Increasing Urban Biodiversity through Greening

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70TH AIPH ANNUAL CONGRESS

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ASSOCIAZIONE NAZIONALE VIVAISTI ESPORTATORI

FLOR MART

PADOVA · ITALY

INTERNATIONAL EXHIBITION OF HORTICULTURE LANDSCAPE ARCHITECTURE AND GREEN INFRASTRUCTURES

PRESENTATION STRUCTURE

- Introduction and critical issues:
  - Biodiversity: What is it? What are its values? How it is measured?
  - Biodiversity hot spots and population growth, habitat loss and fragmentation and mass extinction
  - Biodiversity functions and urban biodiversity: Ecosystem services, Urban green infrastructure
- Solutions and visions:
  - Learning from ecology, from nature and from the past
  - Land sharing or land sparing? Reconciliation ecology
  - Acting at the small and city scales:
    - Biodiverse green roofs
    - Plant species selection: plant sociological approach, interactive databases
    - *Habitecture*
    - Animal city

BIODIVERSITY (BIOLOGICAL DIVERSITY)

What is it?

- Number of species or species richness = number of species in an area and their relative abundance (Pielou, 1977).
- Variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems (CBD, 1992).
- Three-fold definition: ecological diversity, genetic diversity, and organismal diversity (Gaston & Spicer, 1998).

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BIODIVERSITY (BIOLOGICAL DIVERSITY)

Which values does biodiversity have?

- Ecosystemic
- Genetic
- Social
- Economic
- Scientific
- Educational
- Cultural
- Recreational
- Aesthetic.

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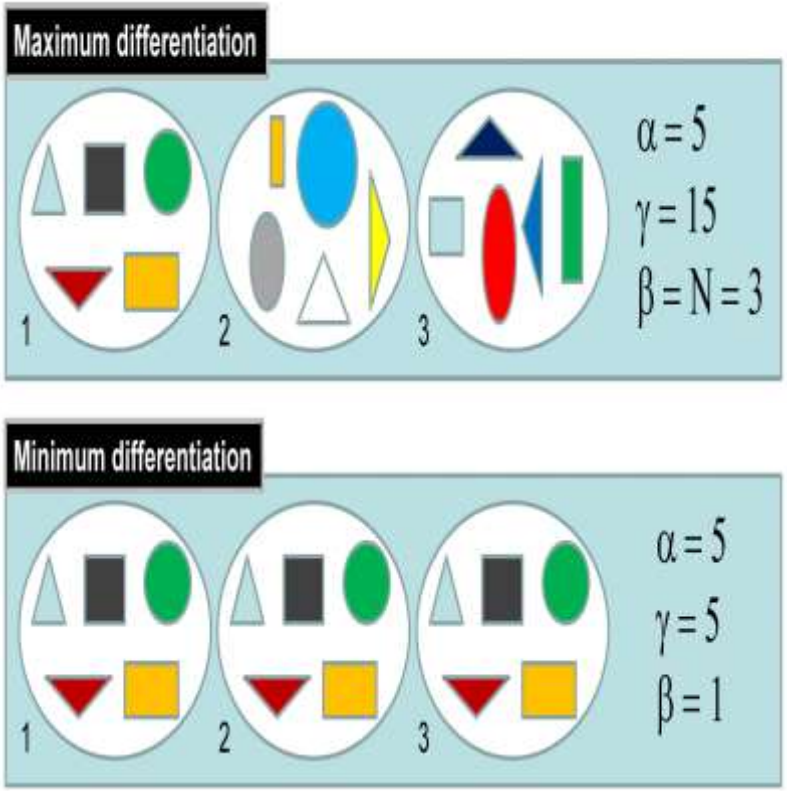
ALFA, BETA & GAMMA DIVERSITY

How is biodiversity measured and evaluated?

It can measured at any spatial scale ranging from microsites and habitat patches to the entire biosphere (DeLong, 1996).

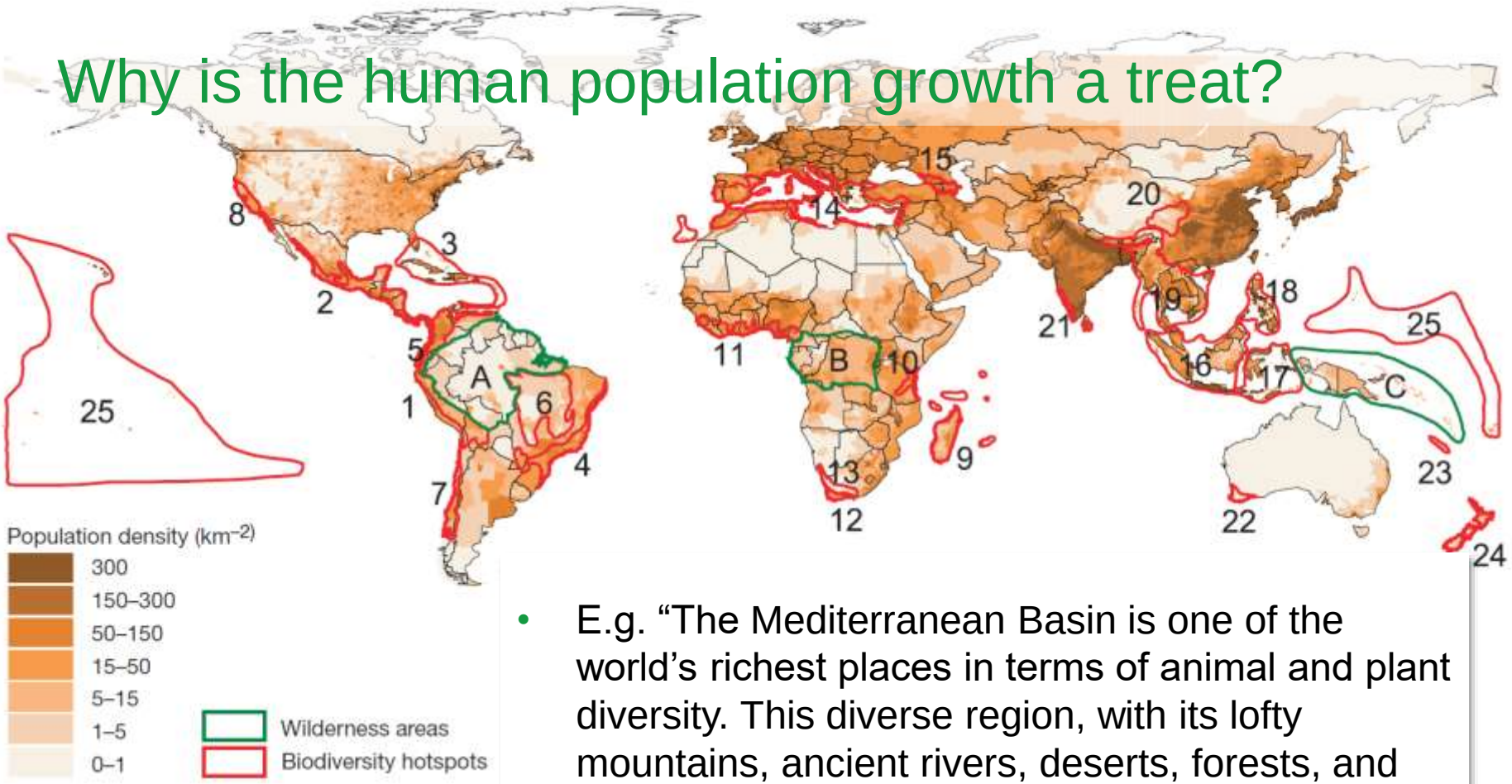
- α = local species richness for single sites (average diversity of habitats)
- β = regional species richness (changes in diversity between sites or in habitats within the landscape)
- γ = changes between sites at geographical scales (landscape).
- Species turnover = degree to which species replace other species at different sites.



http://webspersoais.usc.es/persoais/andres.baselga/beta.html

BIODIVERSITY HOT SPOTS &...

Why is the human population growth a treat?



- E.g. “The Mediterranean Basin is one of the world’s richest places in terms of animal and plant diversity. This diverse region, with its lofty mountains, ancient rivers, deserts, forests, and many thousands of islands, is a mosaic of natural and cultural landscapes, where human civilization and wild nature have coexisted for centuries.”

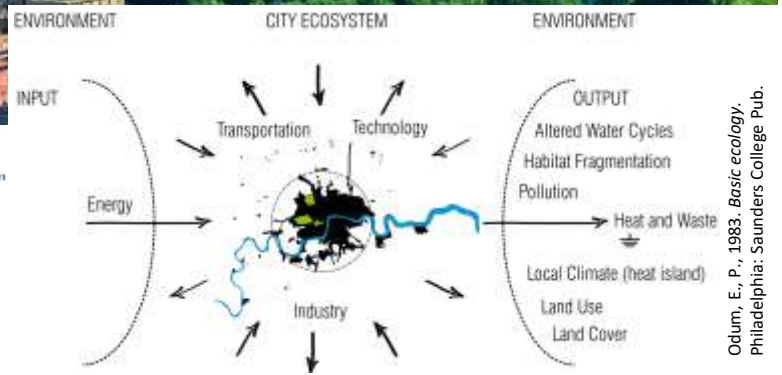
Cincotta, R. P., Wisnewski, J., & Engelman, R. (2000). Human population in the biodiversity hotspots. *Nature*, 404(6781), 990-992.

The 2008 Review of The IUCN Red List of Threatened Species. IUCN Gland, Switzerland.

