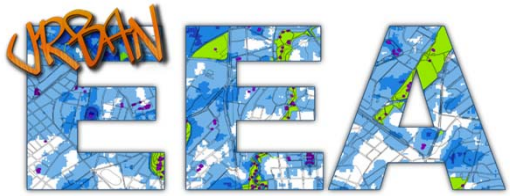


Ecosystem accounting for recreation services and amenities in urban areas

David N. Barton, NINA

with

Zofie Cimburova, Megan Nowell, Frank Hanssen (NINA), Kristine Grimsrud(SSB), Axel Heyman(AHO)

and Marta Suarez (PhD.)

LONDON GROUP ON ENVIRONMENTAL ACCOUNTING

23rd MEETING 1-4 OCTOBER 2018 Central Statistics Office of Ireland

Session D. METHODOLOGICAL WORK SEEA Experimental ecosystem accounting revisions and applications 21. Urban accounts

Wednesday, 3 October 2018

Statistics Norway
Statistisk sentralbyrå

NINA
Norwegian Institute for Nature Research

AHO
Arkitektur- og designhøgskolen i Oslo
The Oslo School of Architecture and Design

Urban ecosystems:

«urban and associated developed areas» (SEEA EEA)

SDG #11: Making cities and human settlements inclusive, safe, resilient and sustainable.

Take home:

1. Urban areas are more easily mapped as gradients of «condition» than as a well-defined «extents»
2. Urban ecosystem «condition» used to predict unobserved local outdoor recreation - amenities for human habitation
3. Use of public green space has small exchange values, but multiplied over daily occasions and large populations can represent large absolute time use and value

