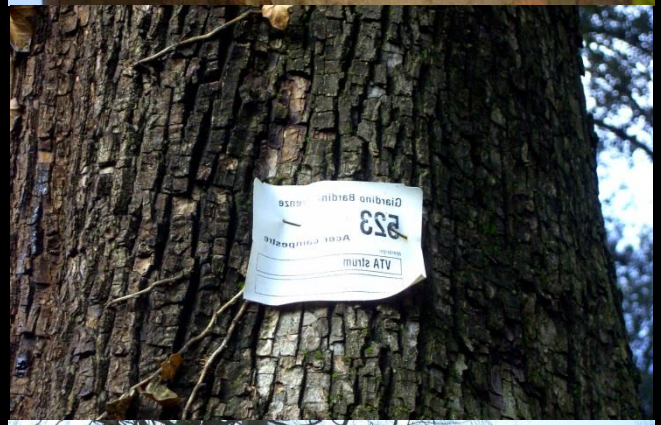
Objetivo de la gestión del arbolado urbano.

Optimizar el área foliar de los bosques urbanos estableciendo y manteniendo una copa de árboles y arbustos genéticamente apropiados (adaptados y diversos) con el mínimo riesgo para el público y de una manera de coste efectiva.

Dr. Andrew Kenney, 2010


MAIRIE DE PARIS
Ici, pour votre sécurité,
nous abattons cet arbre
devenu dangereux.
Un jeune arbre sera replanté
dès cet hiver.
23/09/08


MAIRIE DE PARIS
Ici, pour votre sécurité,
nous abattons cet arbre
devenu dangereux.
Un jeune arbre sera replanté
dès cet hiver.
23/09/08

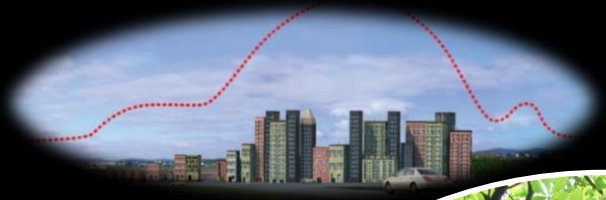



Strategic Urban Forest Management Plan
Goals and Objectives
Tree Inventory
Plan Components
Public Education / Communication
Budget
History and Context
Policies
Management Zones
Trees
Plantable Spots
Mapping/GIS
Inventory Maintenance
Tree Establishment
Maintenance Plan
Tree Protection Plan
Plant Health Care Plan
Hazard/Risk Abatement Plan
Communication Plan
Heritage Trees
Community Partnership
Servicios ecosistémicos
Valoración ornamental
+
Biodiversidad
Estratos de edades
Cambio climático…
Diservicios…
Shaded areas are found in all plan levels


beneficios
DESTOCK 24 OCT 2004

Urban tree benefits

Efecto isla de calor



Cambio climático

Biodiversidad

Caracter de la ciudad

Arquitectura del paisaje /estética y recreo

Valor

Salud y bienestar

Patrimonio cultural

CEA

www.vitoria-gasteiz.org.ceac

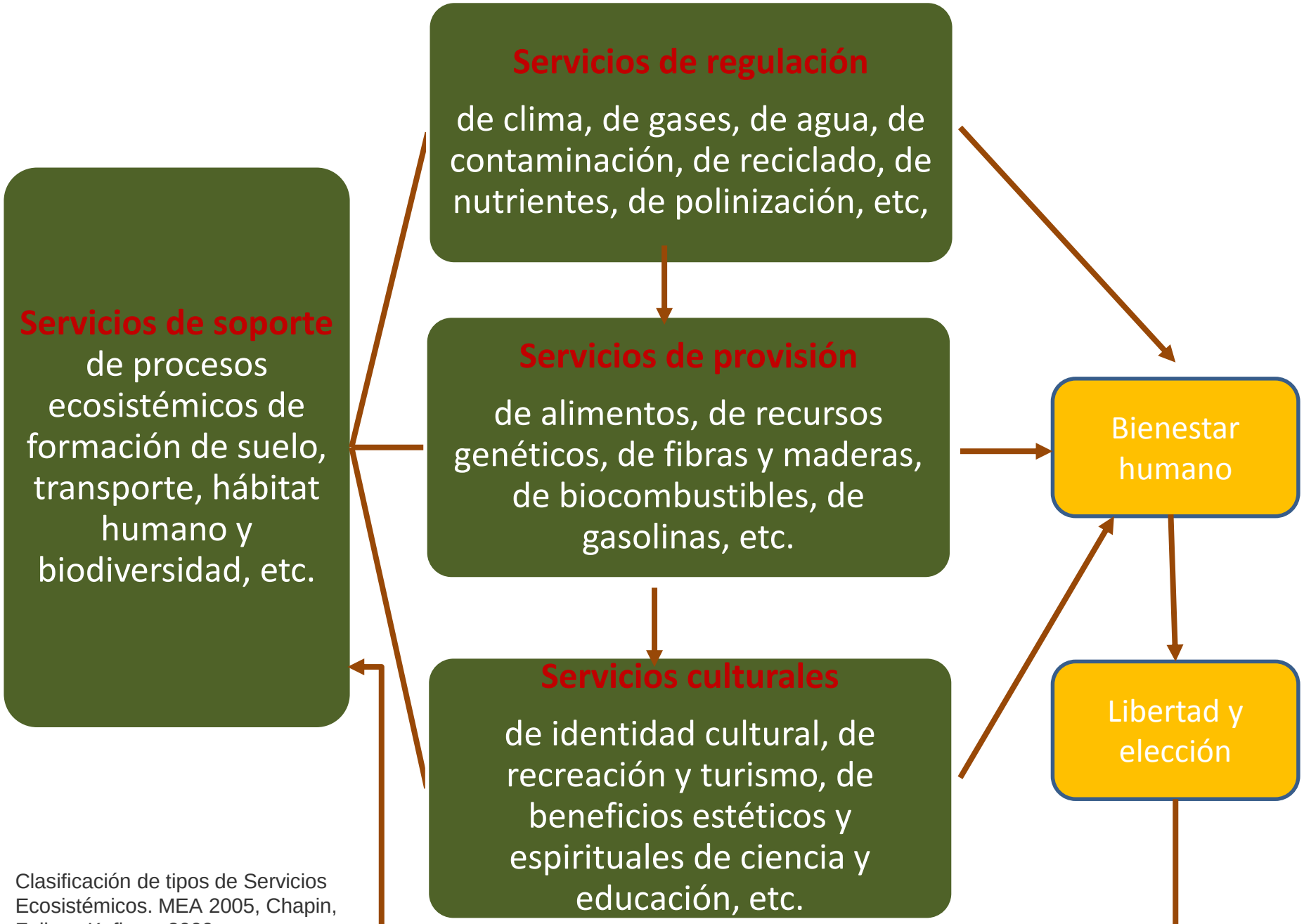

P206 JMC

“Urban trees **can reveal income inequality**”

“You can identify poor neighbourhoods from space” (Google Earth)

Servicios ecosistémicos

beneficios que la poblaci n obtienen de la naturaleza (Forestry Comission 2017).



Clasificación de tipos de Servicios Ecosistémicos. MEA 2005, Chapin, Folke y Kofinas, 2009.

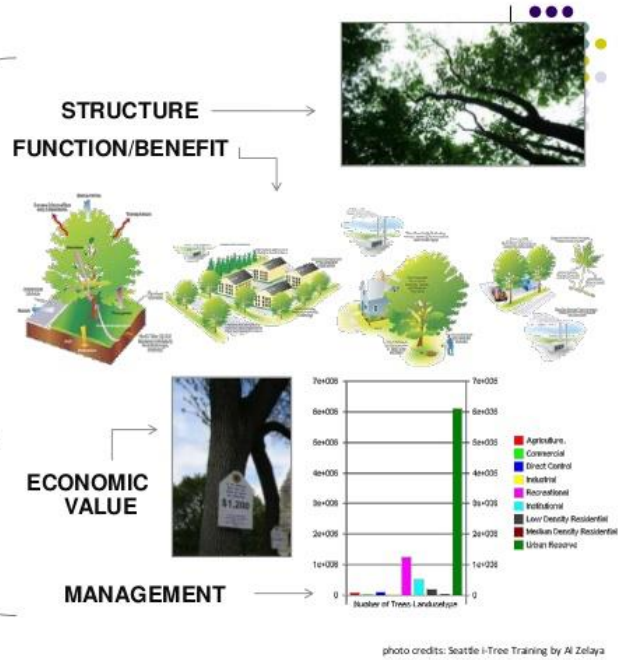
Servicios ecosistémicos.

Cuantificación

tessa

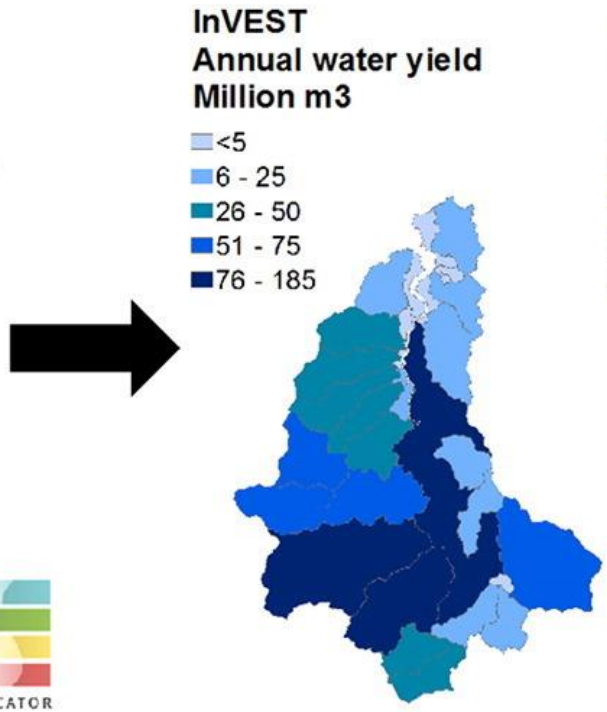
i-Tree

Eco
Streets
Hydro
Vue

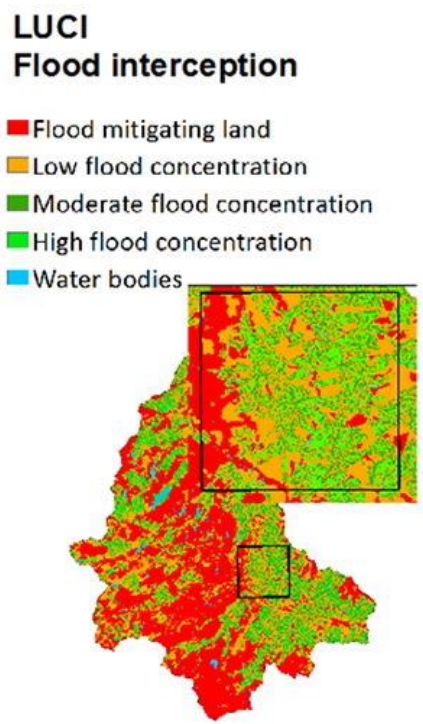


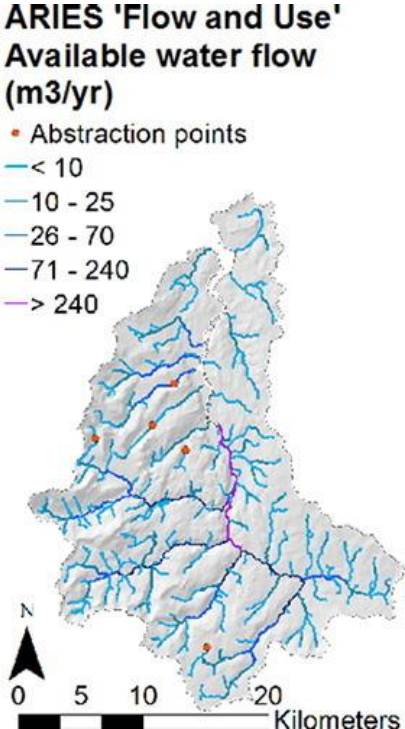
ARIES
ARtificial Intelligence for Ecosystem Services