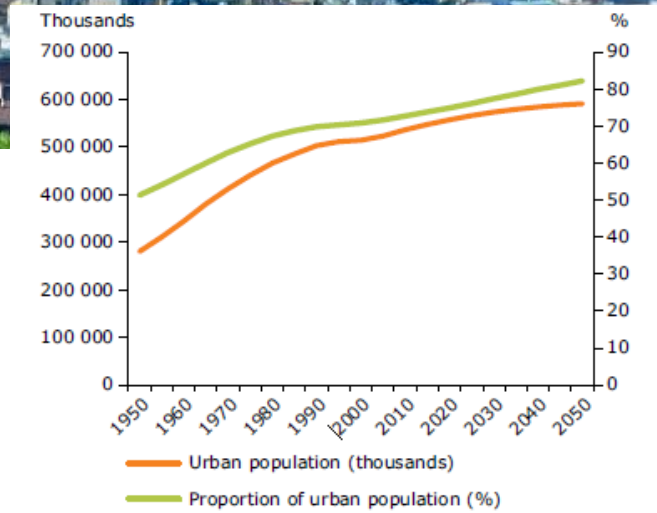
…THE BUILT ENVIRONMENT

Where will people live in future?

https://commons.wikimedia.org/w/index.php?curid=59053766



Odum, E., P., 1983. *Basic ecology.* Philadelphia: Saunders College Pub.



European Environment Agency (EEA), 2012

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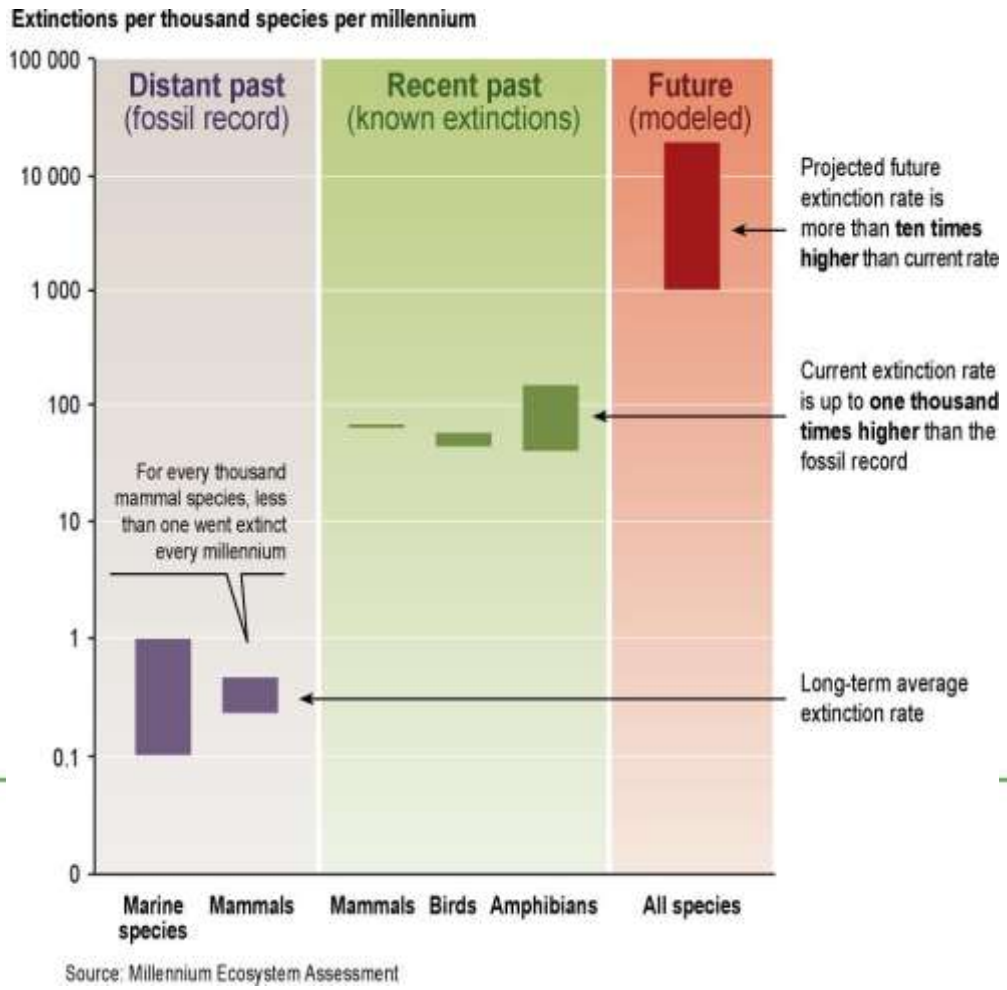
BIODIVERSITY LOSS

What are we making to Nature?

- Species extinction rate 1,000 times over background rates typical over the planet's history
- 10–30% of mammal, bird, and amphibian species are currently threatened with extinction

Conservation Biology, Volume 29, No. 2, 452–462
DOI: 10.1111/cobi.12380



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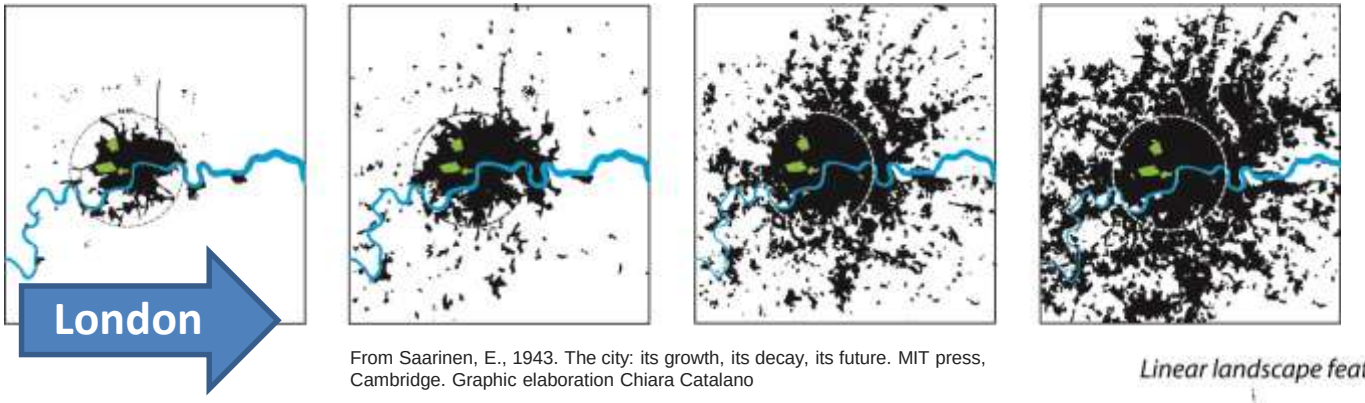
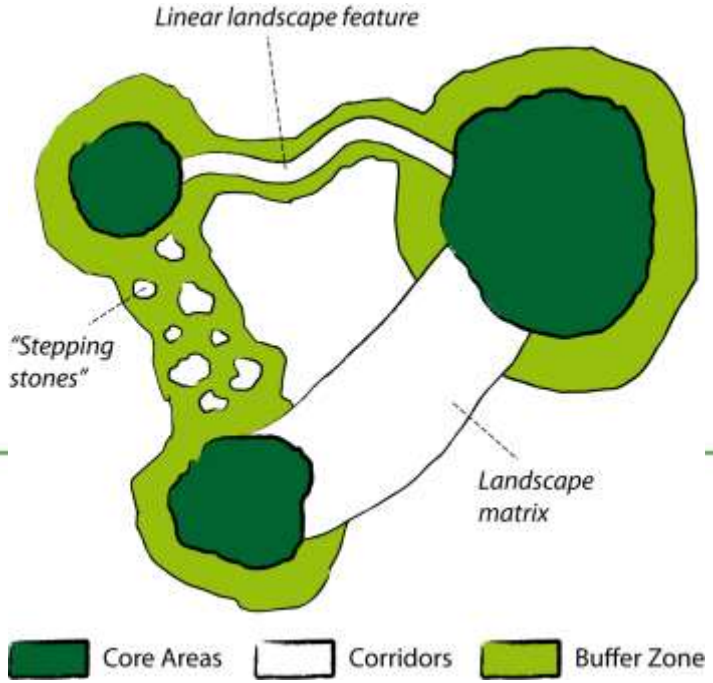
HABITAT FRAGMENTATION

What does it happen while our cities spread?