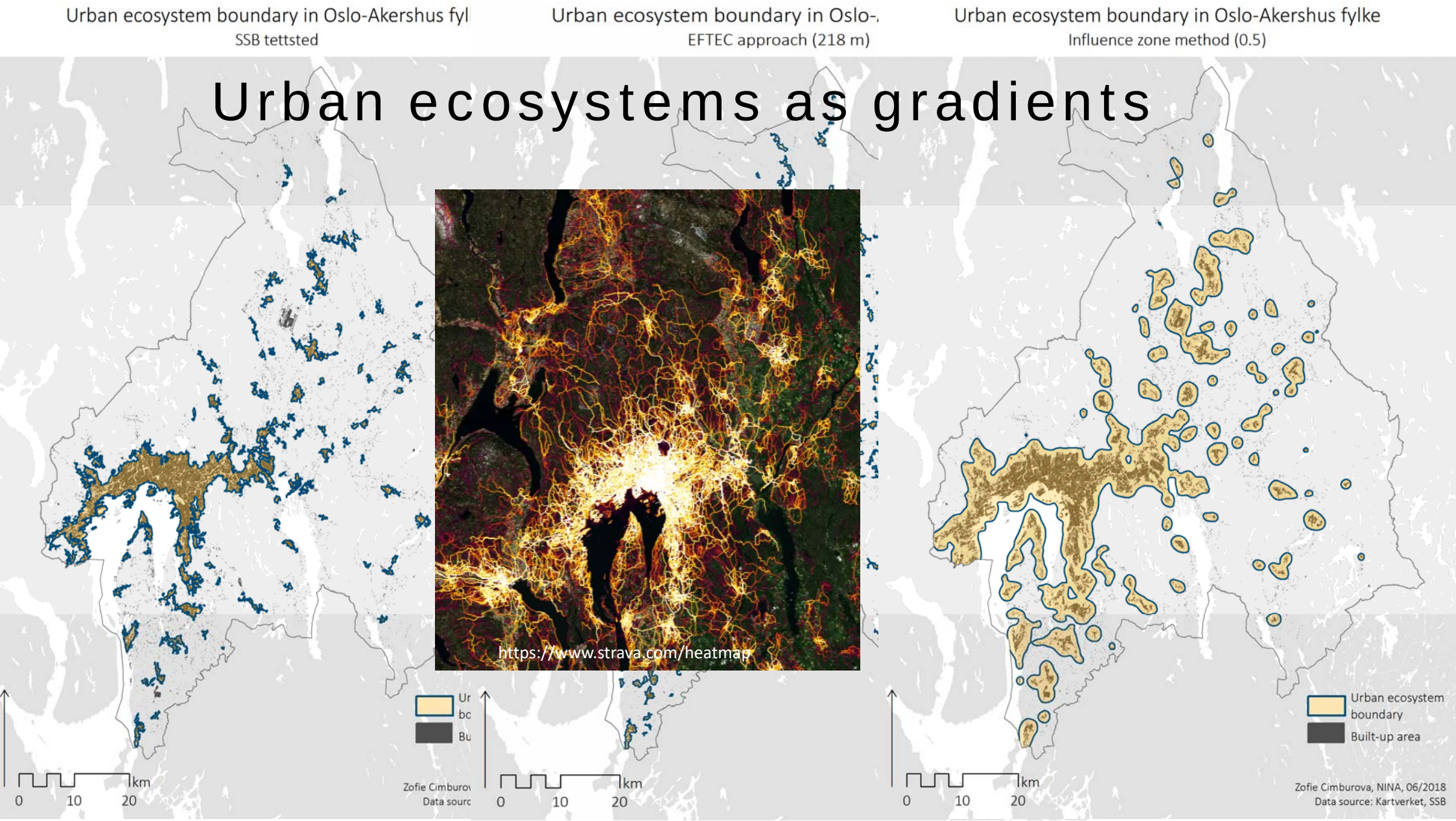
SUSTAINABLE DEVELOPMENT GOALS

Outline

1. **Describing the urban ecosystem and urban recreation services**
2. Measuring recreation service flow
3. Measuring ecosystem condition for recreation
4. Valuation


Green space?

Urban ecosystems as gradients



What is local?

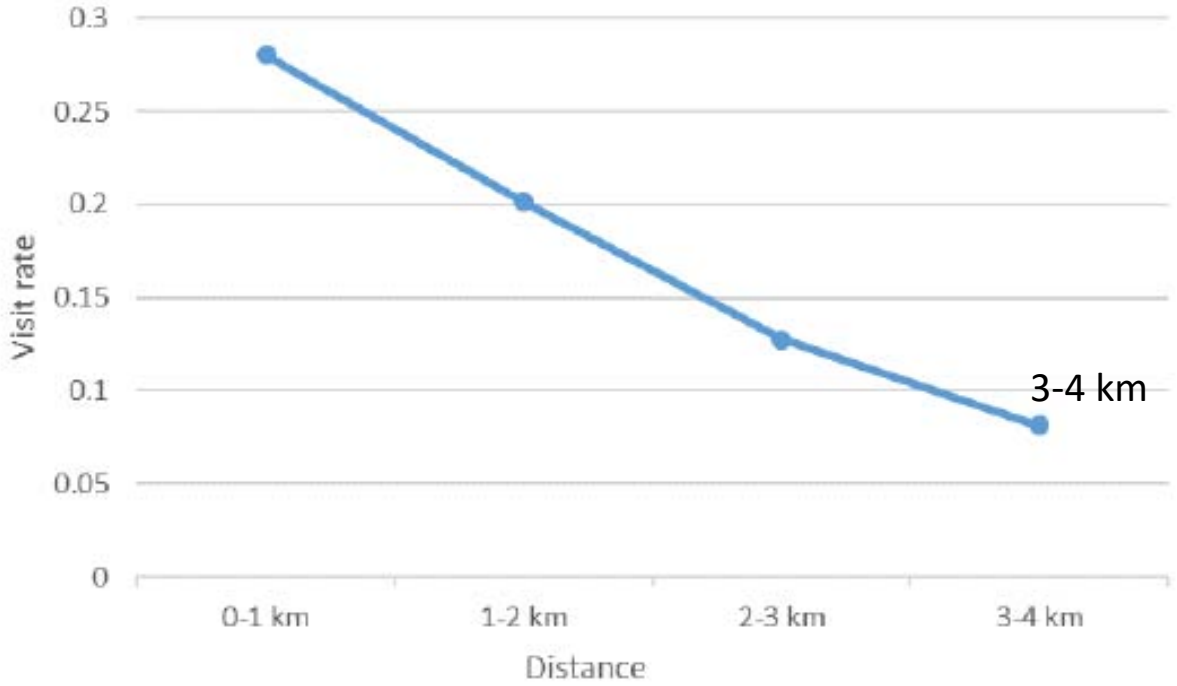


Figure 3.7. Rate of visits in relation to the population at different distances from the 'areas for daily recreation' (Average at the EU level)

Source: Vallecillo S, La Notte A, Polce C, Zulian G, Alexandris N, Ferrini S, Maes J. 2018. Ecosystem services accounting: Part I - Outdoor recreation and crop pollination, EUR 29024 EN; Publications Office of the European Union, Luxembourg, doi:10.2760/619793, JRC110321.