InVEST
integrated valuation of ecosystem services and tradeoffs



LUCI
LAND UTILISATION & CAPABILITY INDICATOR





Action COST FP 1204: **Green Infrastructure approach: linking environmental with social aspects in studying and managing urban forests**

The Cost Of Ecosystem Services In Cities: Ecosystem Disservices

Coste de los servicios ecosistémicos o ecosystem disservices (ED) (Lyytimäki and Sipilä, 2009).

Delshammar, Ötsberg and Öxell (2015) desarrollaron un estudio de los diservicios del arbolado urbano comparando Goteborg, Malmo y Estocolmo.

Interacciones entre SE en bosques urbanos

The Cost Of Ecosystem Services In Cities: Ecosystem Disservices

- ✓ Diservicios medioambientales-Ecológicos:

CO2 + VOCs+alergias+...contaminantes (Calfapietra, 2013; Cariñanos et al, 2015.)

http://www.lifegaia.eu/Gli-alberi

1. Impacto en la salud ([CO_2] + BVOCs (Sur et al., 2013) + polen (Bartra et al., 2007) + Artrópodos-alérgicas (Bonamonte et al., 2013); pájaros son vectores de enfermedades (Lohmur-Balbur 2015)+ peligrosidad...)

- ✓ Problemas/peligros Sociales. crímenes...

- ✓ Costes Económicos (I-tree, directos, indorectos,...)

Inconvenientes

- 1.- Problemas de tipo físico y/o mecánico.
  - Problemas originados por el desarrollo del sistema radicular.
  - Rebrotes de raíz.
  - Presencia de espinas.

Heracleum mantegazzianum

GIANT HOGWEED

- Came to Britain in 1893 from Central Asia
- Grows up to 16ft high
- Member of the Apiaceae family – which also contains carrots and parsnips
- Toxic sap contained within the stem
- Breaking stem causes sap to ooze out
- Just one drop of sap in the eye can cause blindness
- Widespread across England Scotland and Wales
- Found on riverbanks, verges and wasteland
- Growing the plant in Britain is illegal


El árbol urbano.
Peligrosidad.

La víctimas asistían a un concierto de música hebrea al aire libre, que no se suspendió pese al aviso de fuertes vientos

Conmoción en Francia por la muerte de once personas en Estrasburgo por una tormenta

Pese al aviso que el Este de Francia sería azotado por grandes tormentas, en la ciudad de Estrasburgo nadie quiso suspender el concierto de música hebrea que ofreció el grupo Mamas et Papas al aire libre la noche del viernes. Fue el fuerte viento racheado el que acabó aguando la fiesta, al arrancar de cuajo un árbol que se desplomó sobre una carpa que cobijaba a 120 personas. Once jóvenes murieron en el acto al ser aplastados. Otros 18, entre ellos dos niños, resultaron heridos de gravedad. Los franceses asisten conmocionados al desenlace de una tragedia que ya está siendo investigada por la Fiscalía y que algunos creen pudo haberse evitado.

DOMINGOS SAMPEDRO
BRUSELAS. Corresponsal

JEAN MARC LOOS / REUTERS

Un policía permanece junto al árbol derribado por el fuerte viento y que causó la tragedia en Estrasburgo

Astrid Ruff, una joven que asistió al concierto celebrado en los jardines de un castillo situado a las afueras de Estrasburgo, declaró a la televisión francesa que la decisión de celebrarlo «fue imprudente. Podemos decirlo ahora al ver el alcance de esta tragedia».

Aunque visiblemente consternada por lo ocurrido, ella al menos resultó ilesa. No tuvieron la misma suerte los siete hombres y cuatro mujeres que murieron en el acto cuando un árbol arrancado por un repentino pequeño tornado se desplomaba sobre la carpa inestable en la que se guarecían de la fuerte lluvia. El suceso tuvo lugar poco antes de las diez de la noche del pasado viernes. Otras 65 personas que se refugiaban de la tormenta en el mismo lugar resultaron heridos, 18 de ellos de gravedad.

En alerta

Los servicios de socorro, que estaban en alerta por el aviso de fuertes tormentas, movilizaron 130 bomberos, 35 ambulancias y tuvieron que utilizar máquinas para cortar las ramas del árbol para rescatar a los heridos. En el lugar se vivieron escenas de desolación, con jóvenes, muchos de ellos menores, que vagaban ensangretados bajo la lluvia llamando a gritos a familiares y amigos.

Los organizadores habían recibido la autorización para celebrar el concierto al aire libre, pese al pronóstico de fuertes tormentas para los departamentos de la Alsacia, Lorena y el Franco Condado, todos ellos en el Este del país.

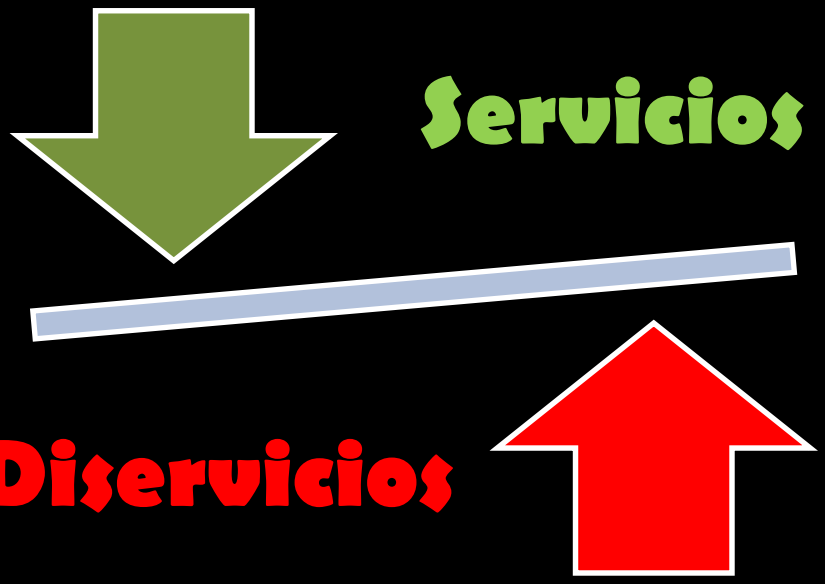
Philippe Marland, responsable del Gobierno en la zona, atribuyó el siniestro a «la fatalidad» y dijo que había sido imposible prever la tragedia.

Estragos en otros lugares del país

La Fiscalía de Estrasburgo abrió ayer una investigación para esclarecer las circunstancias del siniestro que ha costado la vida a once personas. Se trata de esclarecer si existe alguna responsabilidad del Centro Europeo para la Cultura Judía, organizador del concierto al aire libre, por no haber suspendido la actuación pese que el Servicio de Meteorología francés había recomendado que no se saliese de casa e incluso y la gente evitase refugiarse debajo de los árboles.

La tormenta también causó estragos en Tulle, centro-este del país, donde fueron evcuados cientos de vecinos, y en Belfort fue interrumpido un concierto de rock al que asistían 20.000 personas y no circulan trenes. También en el norte de Italia, un huracán arrasó la región de Lombardía, que dejó 60 heridos y numerosos daños.

Además, en el municipio de Felsberg, en el cantón suizo de Grisons (este), una roca de alrededor de 200.000 metros cúbicos, equivalente a un centenar de casas, cayó la pasada noche sin causar víctimas ni daños.



Criterio de planificación urbana

...para desarrollar una correcta gestión sostenible de la vegetación urbana se deben conocer tanto los servicios como los diservicios y se deben comparar para analizar coherentemente su peso específico (Escobedo et al., 2011).

Mental

Físico

Social

Medioambiental (Tº, Vocs, sombra, etc…)

SERVICIOS A LA SALUD

Economía

Sustancias tóxicas

Colapsos

Zarcillos, espinas

BVOCs

Alergias

DISERVICIOS A LA SALUD

Esporas fúngicas

SE y Bosques urbanos

Table 2 Matrix of the relationship between ecosystem services and urban forest components.

Ecosystem service		Urban forest components			
		Single tree	Line of trees	Tree cluster	Woodland
Provisioning	Food provision				
	Fuel provision (woodfuel)				
	Wood provision				
Regulating	Carbon sequestration				
	Temperature regulation				
	Stormwater regulation				
	Air purification				
	Noise mitigation				
Cultural	Health				
	Nature and landscape connections				
	Social development and connections				
	Education and learning				
	Economy				
	Cultural significance				
Disservice	Fruit and leaf fall				
	Animal excrement				
	Blocking of light, heat or views				
	Decrease in air quality				
	Allergenicity				
	Spread of pests and diseases				
	Spread of invasive species				
	Damage to infrastructure				
	Creation of fear				
	Tree and branch fall (especially during storms)				

Commonly delivered Sometimes delivered Rarely delivered

Identificar, cuantificar y evaluar SE de UF

Definir aspectos específicos y factores que influencian la provisión de SE.

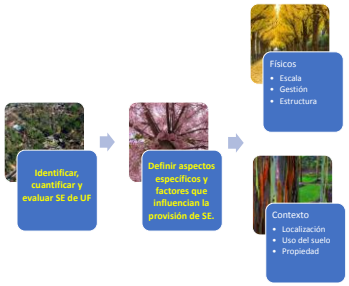
Físicos

- Escala
- Gestión
- Estructura

Contexto

- Localización
- Uso del suelo
- Propiedad

Escala y gestión



Valorados como conjuntos

Provisión y regulación. FCC>>> (McPherson, 1994, Nowak and Crane, 2002)

Árbol aislado

Alineación de árboles

Clúster de árboles

Bosques urbanos (urban woodland, 5000 m2 y 20 m)

Técnicas de arboricultura

Tcas de silvicultura (Kenney et al., 2011)

Físicos

- Escala
- Gestión
- **Estructura**

- Densidad y separación
- Distribución de clases diamétricas y edades
- Sanidad vegetal
- Composición de especies
- Área de superficie foliar
- FCC
- Biomasa

Cobertura de copa…

La cobertura de copa puede servir como un indicador de la extensi n de como los rboles y bosques proporcionan servicios cr ticos a los residentes

(Nowak et al., 2010).