From Saarinen, E., 1943. The city: its growth, its decay, its future. MIT press, Cambridge. Graphic elaboration Chiara Catalano

- Fewer species are able to persist in a number of small habitat fragments with respect to those occurring in the original non-fragmented habitat
- Possible species extinction



Graphic Chiara Catalano

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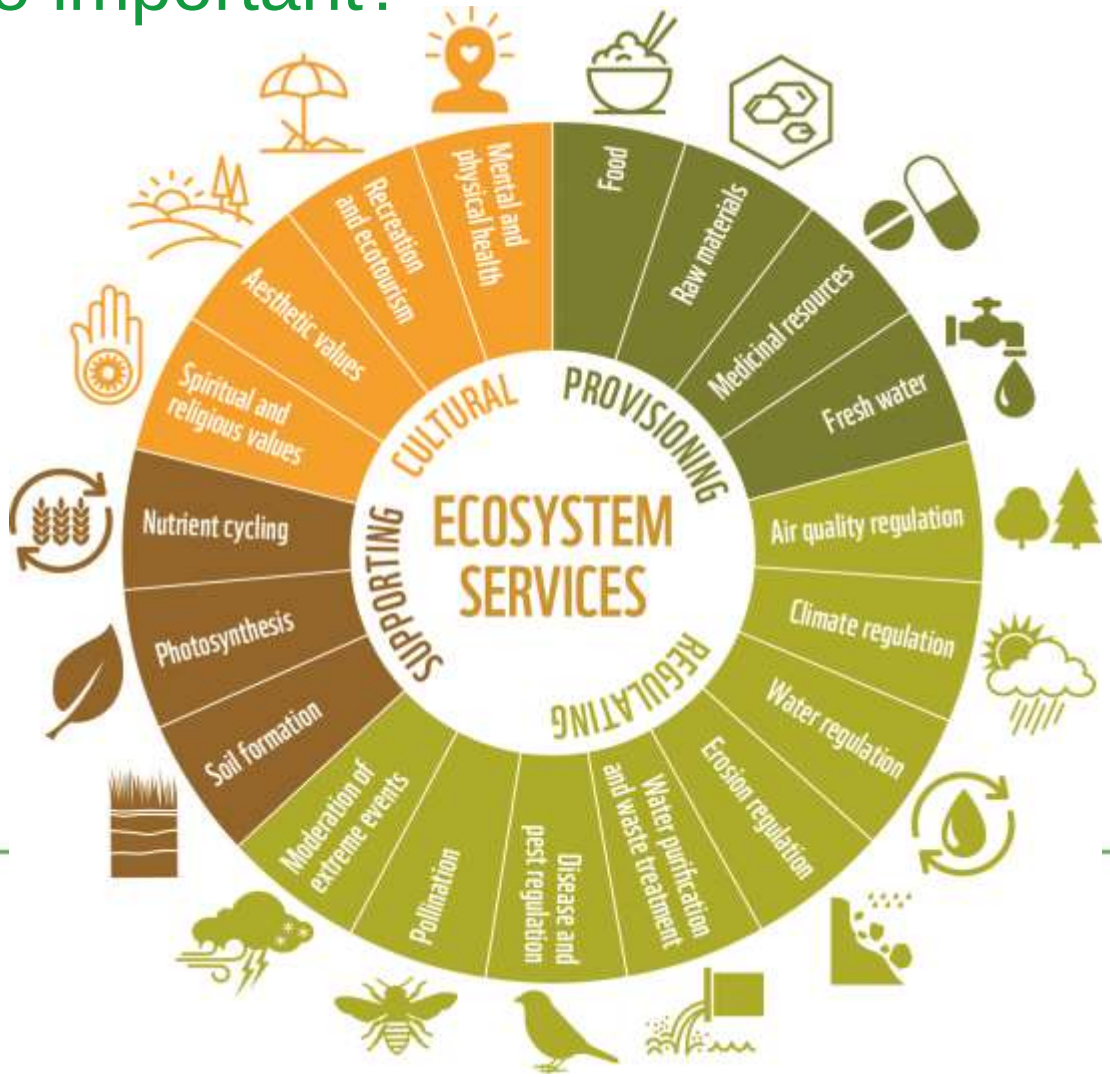
ECOSYSTEM SERVICES

Why is biodiversity so important?

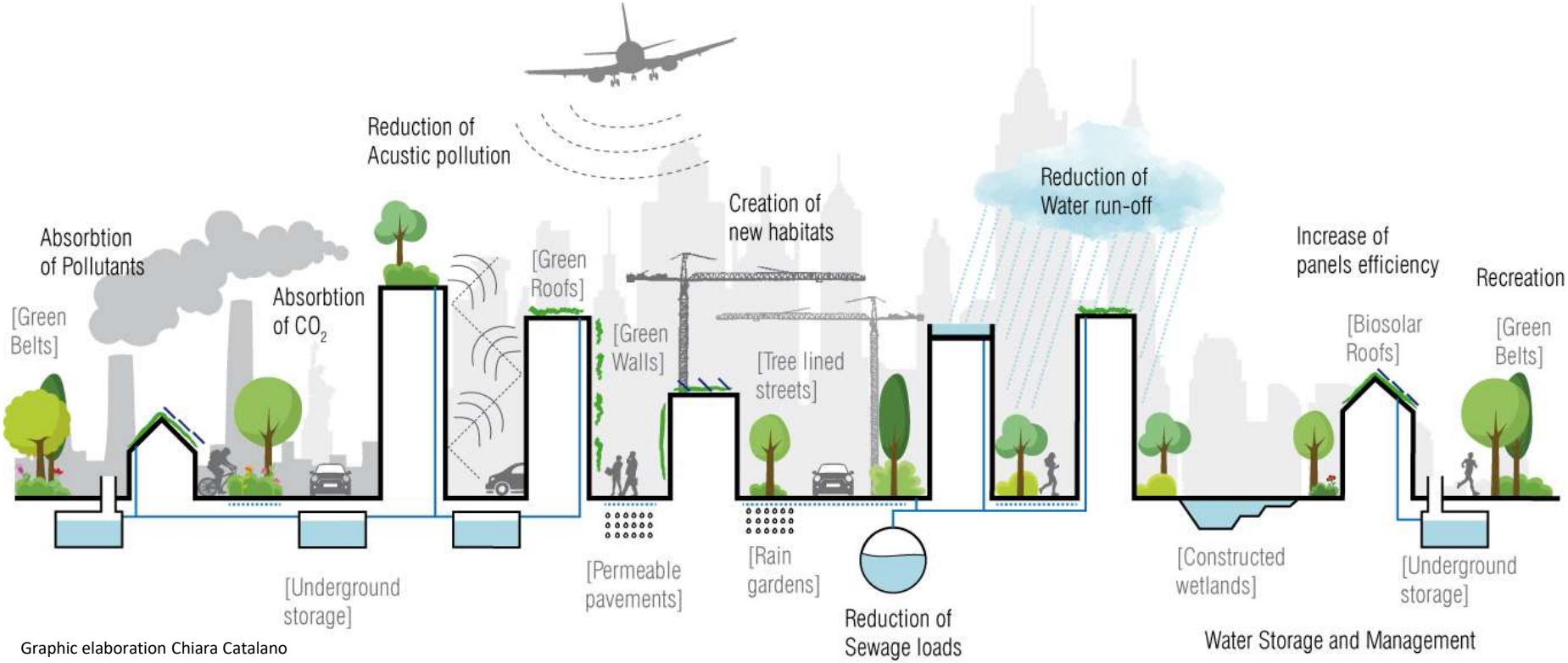
- Maintaining life sustaining systems of the biosphere
- Providing essential services such as food, fuel, clothes and medicine
- Providing purification of water and air, prevention of soil erosion, regulation of climate, pollination of crops by insects
- etc.



http://www.wwf.eu/what_we_do/biodiversity/

URBAN GREEN INFRASTRUCTURE

What does contribute to Urban Biodiversity?



Graphic elaboration Chiara Catalano

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BIODIVERSITY / URBANITIES

Is it possible to reconcile human development with Nature?

London Fieldworks, Spontaneous City

https://www.prohandmade.ru/other/ptichij-gorod/

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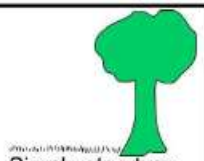
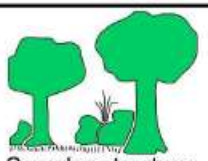
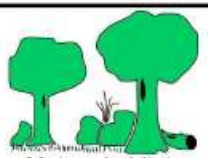
BIODIVERSITY / URBANITIES

What can we learn from ecology?

- Bringing the scientific knowledge into the design process to create habitats for ecological communities in cities
  - Ecosystem design
  - Ecological engineering

Biodiversity value		Comments
Inferior	Superior	
 Small patch of habitat	 Large patch of habitat	More species can persist in a large patch of habitat with more food and shelter resources and less disturbance.The larger a patch of habitat, the more diverse and resilient it is.
 Increased edges	 Decreased edges	Patches of habitat with a high proportion of edges offer less shelter for the species that inhabit them and allow greater disturbance through trampling and weed invasion.
 Fragmented habitat	 Intact habitat	Intact habitats function better than fragmented habitats. Boundaries prevent plants and animals from dispersing through urban environments to find food and shelter resources.
 Disconnected patches	 Connected patches	The interconnection of many small biodiverse areas can emulate the benefits of larger, more intact habitats. Corridors allow biota to disperse through urban environments.
 Simple structure	 Complex structure	A complex assemblage of vegetation is better for wildlife, adapts better to change, and is more highly appreciated by people than a simple assemblage.
 Immature habitat	 Mature habitat	A mature assemblage of vegetation provides habitat for wildlife in logs and tree hollows. It takes many years of succession to establish a complex and healthy ecosystem.

Roetman, P. E., & Daniels, C. B. (2008). Including biodiversity as a component of sustainability as Australian cities grow: Why and how?. In *Proceedings of the Ninth National Street Tree Symposium, University of Adelaide/Waite Arboretum, Adelaide.*

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BIODIVERSITY / URBANITIES

What can we learn from nature (Habitat analogues)?



I go to nature every day for inspiration in the day's work. I follow in building the principles which nature has used in its domain (Frank Lloyd Wright)

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BIODIVERSITY / URBANITIES

What can we learn from the past?

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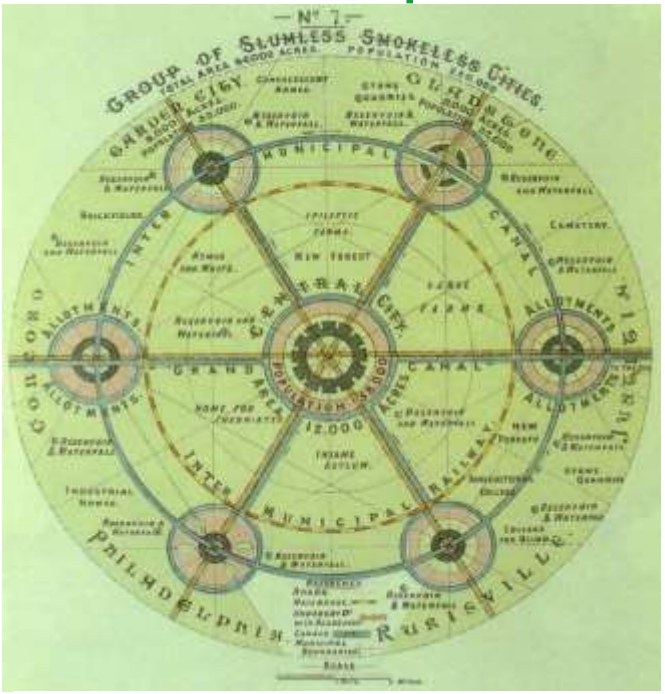
BIODIVERSITY / URBANITIES

What can we learn from the past?

Letchworth Garden City, 1903

https://heritagecalling.com



- *Green cities of tomorrow*, Ebenezer Howard 1898
- The *biophilia hypothesis* E.O. Wilson 1984
- *Biophilic city*, Timothy Beatley 2010

Eden, Bosch 1500

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BIODIVERSITY / URBANITIES

Land Sparing or Land Sharing?

- Intensification of urban systems to increase housing density
  - small tracts of natural or semi-natural habitat patches like parks and forest patches
- Urban extensification characterized by sprawling suburbanization
  - less concentrated, more distributed green space, often predominantly in the form of backyard or streetscape vegetation

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BIODIVERSITY / URBANITIES

Is it possible to reconcile human development with Nature?

London Fieldworks, Spontaneous City

- Reconciliation ecology
  - *How to modify and diversify anthropogenic habitats so that they harbor a wide variety of wild species* (Rosenzweig, 2003)
  - Reconnecting people with nature
  - Recovering degraded habitats
  - Restore ecosystem service

https://www.prohandmade.ru/other/ptichij-gorod/

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ACTING AT THE SMALL SCALE

The building

- Habitecture

Chartier Dalix Architects

- Biodiverse green roofs

Foto Dusty Gadge

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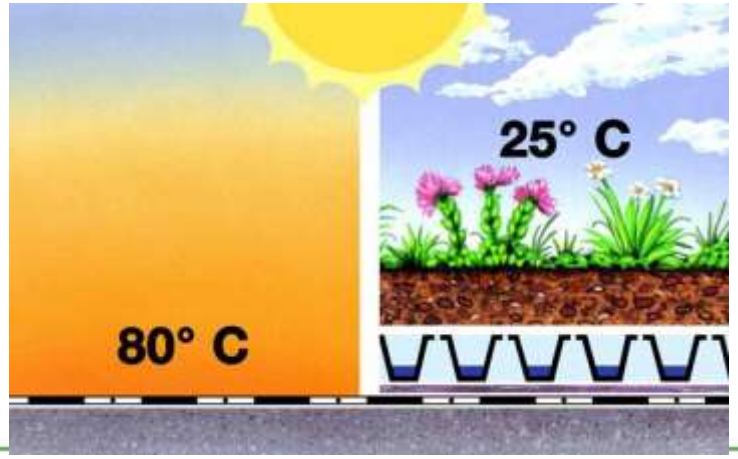
BIODIVERSE GREEN ROOFS

The secret power of green roofs: multifunctionality



https://www.zinco-usa.com/benefits/ecological_benefits.php

Isn’t it against all logic, if a whole urban surface remains unused, missing the dialogue with the stars?

(Le Corbusier, 1930)

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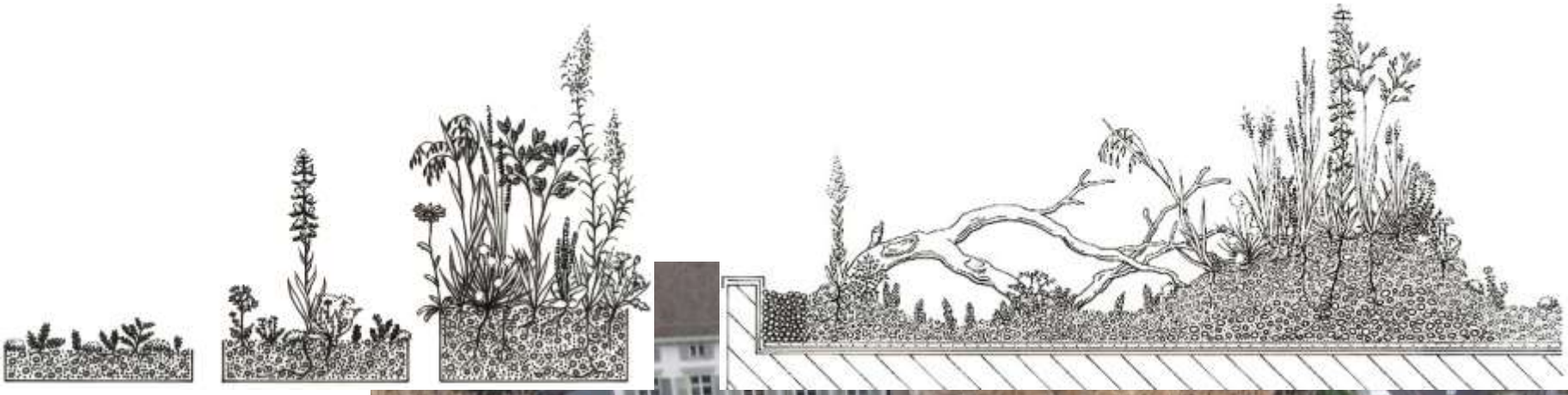
BIODIVERSE GREEN ROOFS

Design principles



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BIODIVERSE GREEN ROOFS

Design principles

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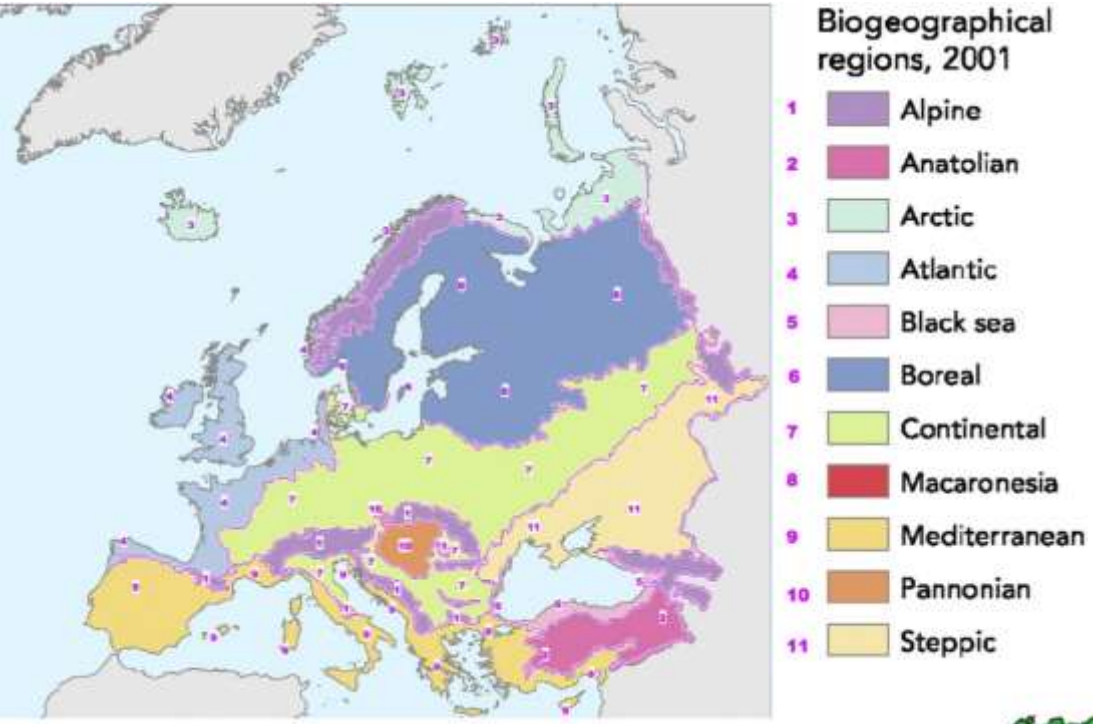
BIODIVERSE GREEN ROOFS

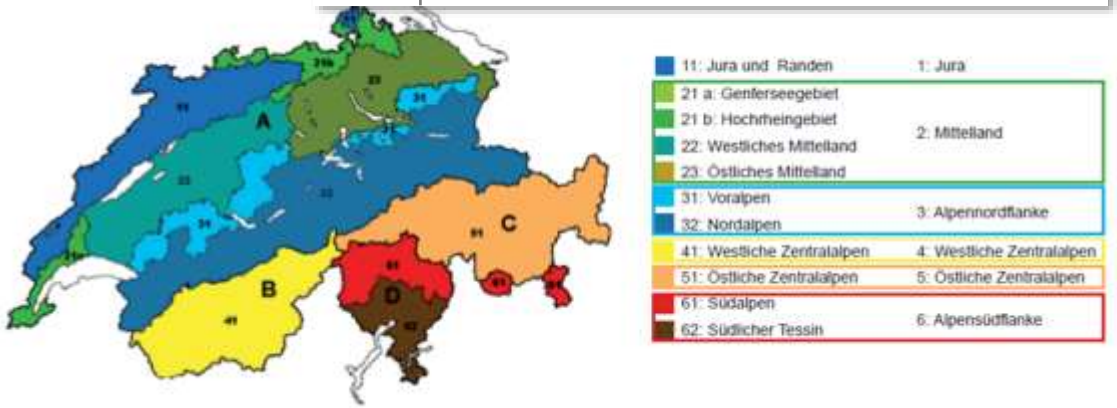
Plant species selection



Ibáñez, J. J., Zinck, J. A., & Dazzi, C. (2013). Soil geography and diversity of the European biogeographical regions. *Geoderma*, *192*, 142-153.