TREE BENEFITS

- **Large maturing trees provide greater value**

from McPherson, E.G.; et. al. 2003. Northern mountain and prairie community tree guide: benefits, costs and strategic planting. Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service.

Large Tree

- Total benefits/year = $55
- Total costs/year = $18
- Net benefits/year = $37
- Life expectancy = 120 years
- Lifetime benefits = $6,600
- Lifetime costs = $2,160
- Value to community = $4,440

Medium Tree

- Total benefits/year = $33
- Total costs/year = $17
- Net benefits/year = $16
- Life expectancy = 60 years
- Lifetime benefits = $1,980
- Lifetime costs = $1,020
- Value to community = $960

Small Tree

- Total benefits/year = $23
- Total costs/year = $14
- Net benefits/year = $9
- Life expectancy = 30 years
- Lifetime benefits = $690
- Lifetime costs = $420
- Value to community = $270

Where the Trees Meet the Seas

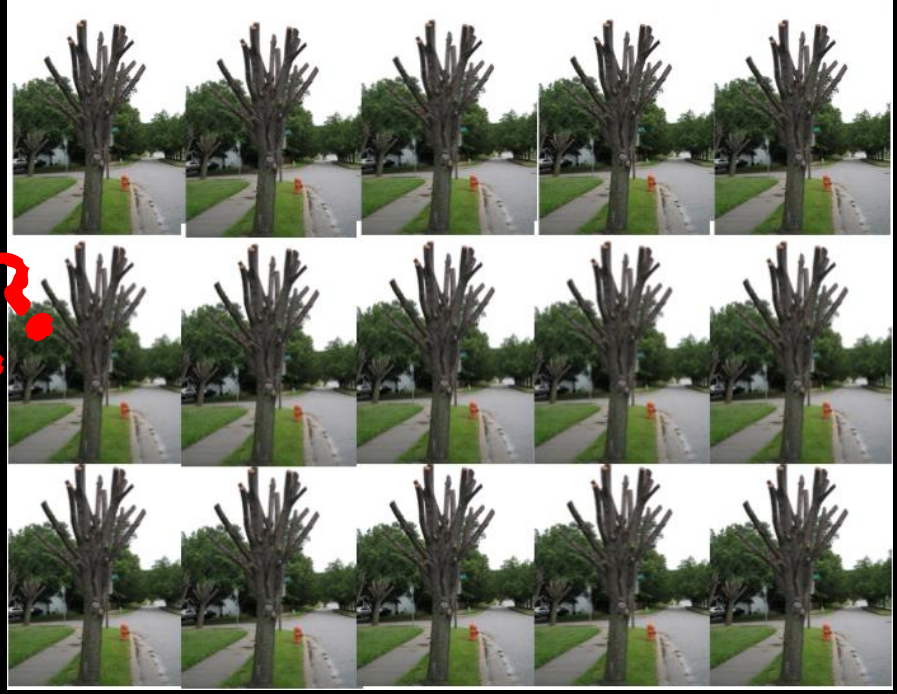
Morris Arboretum of the University of Pennsylvania

TREE BENEFITS

- Large maturing trees provide greater value

Morris Arboretum of the University of Pennsylvania

Numero vs FCC??



Pittsburgh | 42% tree cover

A significant portion of hillside around the world's former steel capital has variously been mined, logged, and built upon. But with the passage of time, much of it has been naturally reforested. This new-growth forest and the city's four large parks make for a patchy canopy, so local environmental organizations have enlisted volunteers to plant 20,000 trees in recent years. The expanded urban forest removes 532 tons of air pollution every year.

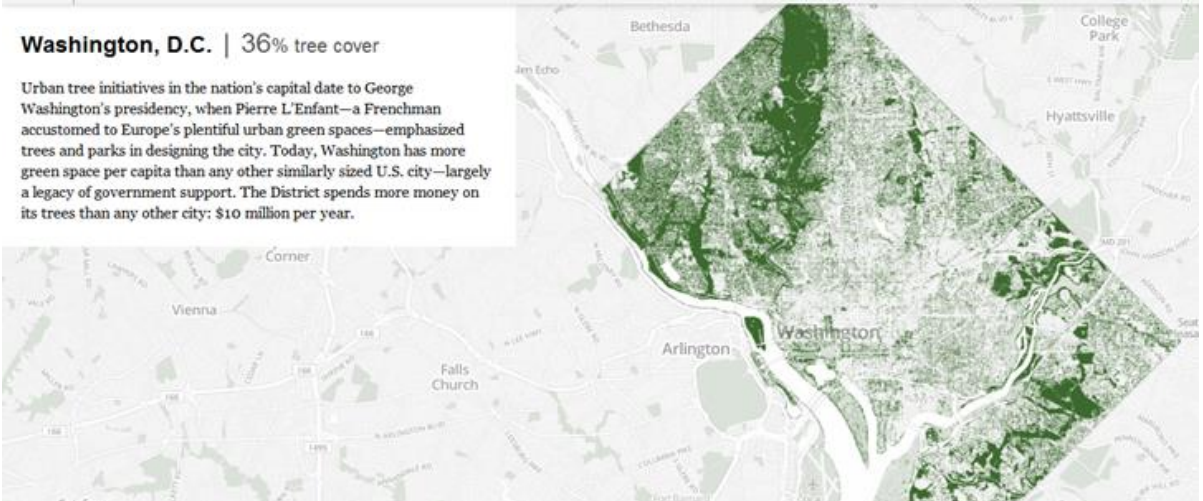
Austin | 37% tree cover

Last March, Austin adopted an Urban Forest Plan to help sustainably preserve its trees through a drought—which began in 2010—and in the face of expected climate change. Almost all the water in Austin's tree-watering tanker trucks is reclaimed and filtered municipal wastewater, reducing the amount of potable water used for tree initiatives by one million gallons per year.

Toronto: 17% cobertura de copa, objetivo: 30-40%

Washington, D.C. | 36% tree cover

Urban tree initiatives in the nation's capital date to George Washington's presidency, when Pierre L'Enfant—a Frenchman accustomed to Europe's plentiful urban green spaces—emphasized trees and parks in designing the city. Today, Washington has more green space per capita than any other similarly sized U.S. city—largely a legacy of government support. The District spends more money on its trees than any other city: $10 million per year.



Necesitamos hojas,

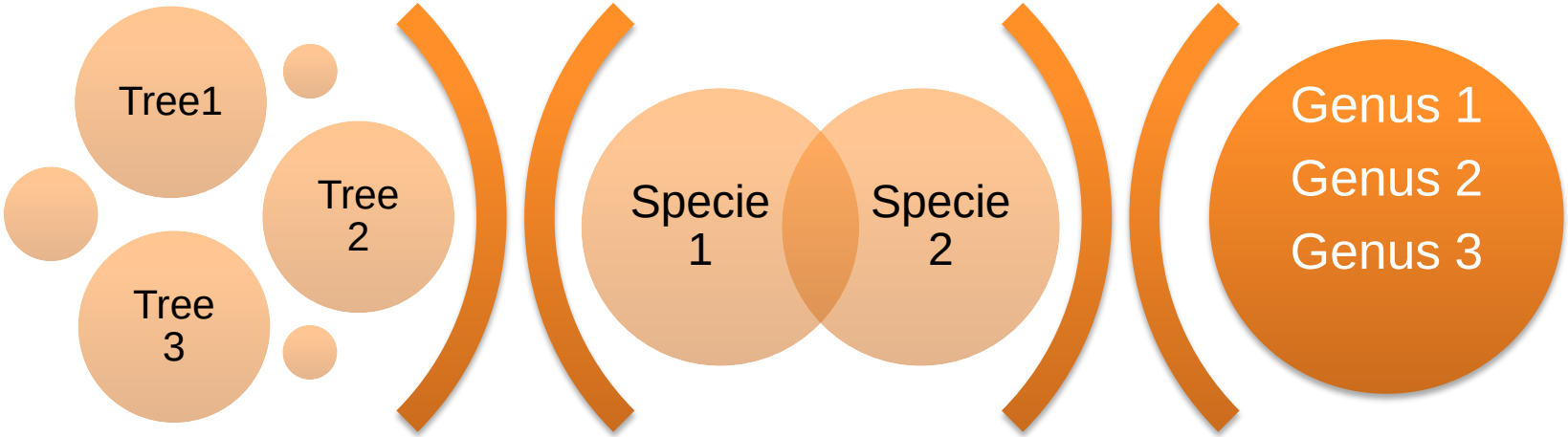
no rboles

(adaptado de Nowak)

Arbolado urbano sano:

biodiversidad + estratos de edad...

ESTUDIO DE BIODIVERSIDAD - SANTAMOUR, 2002.