Plant material classes according to the SIA 312:2013 based on provenance of seed sources

Classes	Plant species provenance
1	Seeds collected locally (from donor meadows) and transferred with hay containing seeds and/or obtained from threshed hay
2	Swiss eco-types of the same biogeographic region
3	Swiss eco-types of wild species without any regional specification
4	Plant material with any specific characteristics



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BIODIVERSE GREEN ROOFS

Seed mixtures and/or hay from donor meadows

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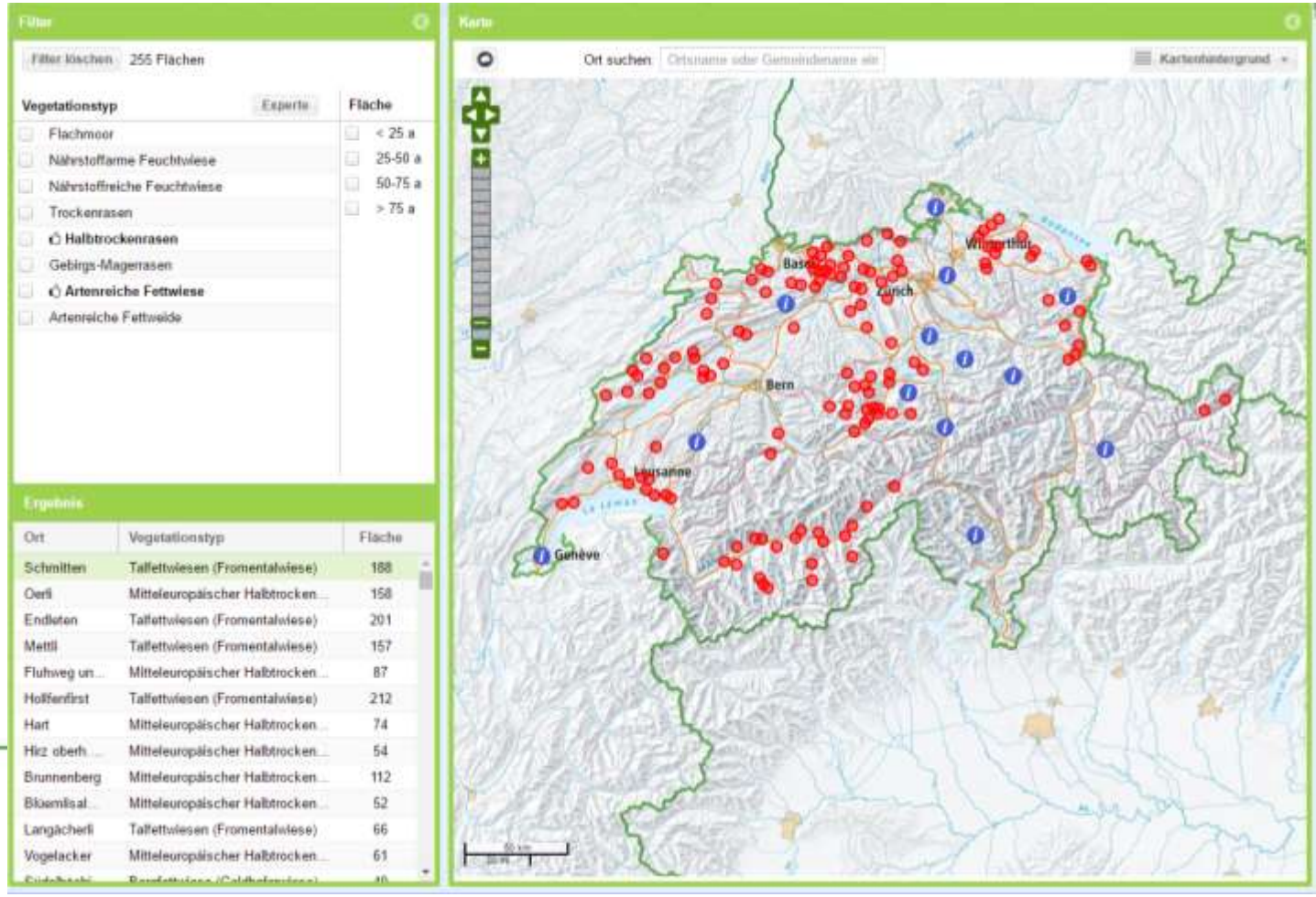
BIODIVERSE GREEN ROOFS

Where and how to find donor meadows

- Regio Flora



https://www.regioflora.ch/de/startseite-de/

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BIODIVERSE GREEN ROOFS

Moos Water Filtration Plant

- Location: Zurich
- Surface: 21.000 m^2
- Year of construction: 1914

BIODIVERSE GREEN ROOFS

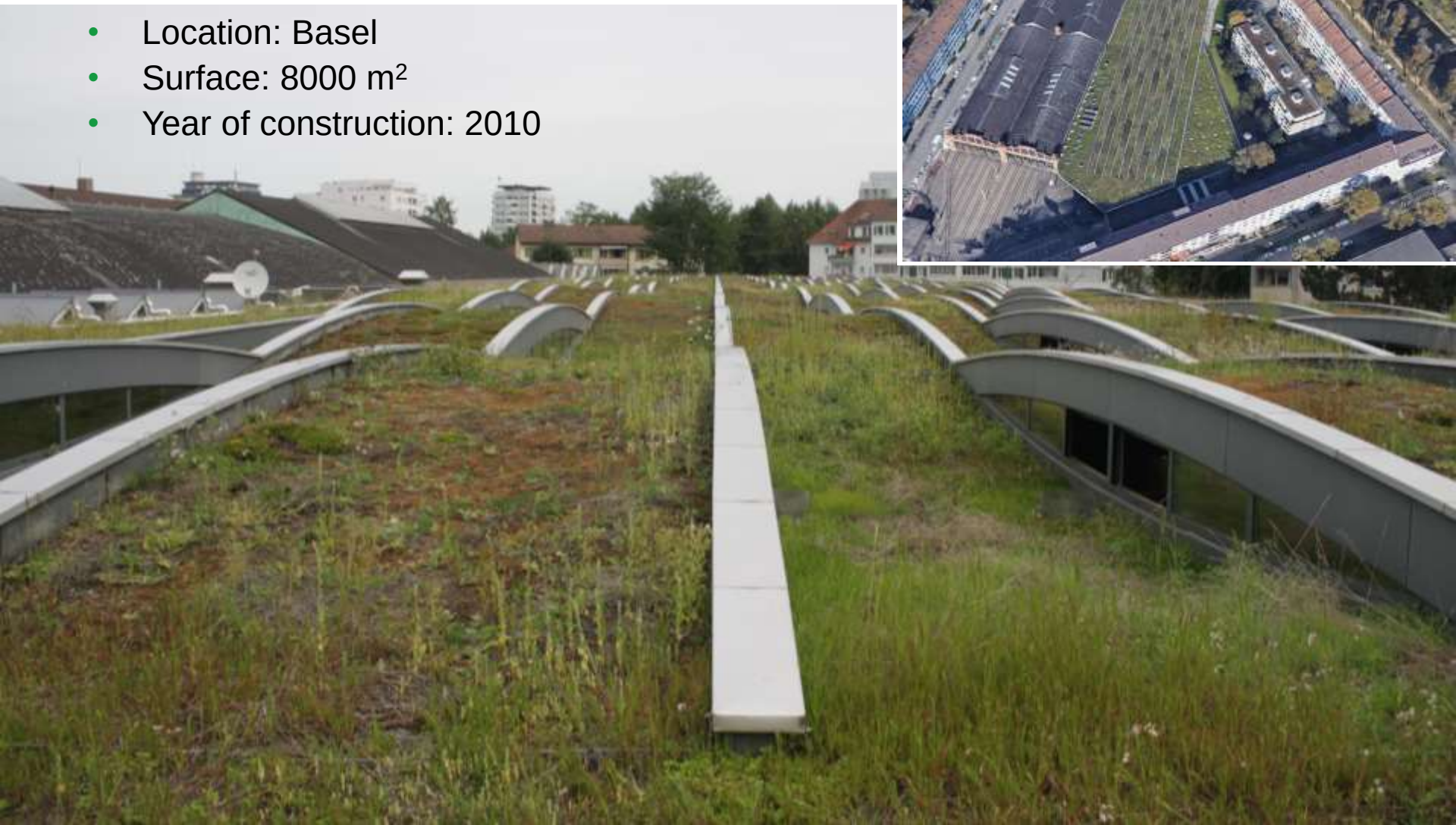
Stücki Shopping Center

- Location: Basel
- Surface: 38.000 m²
- Year of construction: 2009

BIODIVERSE GREEN ROOFS

BVB Wiesenteppich

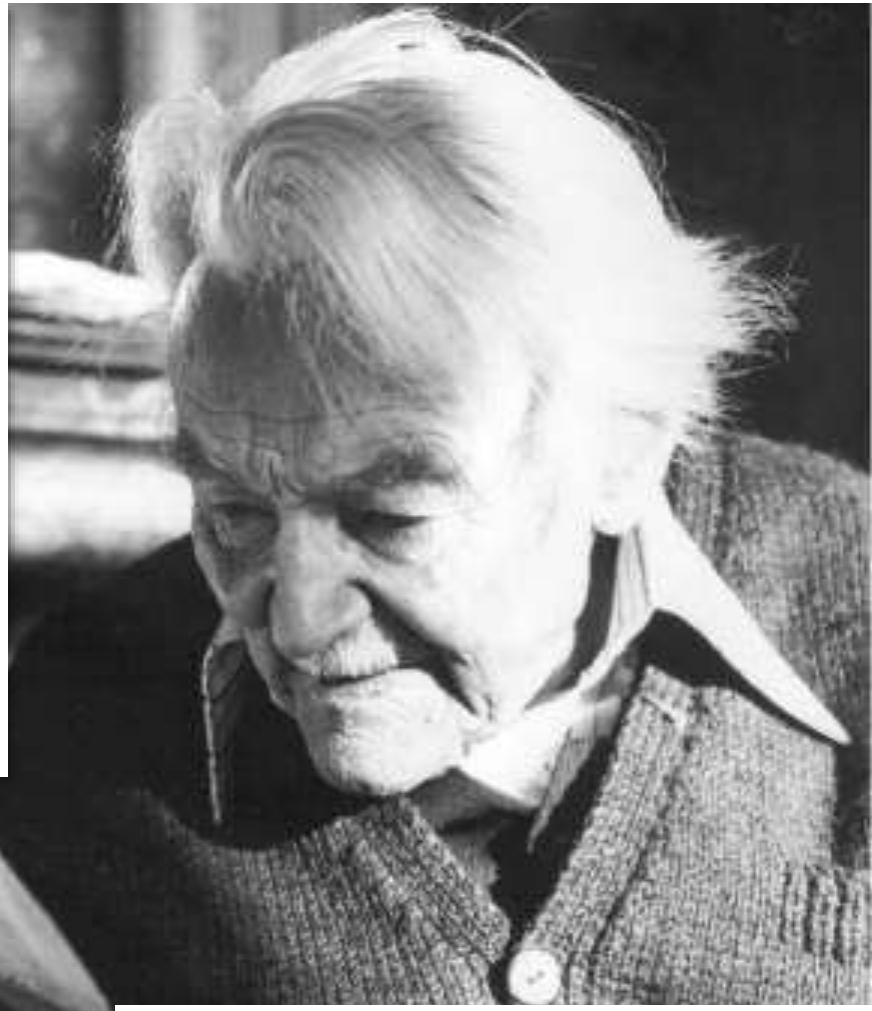
- Location: Basel
- Surface: 8000 m^2
- Year of construction: 2010



PLANT SPECIES SELECTION

How to select the right plant species assemblage

- **Plant sociological approach** (Catalano et al. 2013)
- **Plant sociology or phytosociology** is a subdiscipline of plant ecology that classifies the co-occurrence of plant species in communities, namely:
  - **Associations** (-etum),
  - **Alliances** (-ion),
  - **Orders** (-etalia),
  - **Classes** (-etea).



Josias Braun-Blanquet (1884–1980).

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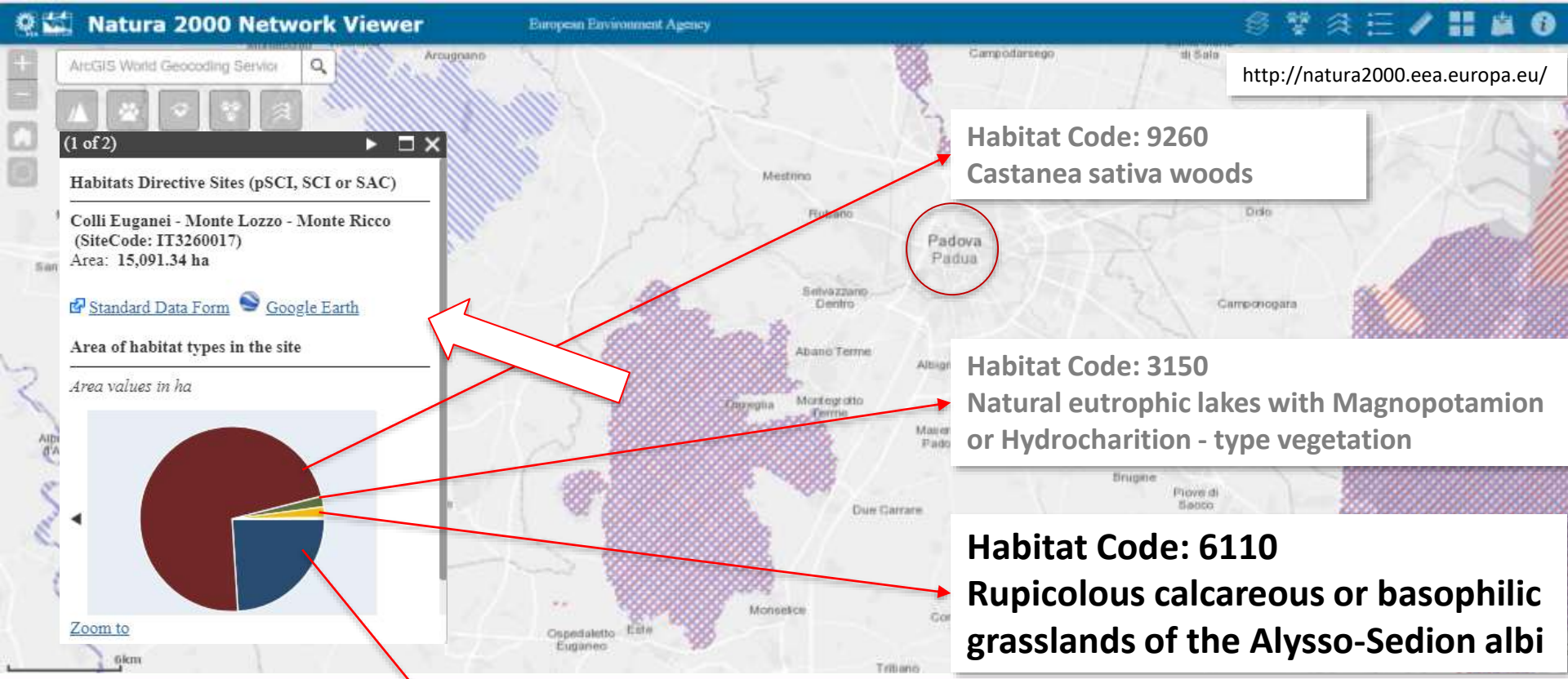
PLANT SOCIOLOGICAL APPROACH

Natura 2000 Habitat screening



http://natura2000.eea.europa.eu/

Habitat Code: 9260
Castanea sativa woods

Habitat Code: 3150
Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation

Habitat Code: 6110
Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi

Habitat Code: 6210
Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)

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PLANT SOCIOLOGICAL APPROACH

Alysso-Sedion albi [6110]

Habitat Italia

http://www.vnr.unipg.it/habitat/index.jsp

home collaboratori documenti archivio link tematici

mostra didascalie (in ogni campo)

61: Formazioni erbose naturali

6110*: Formazioni erbose rupicole calcicole o basofile dell'Alysso-Sedion albi

Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi

Combinazione fisionomica di riferimento

Alyssum alyssoides, *A. montanum,* ***Arabis auriculata (= A. recta)****,* ***Cerastium pumilum, C. semidecandrum, C. glutinosum,*** *C. brachypetalum, Erophila verna* agg.*, Micropus erectus,* ***Hornungia petraea****, Orlaya grandiflora, Minuartia hybrida,* ***Saxifraga tridactylites****,* ***Sedum acre, S. album, S. montanum*** **agg.****,*** ***S. sexangulare****, S. rupestre,* ***Sempervivum tectorum****.,* ***Teucrium botrys****, Thlaspi perfoliatum Valerianella rimosa, V. eriocarpa,Trifolium scabrum, Catapodium rigidum, Veronica praecox, Melica ciliata, Poa badensis, Poa molineri, Ptychotis saxifraga, Petrorhagia prolifera), Jovibarba* spp., e i muschi *Tortella inclinata e Fulgenzia fulgens.*

https://www.infoflora.ch/it/

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PLANT SOCIOLOGICAL APPROACH

Alysso-Sedion albi [Habitat Code: 6110]