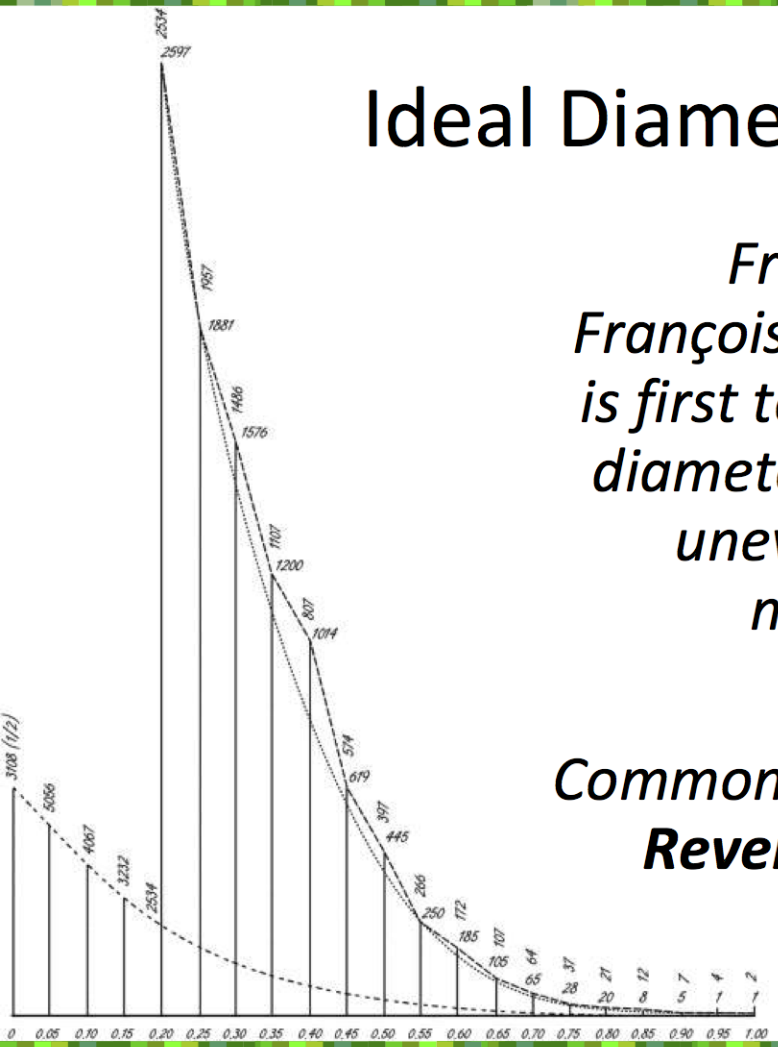


Nº trees of the same SPECIE<10% TOTAL

Nº of trees of the same GENUS <20%

Nº of trees of the same FAMILY < 30% TOTAL

Distribución diamétrica de la masa arbórea urbana



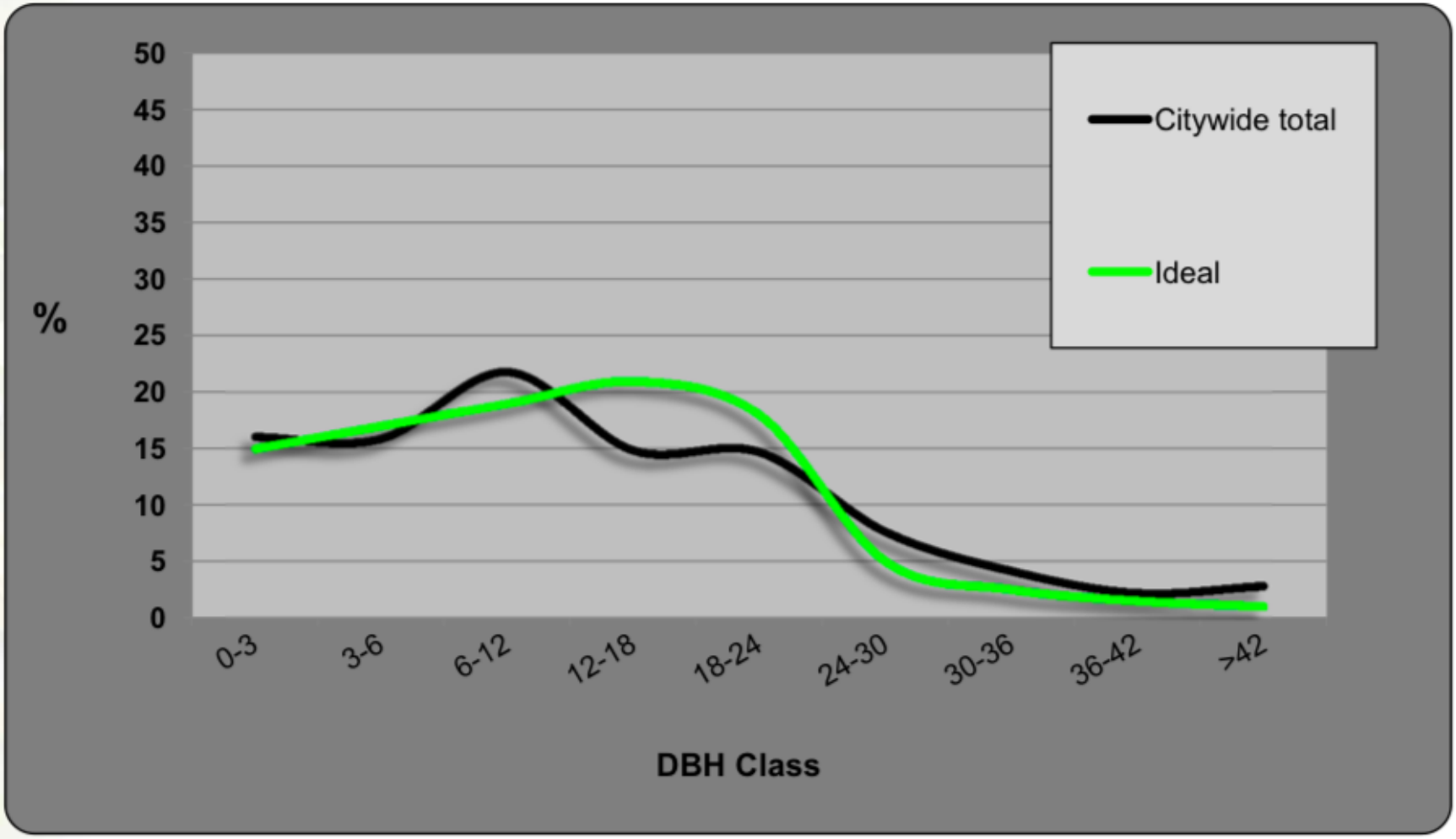
Ideal Diameter Distribution?

French forester
François de Liocourt (1898)
is first to formally describe
diameter distributions for
uneven aged forest
management

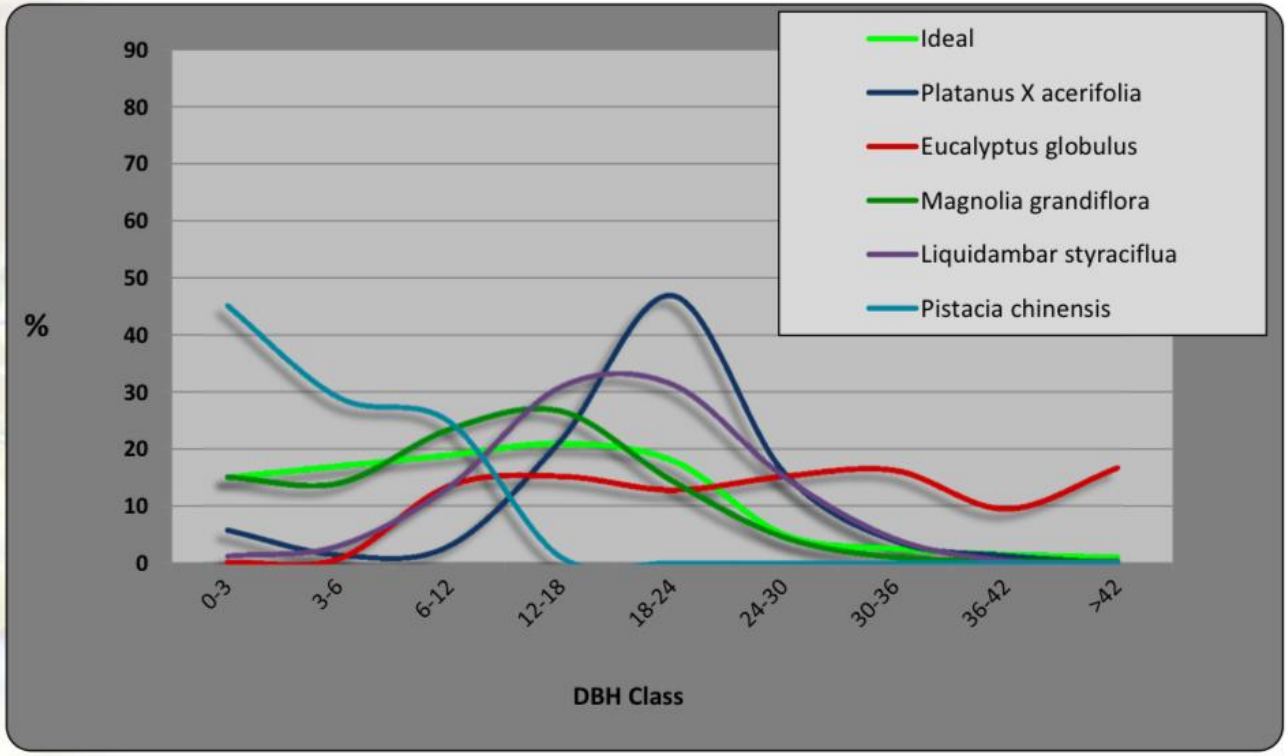
Commonly referred to as the
***Reverse-J** distribution*

No existe una distribución ideal

de Liocourt, F., 1898, De l'amenagement des sapinières, in: *Bulletin Trimestriel, Société Forestière de Franche-Comté et Belfort, Julliet, pp. 396-409.*


50
45
40
35
30
25
20
15
10
5
0
%
Citywide total
Ideal
0-3
3-6
6-12
12-18
18-24
24-30
30-36
36-42
>42
DBH Class

Age Structure



From Sapling to Maturity - Exploring Structural Diversity in Urban Forests

Justin Morgenroth
New Zealand School of Forestry
University of Canterbury

David Nowak
USDA Forest Service

What is the ideal UF dbh distribution?

Urban Ecology, 7 (1982/1983) 159–171 159
Elsevier Scientific Publishing Company, Amsterdam — Printed in The Netherlands

DIVERSITY AND STABILITY IN A STREET TREE POPULATION

N.A. RICHARDS

College of Environmental Science and Forestry, School of Forestry, State University of New York, Syracuse Campus, Syracuse, NY 13210 (U.S.A.)

(Accepted 5 May 1982)

ABSTRACT

Richards, N.A., 1983. Diversity and stability in a street tree population. *Urban Ecol.*, 7: 159–171.

The relationship of species diversity to the stability of a street tree population is explored, using data from Syracuse, NY. Because streetside spaces are complexly-stressed environments, one generally observes that relatively few species prove wide adaptation and good longevity in a particular community, and that there is greater species diversity among recently planted trees than among older trees in the population. The few species surviving to be well represented among the older trees are likely to be better prospects for contributing to population stability in the uncertain future than are short-lived, ill-adapted, or little-tested species that may be added to increase diversity. Population stability depends on species adaptation to the diversity of streetside conditions in a community over time, rather than on species diversity per se. Good age diversity, to provide adequate successful replacements, is essential for population stability. Undue emphasis on species diversity in replacement plantings may further threaten stability by causing inadequate replacement of the proven adapted species in the older population.

- Richards most cited in UF literature
- But is distribution ideal or generally applicable?
- Richards calls them "*my approximate guidelines*"

Richards, N. A. (1983). Diversity and stability in a street tree population. *Urban Ecology, 7(2), 159-171.*

My Approximate Guidelines…

- Richards' "*approximate guidelines*"

"For adapted, long-lived species […] in Syracuse, […] a good age distribution for population stability would be about ***40% trees under 20 cm*** *diameter,* ***30% 20 – 40 cm*** *trees in the early functional stage,* ***20% 40 – 60 cm*** *functionally mature trees, and* ***10% older trees*** *with most of their functional life behind them."*

Richards, N. A. (1983). Diversity and stability in a street tree population. *Urban Ecology, 7(2), 159-171.*

What is the ideal distribution?

Journal of Environmental Management 91 (2010) 2215–2224

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Structure of a forested urban park: Implications for strategic management

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i-Tree
Leaf area
Age structure
Strategic management

ABSTRACT

Informed management of urban parks can provide optimal conditions for tree establishment and growth and thus maximize the ecological and aesthetic benefits that trees provide. This study assesses the structure, and its implications for function, of the urban forest in Allan Gardens, a 6.1 ha downtown park in the City of Toronto, Canada, using the Street Tree Resource Analysis Tool for Urban Forest Managers (STRATUM). Our goal is to present a framework for collection and analysis of baseline data that can inform a management strategy that would serve to protect and enhance this significant natural asset. We found that Allan Garden's tree population, while species rich (43), is dominated by maple (*Acer* spp.) (48% of all park trees), making it reliant on very few species for the majority of its ecological and aesthetic benefits and raising disease and pest-related concerns. Age profiles (using size as a proxy) showed a dominance of older trees with an inadequate number of individuals in the young to early middle age cohort necessary for short- to medium-term replacement. Because leaf area represents the single-most important contributor to urban tree benefits modelling, we calculated it separately for every park tree, using hemispheric photography, to document current canopy condition. These empirical measurements were lower than estimates produced by STRATUM, especially when trees were in decline and lacked full canopies, highlighting the importance of individual tree condition in determining leaf area and hence overall forest benefits. Stewardship of natural spaces within cities demands access to accurate and timely resource-specific data. Our work provides an uncomplicated approach to the acquisition and interpretation of these data in the context of a forested urban park.

- Millward & Sabir modify Richards and propose:

- "…a generalized ideal distribution […] that would see **40%** of a tree population fall within a DBH class of **0 – 15 cm**, **30%** from **15 – 60 cm**, **25%** in class **60 – 90 cm**, and **5%** classified as **90 cm** and above."

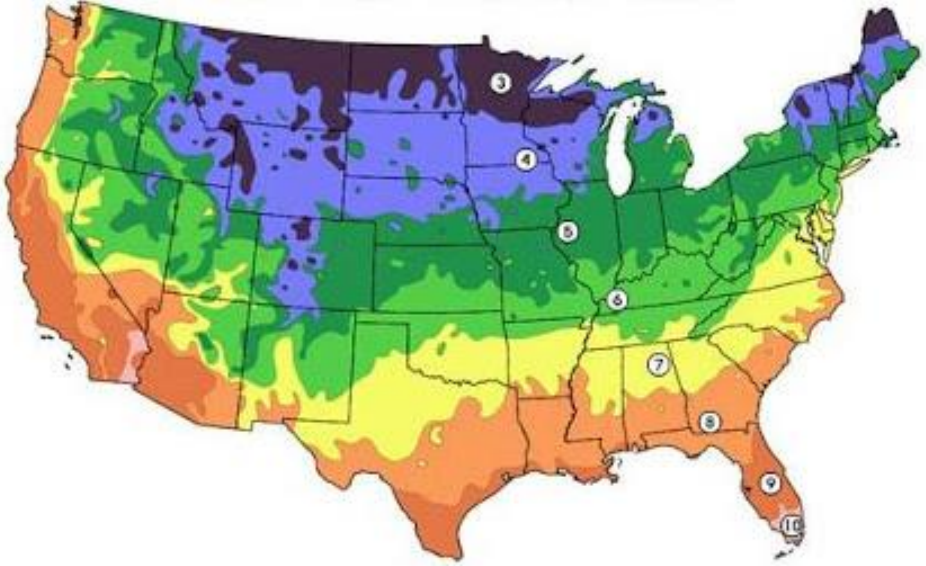
Millward, A.A., & Sabir, S. (2010). Structure of a forested urban park: Implications for strategic management. *Journal of Environmental Management, 91(11), 2215-2224. doi: http://dx.doi.org/10.1016/j.jenvman.2010.06.006*

KITCHENER (CA)

1. **Trees & Forests** – Targets related to the status of the vegetation resource itself and/or knowledge of that resource.						
#	Target	Key objective	2017 Rating			
			Low	Fair	Good	Optimal
T3	**Species diversity**	Establish a genetically diverse tree population across municipality as well as at the neighborhood level.	Five or fewer species dominate the entire tree population across municipality.	No single species represents more than 10% of total tree population; no genus more than 20%; and no family more than 30%.	No single species represents more than 5% of total tree population; no genus more than 10%; and no family more than 15%.	At least as diverse as "Good" rating (5/10/15) municipality-wide – *and* at least as diverse as "Fair" (10/20/30) at the neighborhood level.
T2	**Age diversity (Size class distribution)**	Provide for ideal uneven age distribution of all "intensively" (or individually) managed trees – municipality-wide as well as at neighborhood level.	Even-age distribution, or highly skewed toward a single age class (maturity stage) across entire population.	Some uneven distribution, but most of the tree population falls into a single age class.	Total tree population across municipality approaches an ideal age distribution of 40% juvenile, 30% semi-mature, 20% mature, and 10% senescent.	Total population approaches that ideal distribution municipality-wide as well as at the neighborhood level.