Isidre blanc

Franz Xaver

HermannSchachner

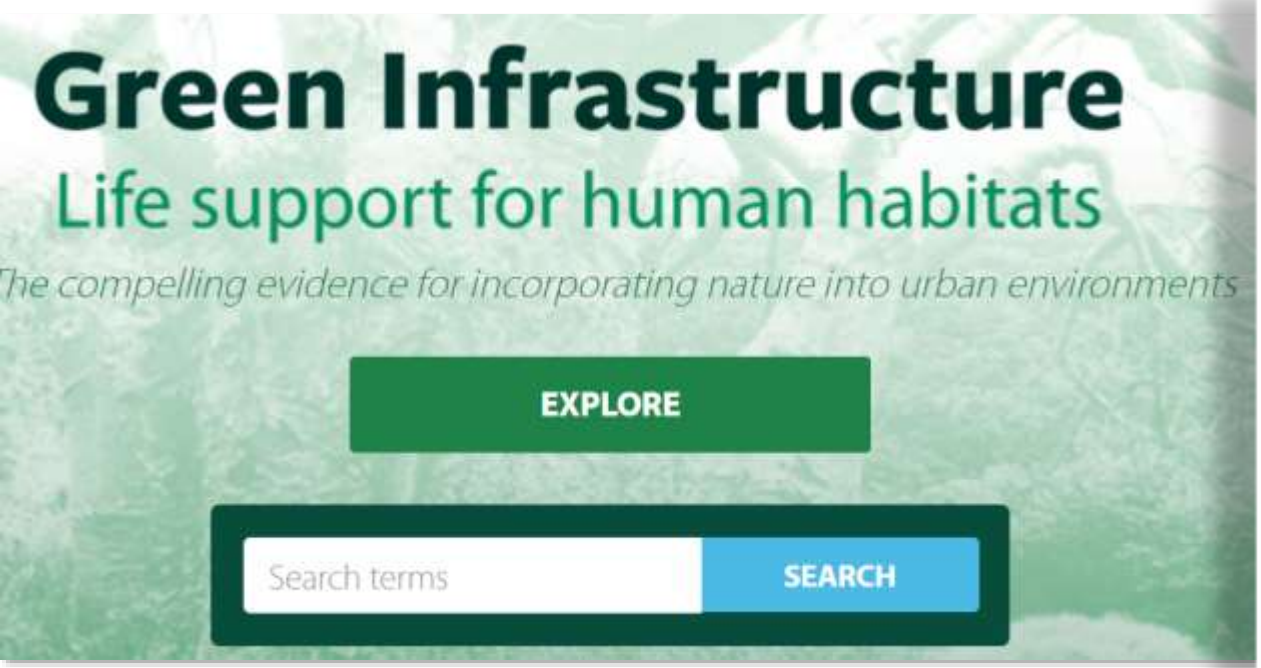
Bernd Haynold

Isidre blanc

Stefan.lefnaer

PLANT SPECIES SELECTION

Interactive databases



http://gievidencebase.botanicgardens.sa.gov.au/

http://plantselector.botanicgardens.sa.gov.au/

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INTERACTIVE DATABASES

Species screening

Plant Selector +

Refine Search

Appearance | Growing Requirements | Placement | Purpose | Origin

Clear All | Landscape | Soil Texture | Ph | Minimal | Positions | Tolerates

Landscape

- [ ] 2nd line coast
- [ ] Coast
- [ ] Coastal cliffs
- [ ] Coastal dunes
- [ ] Coastal estuary
- [ ] Coastal footslopes
- [ ] Desert dunes
- [ ] Dunes
- [ ] Floodplains
- [ ] Footslopes
- [x] Hills
- [ ] Plains
- [ ] Pond
- [ ] Swamp flat
- [ ] Tidal flats
- [ ] Watercourse

Soil Texture

- [ ] Clay
- [x] Gravel
- [ ] Loam
- [x] Rock
- [ ] Sand

pH

- [ ] Acidic
- [ ] Alkaline
- [x] Neutral

Supplementary watering

Minimal

Export data

Position/Aspect

- [ ] Full Shade
- [x] Full Sun
- [ ] Part Shade

Tolerates

- [ ] Coast
- [ ] Compacted soil
- [x] Drought
- [ ] Fire
- [ ] Flooding
- [ ] Heavy frost
- [ ] Light frost
- [ ] Lime
- [ ] Moderate frost
- [ ] Pollution
- [ ] Salt spray
- [ ] Soil salinity
- [ ] Water logging
- [x] Wind

INTERACTIVE DATABASES

Species screening

BotanicalName	Origin	Form	Height	Spread	Ph	Position	Notes
Craspedia variabilis	Sa, AW, Vic, NSW, Qld	Groundcover	0.30-0.50m	0.10-0.30m	Alkaline, Neutral, Acidic	Full Sun	Uses: Ornamental perennial herb for native landscapes, rockeries, parks and reserves. Requires well-drained soils. Attracts nectar eating native butterflies. Often dies back over hot summers.
Glischrocaryon behrii	NSW, VIC, SA	Groundcover	0.20-1.00m	0.30-1.00m	Acidic, Neutral, Alkaline	Full Sun	Uses: A perennial native herb, which spreads by suckering. Plant in informal drifts in native landscapes amongst other shrubs creates a floral display in Spring. Requires well-drained soils. Attracts native butterflies.
Hemiandra pungens	WA	Groundcover	0.05-0.10m	1.50-2.00m	Alkaline, Neutral, Acidic	Full Sun	Uses: As a ornamental ground cover for embankments, nature strips, roundabouts and verges. Useful for the control of soil erosion or a low screen, or barrier in low traffic areas due to its prickly foliage. Requires well-drained soils. Attracts native honey eaters and butterflies.

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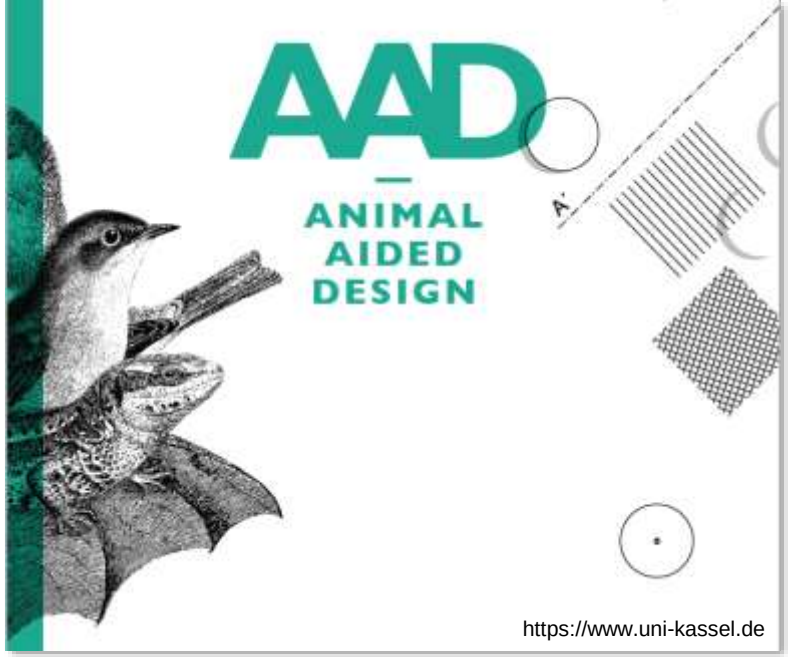
HABITECTURE

Architecture for wildlife

The integration of habitat for other species into structures designed for human purposes (J.B. MacKinnon, 2013)



https://www.uni-kassel.de

http://geography.utoronto.ca

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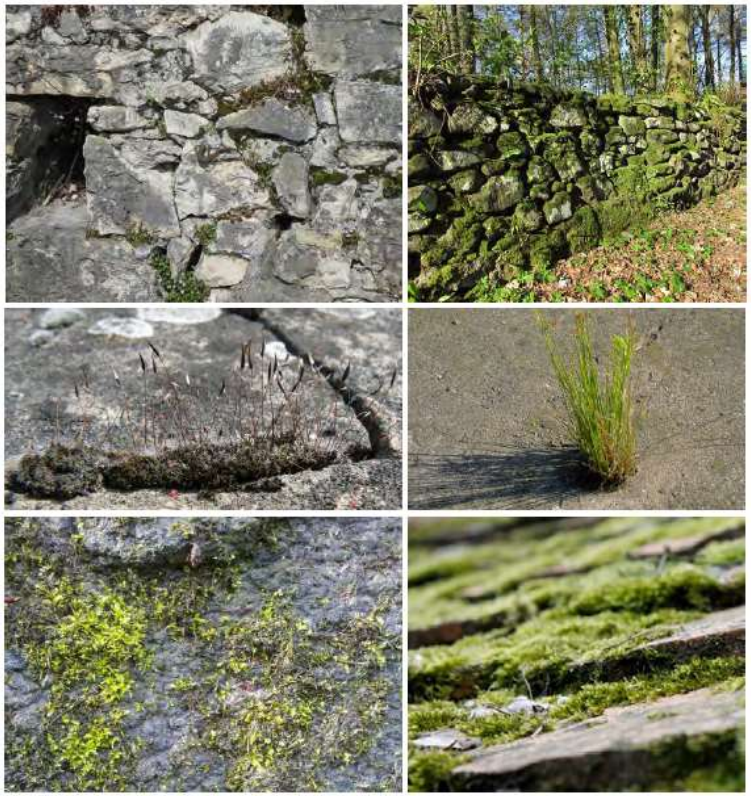
HABITECTURE

Biodiversity School and Gymnasium

http://www.chartier-dalix.com/project/groupe-scolaire-de-la-biodiversite-et-gymnase-a-boulogne-billancourt-92/