Zonas USDA PHZM

Calentamiento global



1990

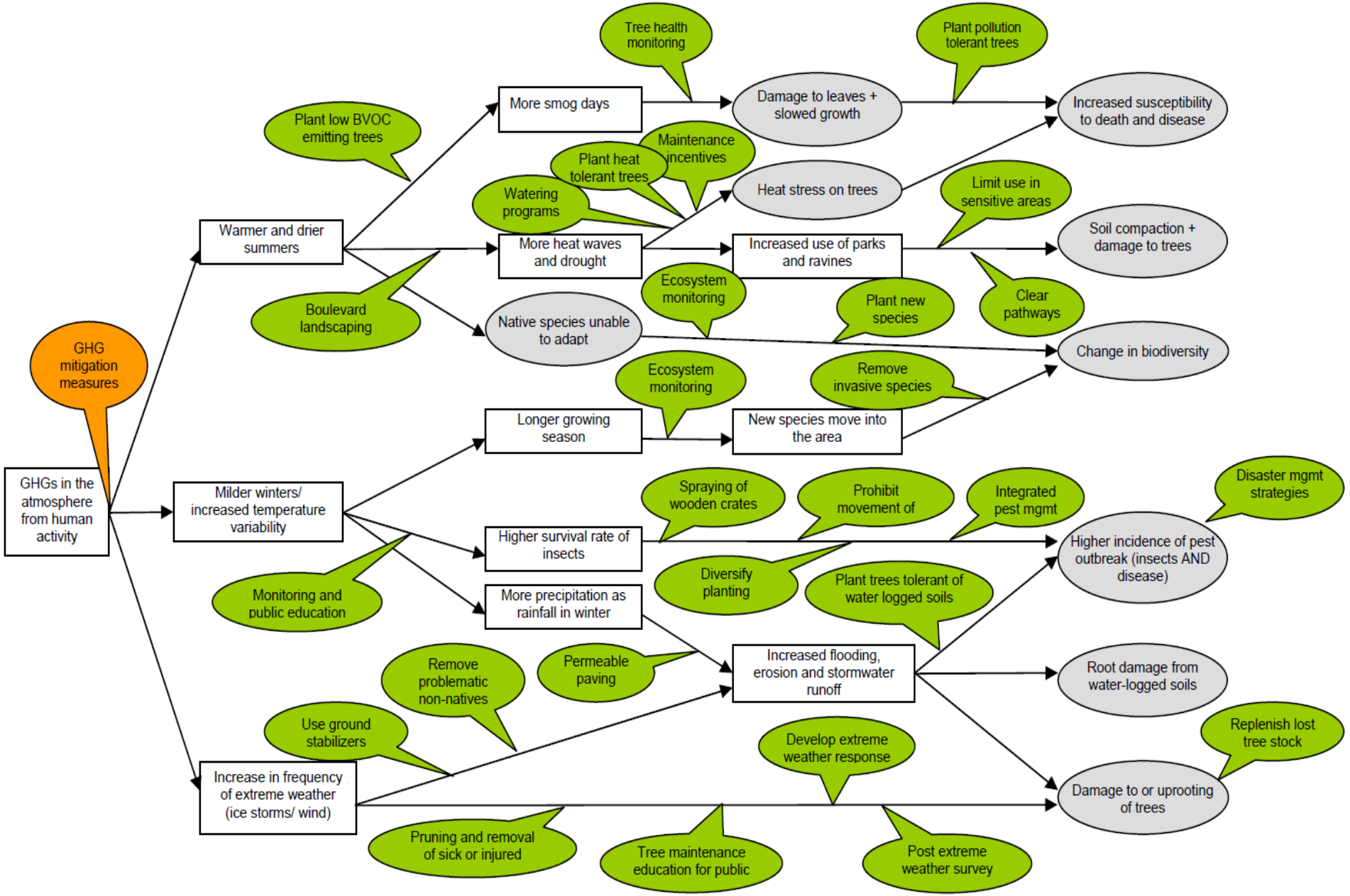
2012

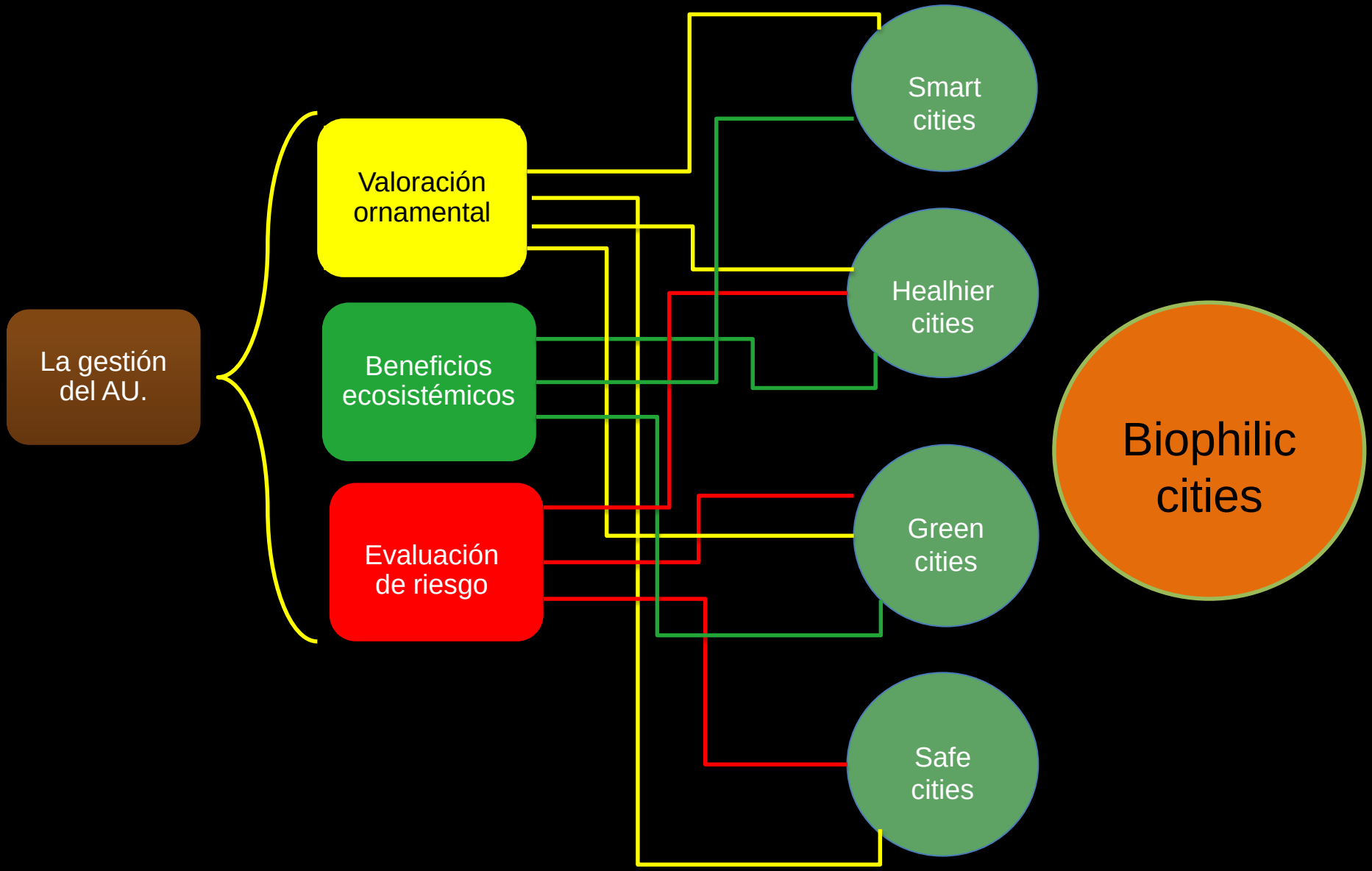
Zones

2 3 4 5 6 7 8 9 10

http://planthardiness.ars.usda.gov/PHZMWeb/#

FIGURE 2: ADAPTATION STRATEGIES FOR THE URBAN FOREST IN THE CITY OF TORONTO




La gestión del AU.
Valoración ornamental
Beneficios ecosistémicos
Evaluación de riesgo
Smart cities
Healhier cities
Green cities
Safe cities
Biophilic cities


Tamaño


Estado sanitario


Especie

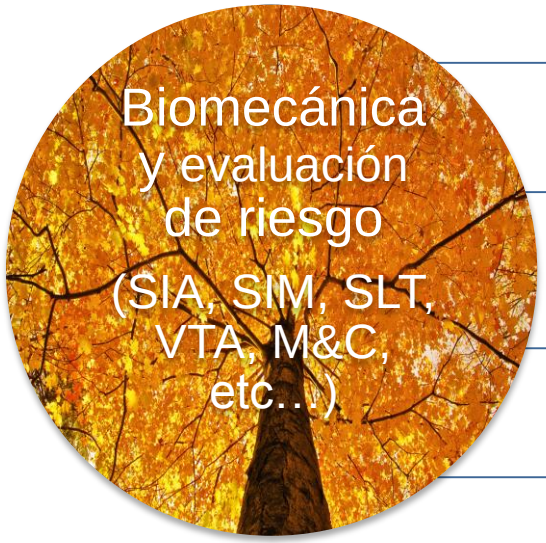

Factores intrinsecos y extrínsecos…


Especie


Estado general

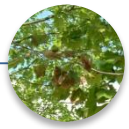

Funcionalidad


F. Estructurale y externos




Gestión racional


Estado sanitario, fisiopatías…


Especie


Factores de evaluación de riesgo…

USC
UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Valor básico

BDD+análisis estadístico + ecuación (es) y sustituibles.

UNIVERSIDAD POLITÉCNICA MADRID
POLITÉCNICA

Factores extrínsecos e intrínsecos

Rev. de factores, definición, eliminación y sustitución, análisis de ponderación, etc.

Universidad Politécnica de Cartagena

Valoración ornamental de palmáceas

Revisión del método, cálculo de índices y ampliación de especies.

Análisis de daños parciales

Rev. internacional, análisis y propuestas.

ASOCIACIÓN ESPAÑOLA DE PARQUES Y JARDINES PÚBLICOS

Valor ornamental

Servicios ecosistémicos

Riesgo


Bosques urbanos y servicios ecosistémicos

SE y Bosques urbanos

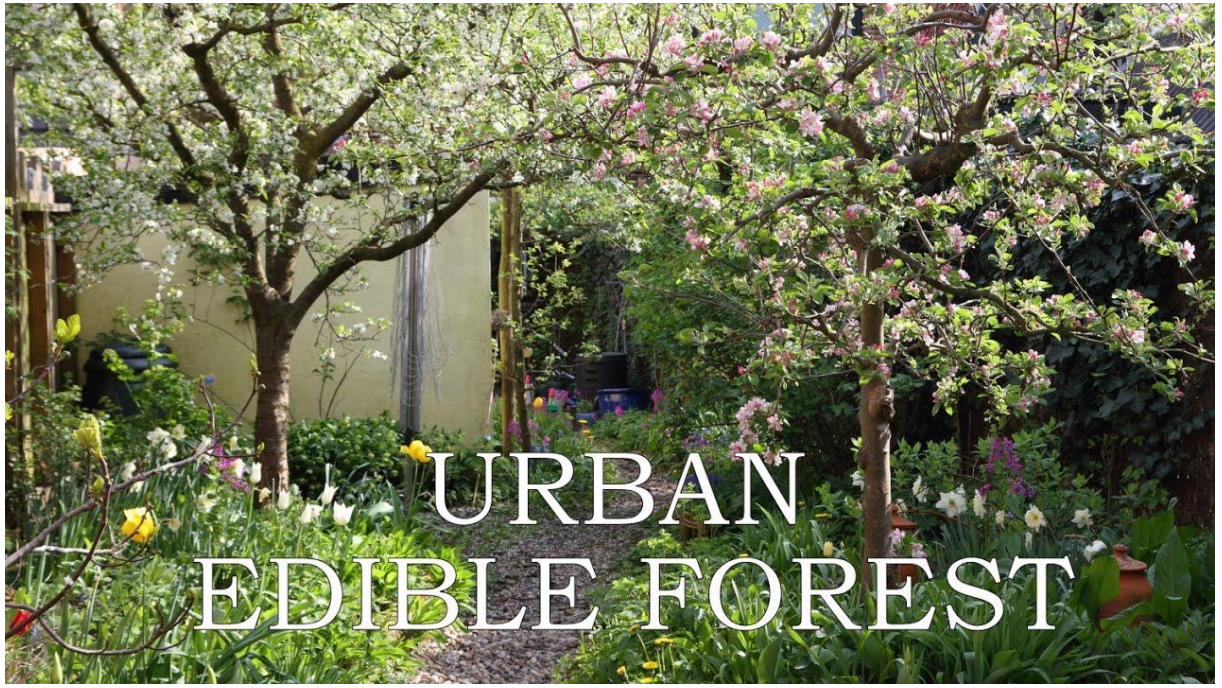
Table 2 Matrix of the relationship between ecosystem services and urban forest components.

Ecosystem service		Urban forest components			
		Single tree	Line of trees	Tree cluster	Woodland
Provisioning	Food provision				
	Fuel provision (woodfuel)				
	Wood provision				
Regulating	Carbon sequestration				
	Temperature regulation				
	Stormwater regulation				
	Air purification				
	Noise mitigation				
Cultural	Health				
	Nature and landscape connections				
	Social development and connections				
	Education and learning				
	Economy				
	Cultural significance				
Disservice	Fruit and leaf fall				
	Animal excrement				
	Blocking of light, heat or views				
	Decrease in air quality				
	Allergenicity				
	Spread of pests and diseases				
	Spread of invasive species				
	Damage to infrastructure				
	Creation of fear				
	Tree and branch fall (especially during storms)				

Commonly delivered Sometimes delivered Rarely delivered

SE de provisión y Bosques urbanos

- Provisión directa (frutos, semillas, nueces, etc.).
- Provisión indirecta (setas, ciervos, etc…)
- Servicio específico de ciertas especies. Conversión y almacenaje de la energía vía la fotosíntesis en materia biológica comestible.
- Productividad de fruta…. 500-600 árboles por ha.
- Más comunes en Londres: peras, manzanos… (Rogers at al., 2015)



SE de provisión y Bosques urbanos. Provisión de alimentos.

Table 3 Urban forest parameters that are reported to improve the ecosystem service of food provision.

Scale and management	Pest and disease control will ensure that trees stay healthy and thus produce higher quality fruit (Goldschmidt, 1999).
	Tree pruning and feathering techniques can result in greater yields of fruit (Robinson *et al.*, 2007).
Urban forest structure	Trees with pyramid-shaped crowns produce more and better quality food than those with globe-shaped crowns due to the greater exposure to light (Robinson *et al.*, 2007).
	The harvesting of fruit, berries and nuts, as well as ongoing tree maintenance, is easier for smaller trees (Robinson *et al.*, 2007).
	Larger trees tend to produce larger fruit (Clark and Nicholas, 2013).
	Urban orchards in Europe are typically planted at a density of 500–600 trees per hectare due to diminishing returns (Robinson *et al.*, 2007).
	Some species produce greater yields in monocultures due to resource competition from other species, while some fare better in polycultures with complementary processes (Rivera *et al.*, 2004).
Location and proximity to people	Trees located near transport routes may have trace metal content (e.g. cadmium and lead) in their fruits, nuts and berries; however, they are less susceptible to pollution than vegetables (von Hoffen and Säumel, 2014).
	The closer food producing trees are to urban populations, the more likely people are to benefit from the increasingly popular trend of eating locally grown food (Clark and Nicholas, 2013).
	The feasibility of harvesting food from local trees or woods may be reduced where accessibility is difficult or impractical (e.g. due to the height of the tree or an adjoining busy road).
Land use and ownership	Fruit trees can be used as incentives for city dwellers to plant trees in private gardens (McLain *et al.*, 2012).
	Publicly owned and accessible open space is likely to be best suited to the provision of public food trees (McLain *et al.*, 2012).

SE de regulación y Bosques urbanos.

Regulación de aguas de tormenta.

Materiales de Albedo bajo afectan a la Tº y a la infiltración…

BU interceptan y almacenan agua de lluvia, favorecen evaporación y minimizan erosión

Table 7 Urban forest parameters that are reported to improve the ecosystem service of stormwater regulation.