BIODIVERSITY SCHOOL AND GYMNASIUM

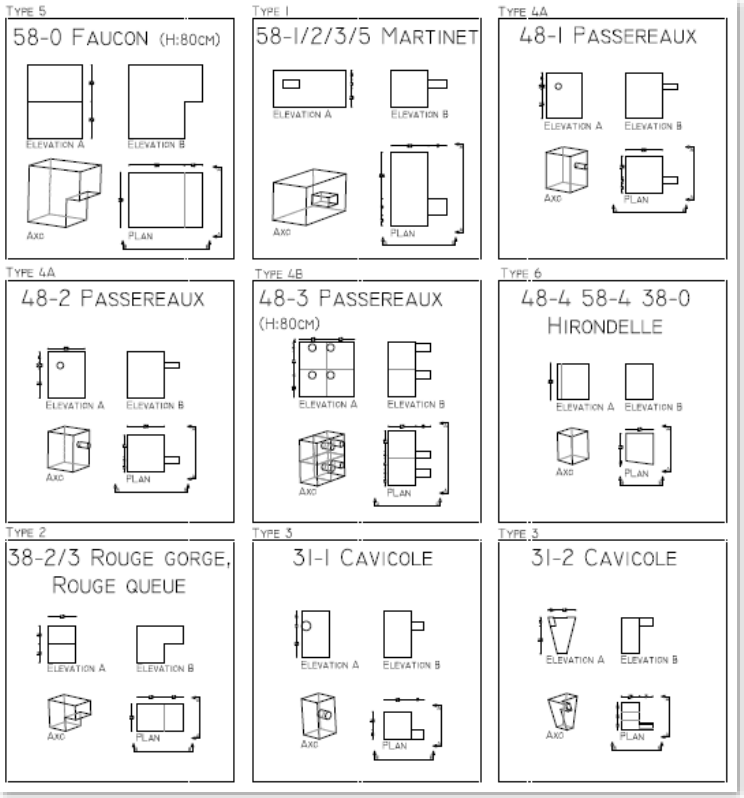
The Habitat wall

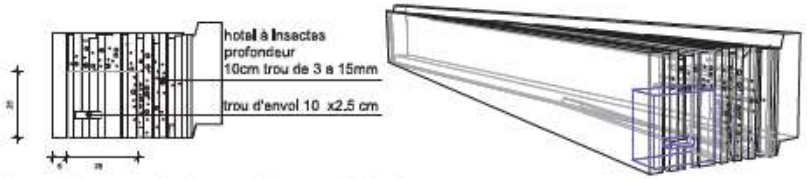


http://www.chartier-dalix.com/project/groupe-scolaire-de-la-biodiversite-et-gymnase-a-boulogne-billancourt-92/

BIODIVERSITY SCHOOL AND GYMNASIUM

The Habitat wall



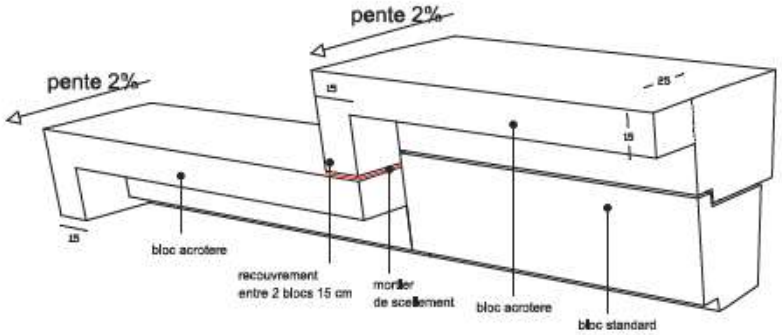


Les blocs spéciaux : blocs nichoirs

200 BLOCS NICHOIRS
ET 40 BLOCS INSECTES

Les blocs spéciaux : blocs jardinières

47 BLOCS JARDINIÈRES



Les blocs spéciaux : blocs acrotères

110 BLOCS ACROTÈRES

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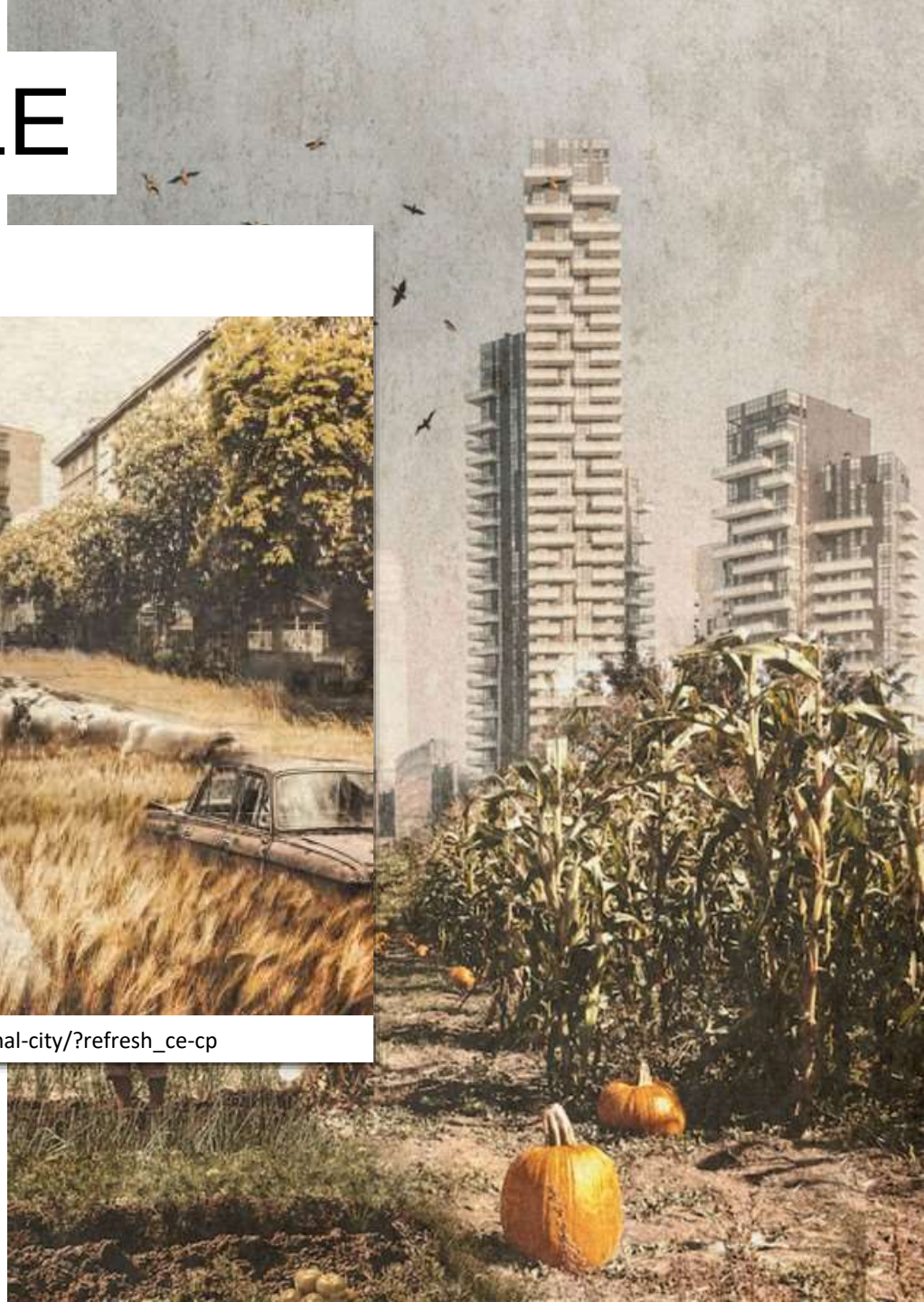
THE CITY SCALE

Animal City

http://www.abitare.it/it/habitat/urban-design/2016/04/09/milano-animal-city/?refresh_ce-cp



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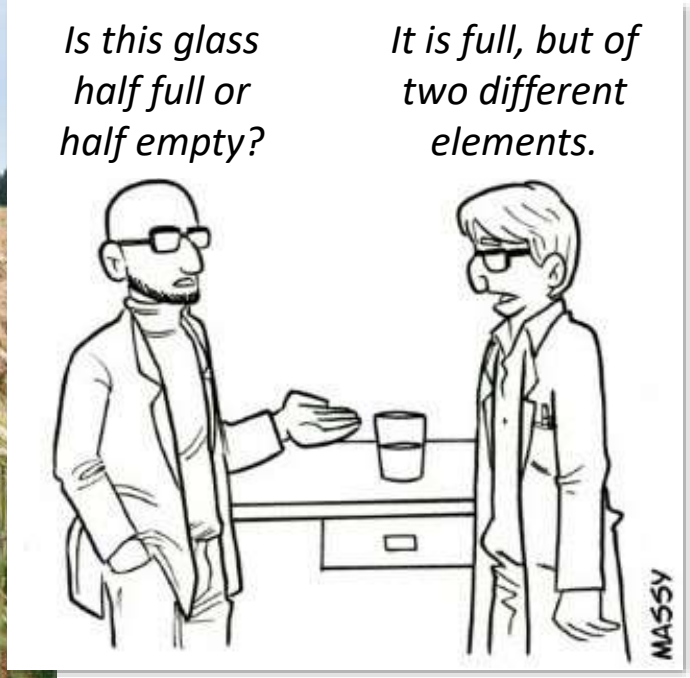
HUMANS / BIODIVERSITY

Is an “ecological aesthetic” possible?



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Thank you! Danke! Grazie!

Dr. Chiara Catalano
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