Scale and management	Greater canopy cover increases rainfall interception (Inkiläinen *et al.*, 2013).
	Isolated, single trees use more water due to greater exposure and canopy size (Nisbet, 2005).
	Weed, pest and disease control will ensure that trees and canopies stay healthy, while arboricultural thinning affects structural density, thus reducing interception and increasing the speed with which rainfall reaches rivers (Xiao and McPherson, 2002).
Urban forest structure	Taller trees (~30 m) can reduce the amount of rainfall converted into throughfall more than smaller trees (~10 m), as aerodynamic turbulence and evaporation increase (Llorens and Domingo, 2007).
	Large-canopied trees play an important role in regulating stormwater through greater evapotranspiration (Gill *et al.*, 2007).
	Annual and peak event rainfall interception per tree increases with stem diameter, multiple layers of branching and rough bark surfaces (Xiao and McPherson, 2002).
	For small (canopied) trees, infiltration is more effective at reducing runoff than interception (Armson *et al.*, 2013b).
	Trees with greater LAI (denser canopies) can reduce the amount of throughfall through greater interception rates (Nisbet, 2005).
	Coniferous and evergreen broadleaved trees are more effective at intercepting rainfall than deciduous ones for which interception is significantly reduced during the leaf-off season (Xiao and McPherson, 2002).
	Fast-growing and deep-rooting trees transpire more water than slow-growing and shallow-rooting trees (Calder *et al.*, 2008).
	Structural diversity in (broadleaved) woodland increases its aerodynamic roughness and thus its evaporation rate (Calder *et al.*, 2008).
Location and proximity to people	Urban woodland is most effective at reducing flooding if located upslope of urban areas (Matteo *et al.*, 2006).
	Flooding is decreased and groundwater recharge increased when trees are located next to roads and rivers (Matteo *et al.*, 2006).
	Trees planted over pervious surfaces reduce surface runoff by more than those planted over impervious surfaces (Armson *et al.*, 2013b).
	Greening of sandy soils is more effective at reducing runoff than greening of clay soils (Gill *et al.*, 2007).
	In terms of the distribution of trees, studies typically focus on increasing tree cover in low tree cover areas across a city as a whole in order to have measurable reductions on runoff (Ellis, 2013; Sjöman and Gill, 2014).
	Peri-urban and even rural woodlands (in the riparian zone and floodplain) can contribute to flood alleviation in urban areas by delaying the downstream passage of flood flows (Forest Research, 2010).
Land use and ownership	Recategorising parkland to account for individual trees as distinct from amenity grassland results in more accurate scores for flood control (Farrugia *et al.*, 2013).
	The potential for maximising the possible contribution of green infrastructure to stormwater regulation is largely dependent on co-operative management of privately owned land (Ellis, 2013).

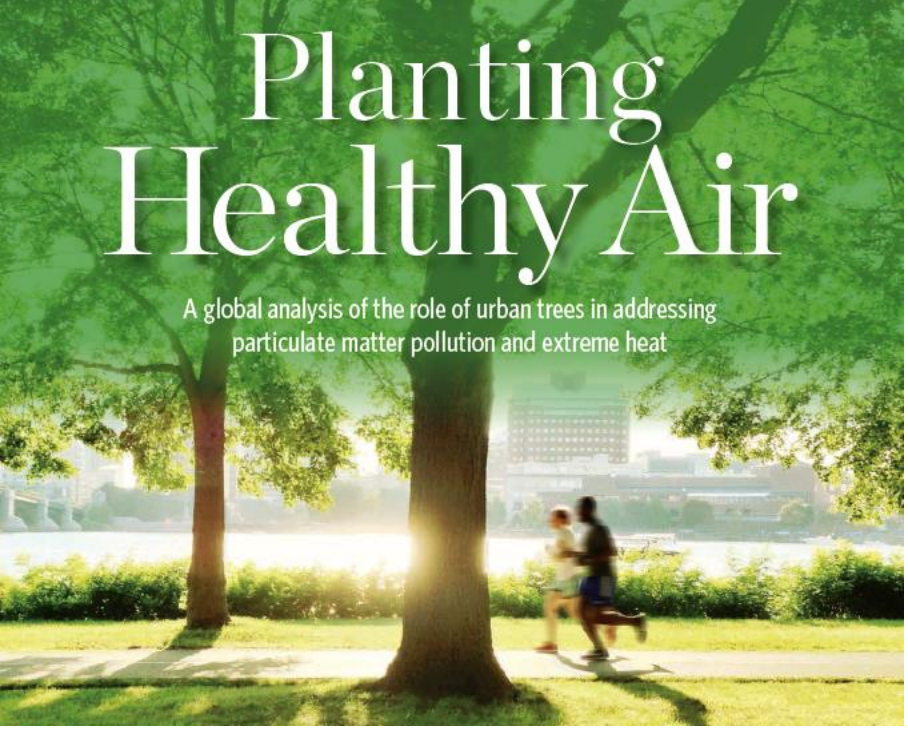
SE de regulación y Bosques urbanos.

Purificación del aire.

Deposición mecanismo por el cual los contaminantes gaseosos y particulados son capturados por las plantas y absorbidos por sus hojas, ramas y troncos.

Table 8 Urban forest parameters that are reported to improve the ecosystem service of air purification.

Scale and management	The greater the (continuous) canopy cover and tree density, the greater the deposition of air pollutants (Alonso *et al.*, 2011).
	Unhealthy or stressed trees have reduced ability to remove air pollutants due to stomatal closure (Jim and Chen, 2008).
	Managing urban forests at intermediate scales (e.g. remnant patches around neighbourhoods) can reduce PM_{10} more effectively than landscape-scale tree cover (Escobedo *et al.*, 2011).
	Management of street trees and woodlands were found to be a cost-effective way of reducing PM_{10} compared to technological or policy measures such as the use of greener fuels (Escobedo *et al.*, 2008).
	The presence of street trees is associated with reduced prevalence of asthma (Lovasi *et al.*, 2008).
Urban forest structure	Conifers absorb the least O_3 and evergreen broadleaf species the most (Alonso *et al.*, 2011).
	Deciduous species assimilate more nitrogen oxides (NO_x) than evergreen species (Bowler *et al.*, 2010b).
	Coniferous trees are better at accumulating airborne $PM_{2.5}$ particles on their foliage than broadleaved species because of their thicker wax layer (Nguyen *et al.*, 2015).
	Trees with larger crown dimensions are more effective at air pollution removal (Alonso *et al.*, 2011).
	Air purification by trees is lowest in winter and highest in spring and summer due to leaf-on period (Baró *et al.*, 2014).
	The removal of air pollutants is related to total leaf area (Jim and Chen, 2008).
	Urban forests with diversified species and biomass structures are better for mitigating air pollution as overall canopy is increased (Jim and Chen, 2008).
Location and proximity to people	The availability of moisture in the soil will enhance a tree's ability to remove air pollutants (Baró *et al.*, 2014).
	Trees in closer proximity to a pollution source will be more effective at mitigating it, thus those between high pollution areas such as busy roads and vulnerable areas such as playgrounds, schools, hospitals and residential areas should be prioritised (Escobedo *et al.*, 2011).
	Conifers are generally less tolerant to high traffic-related pollution, so are less suitable for roadside plantings (Nguyen *et al.*, 2015).
	In narrow, busy streets tall and/or densely planted trees can reduce wind speed to the extent that pollutants may be trapped beneath the canopy, thus reducing air quality for pedestrians and cyclists – this is known as the street canyon effect (Vos *et al.*, 2013).
Land use and ownership	The greater the proportion of built area, the higher the level of PM_{10} exposure (Weber *et al.*, 2014).



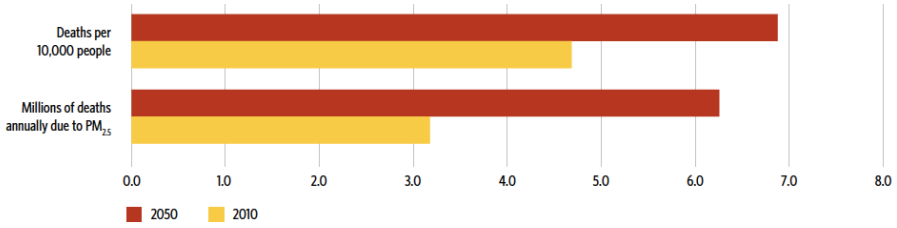
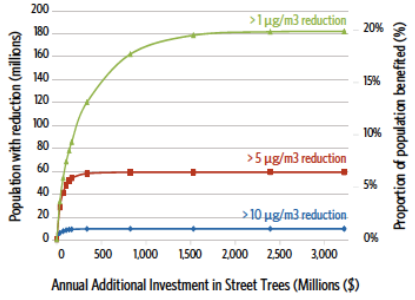
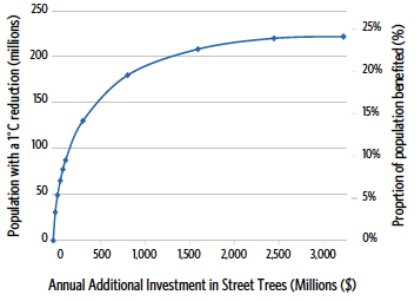


Figure E1. Forecasted global mortality from $PM_{2.5}$ in 2050 compared to 2010, expressed either as the total number of deaths, or as the number of deaths per 10,000 people. The number of people forecasted to be killed will almost double (i.e., increase by 100 percent). Some of that increase is due simply to population growth. The number of deaths per 10,000 people, however, is still expected to go up by roughly 50 percent, primarily due to an increase in $PM_{2.5}$ concentrations in cities in the developing world. Data taken from Lelieveld et al.[4]





In The Nature Conservancy – in coordination with C40 Cities Climate Leadership Group – has tried to understand whether nature can play a role in helping to solve these twin challenges.

The answer appears to be a qualified “yes.”

Street trees can be a part of a cost-effective portfolio of interventions aimed at controlling particulate matter pollution and mitigating high temperatures in cities.

While trees cannot and should not replace other strategies to make air healthier, trees can be used in conjunction with these other strategies to help clean and cool the air.

In the right spot, trees can both help make our air healthier and our cities more verdant and livable.

SE cuturales y Bosques urbanos.

Conexiones naturales y paisaje.

Estimulación sensorial y sentimientos de conexión con la Nª.

Visual.
Sonora.
Olorosa.
Tacto.

Table 11 Urban forest parameters that are reported to improve the well-being benefit of nature and landscape connections.

Scale and managemen	Individual trees, especially veteran ones, can provide great character and sense of history to a place (Scottish Government, 2014b).
	Individual trees have a positive effect on the perceived aesthetics of urban squares, enhancing city image, duration of visit and the willingness to revisit (Rašković and Decker, 2015).
	Lines or clusters of trees can provide aesthetic enhancements to streets, civic spaces and parks (Coles *et al.*, 2013).
	Woodlands should be of a suitable size (minimum of 2 ha) to create a woodland environment (Coles and Bussey, 2000).
	The greater the number of greenspaces the greater the overall aesthetic value, though with diminishing returns (Mitchell and Popham, 2007).
	Management activities such as selective arboricultural thinning and undergrowth clearance (as well as removal of litter and graffiti) can improve visual perceptions (Tyrväinen *et al.*, 2003).
Urban forest structure	Large, mature trees are generally more aesthetically pleasing than small, immature ones (Tyrväinen *et al.*, 2005), though this is less important in residential environments (Coles *et al.*, 2013).
	Broadleaved or deciduous species are typically preferred to coniferous ones, though mixed woodlands are preferred overall (Coles and Bussey, 2000; Gerstenberg and Hofman, 2016).
	Crown size and density are both positively related to people's preferences, with globe-shaped crowns particularly preferred (Gerstenberg and Hofman, 2016).
	The smell of damp wood after rain and of pine trees, and the sounds of walking on crunchy leaves, bird song and the wind in trees, add to feelings of connection with nature (O'Brien *et al.*, 2014).
	Perceived naturalness can enhance the visual appeal of a woodland, and thus the use of native species may be beneficial (Ryan and Simson, 2002).
	Woodlands with greater structural complexity (more canopy layers and different species) are preferred (Coles and Bussey, 2000).
	Woodlands should be open with well-spaced trees in order to improve visibility and thus feelings of security (Nielsen and Jensen, 2007).
	Clear views with low-density understorey vegetation are associated with increased pleasure and are preferred by visitors (Tyrväinen *et al.*, 2003).
	Visual variation (i.e. combining mature stands with smaller trees, as well as the presence of other habitats such as water) is more aesthetically pleasing (Tyrväinen *et al.*, 2005).
	People prefer/self-report high benefits from greenspace that they perceive to have higher biodiversity (Dallimer *et al.*, 2012).
Location and proximity to people	Trees and woodlands must be visible and in fairly close proximity for the service of aesthetic enhancement to be provided, as evidenced by the effect of green views on property prices (Jim and Chen, 2006).
	Access to and views of greenspace within a workplace have significant benefits for well-being as well as increased productivity (Grahn and Stigsdotter, 2003).
	There is enhanced recovery from illness or surgery when patients have views of trees from hospital (Ulrich, 1984).
Land use and ownershi	A view of a (publicly inaccessible) greenspace can be as effective for mental well-being as having access (Grahn and Stigsdotter, 2003).

Fisiológica.

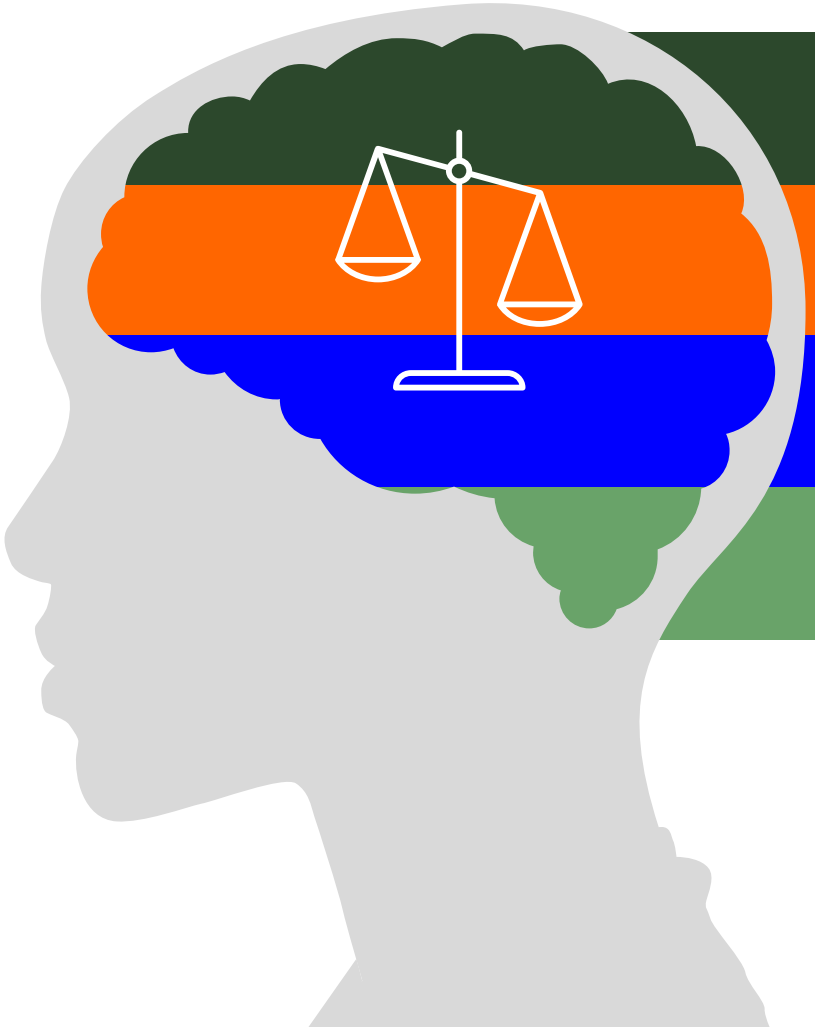
Músculos, esqueleto, respiratorio, …

(Tzoulas et al., 2007; Park et al., 2009)

EVIDENCIAS

Bienestar Físico • Bienestar Psicológico • Bienestar Social

FCE gestiona 222000 ha de bosques y está promoviendo su papel en salud pública, relax y desconexión de los stresses diarios. Pretenden:



H Aumentar el número de visitas a las zonas naturales y desarrollar actividades sanas.

E Establecer una asociacion entre la salud, el bienestar y los bosques en la psicología de la poblacion.

A Promover la actividad física entre los usuarios de los bosques.

LT Ayudar a buscar estilos de vida más sanos.

The campaign is supported by the British Heart Foundation.

Psicológica

Atención, adaptabilidad, concentración, emociones, sentimientos, etc…
Naturaleza restauradora: Hartig et al., 2010; Alcok et al., 2013)…

Cognitiva

Agilidad mental y memoria, capacidad de aprender, pensar, lógica, etc….

Atención directa consume energía……fatiga mental… (Kellert at al., 2008; van der Berg et al., 2007).

Shinrin Yoku

Respira. Relájate. Camina.

Toca. Escucha. Recupérate.

"caminando de manera suave iremos aspirando los elementos y sustancias tan beneficiosos que deprenden las plantas y árboles, que se irán incorporando a nuestro sistema respiratorio y entrando en nuestro torrente sanguíneo de una manera natural…"

Adaptado a cualquier persona.


Sinergias
Mejora condiciones ambientales (Tª, Insolación, Nivel acústico, etc…)
Mejora contacto directo (Biofilia, ART, Restauración, cohesión social, etc.)
Mejora por promoción de actividad física y deportes (GI+PH, tiempo de disfrute, socialización, etc…)

Significance of urban forest type for human health and well-being

Urban forest type	Significance (on a scale of 1–5*)
Peri-urban forests and woodlands	
City parks and urban forests (>0.5 ha)	
Pocket parks and gardens with trees (<0.5 ha)	
Trees on streets or in public squares	
Other green spaces with trees	

FAO (2016)

* Where 1 = very low significance and 5 = very high significance.

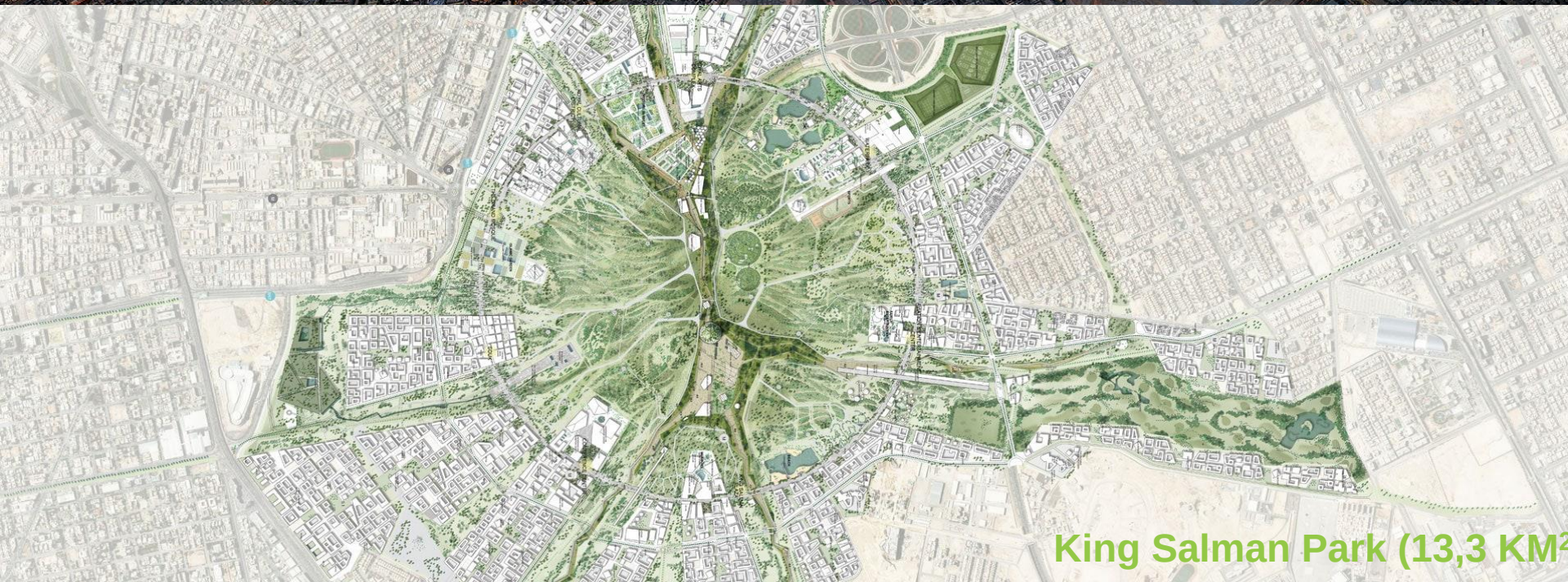
Planificación, diseño y gestión

• *Adopt sound* ***standards for the design and management*** of urban forests with the aim of encouraging physical activities and improving mental health.

• Optimize the **availability**, **accessibility**, **proximity** and **security** of urban forests to promote the use of such resources by all.

• **Include urban forests** in the planning and **design of hospitals and schools** for their proven therapeutic and psychological benefits.

• ***Minimize the potential undesirable impacts of urban forests*** on human health and well-being in designing and managing urban forests.


King Salman Park (13,3 KM²


El árbol...los servicios... ¿La respuesta del ser humano?
La deforestación,
"la palabra 'bosque' nos hace pensar en las afueras, y eso es lo que hemos hecho con la naturaleza: expulsarla de la ciudad. Emanuele Coccia.
'Nous les Arbres'
Thijs Biersteker y Steffano Mancuso

Muchas gracias

Madrid, 9 de octubre de 2019

Pedro Calaza Martínez
PhD-Eng. + PhD-L.A.