What is daily?

recreation also from «active transport»

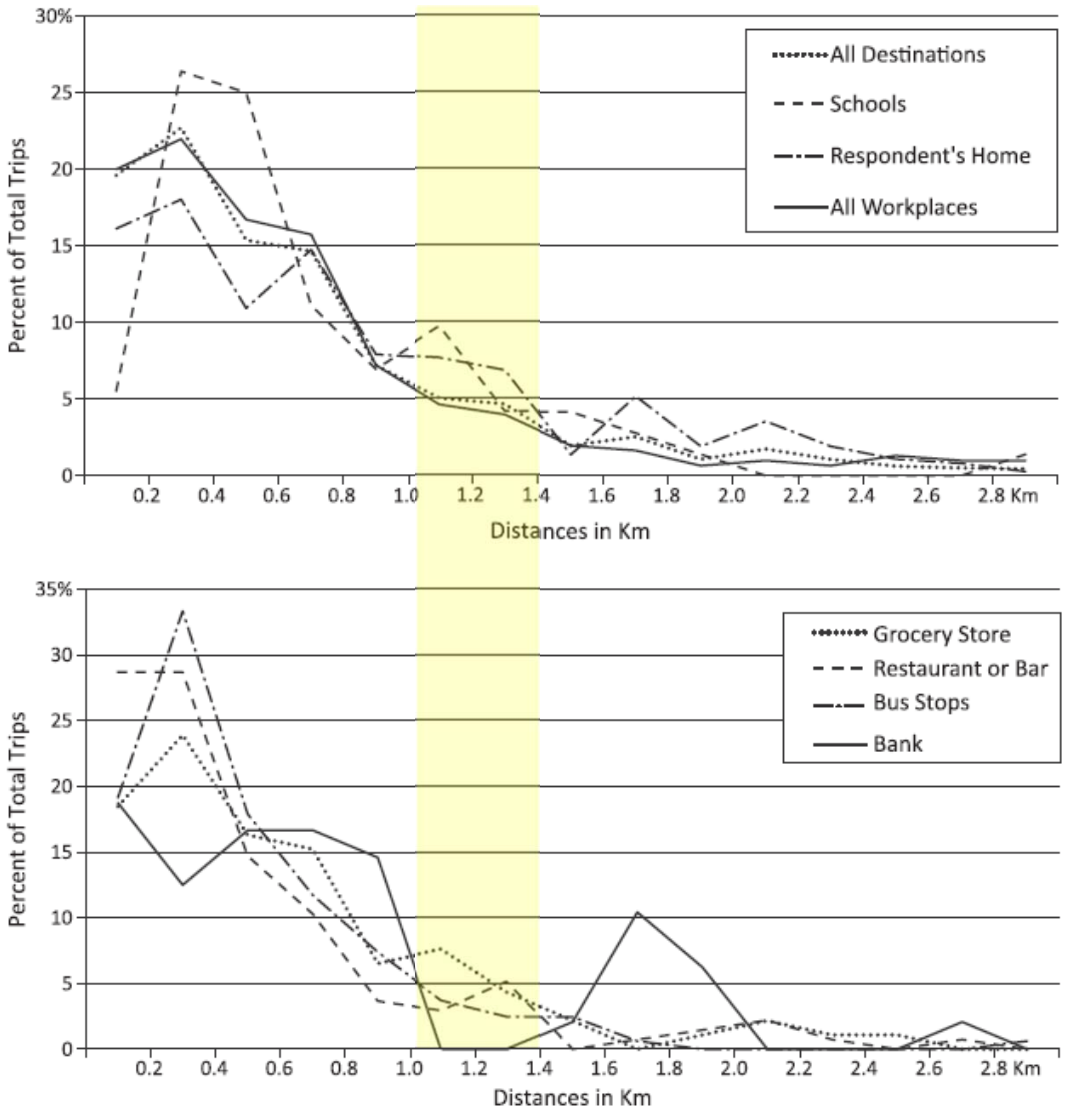
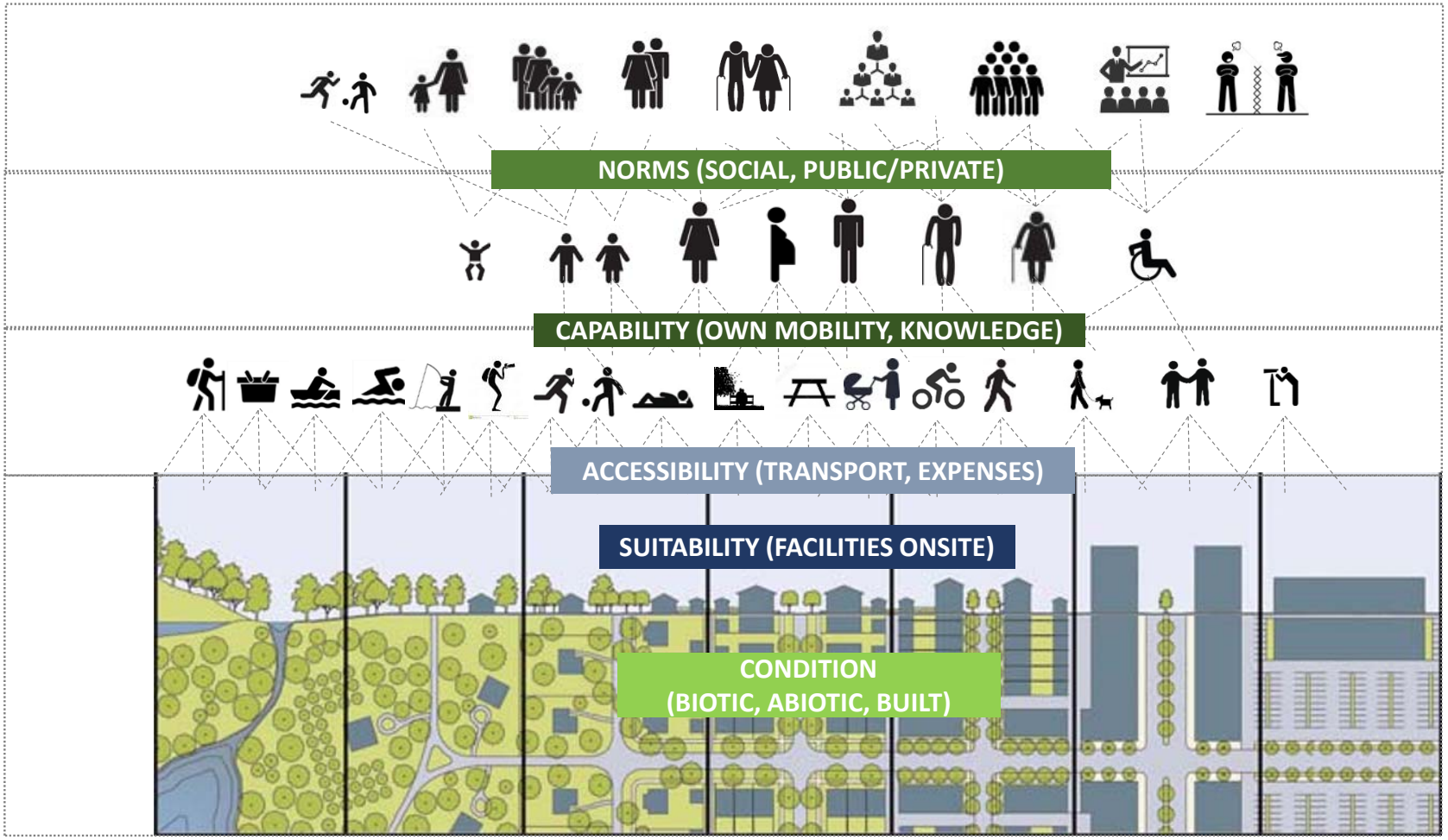


Fig. 2. Distance-decay gradients for major AT-walking destinations.

Local outdoor recreation for daily use* biotic condition part of a complex

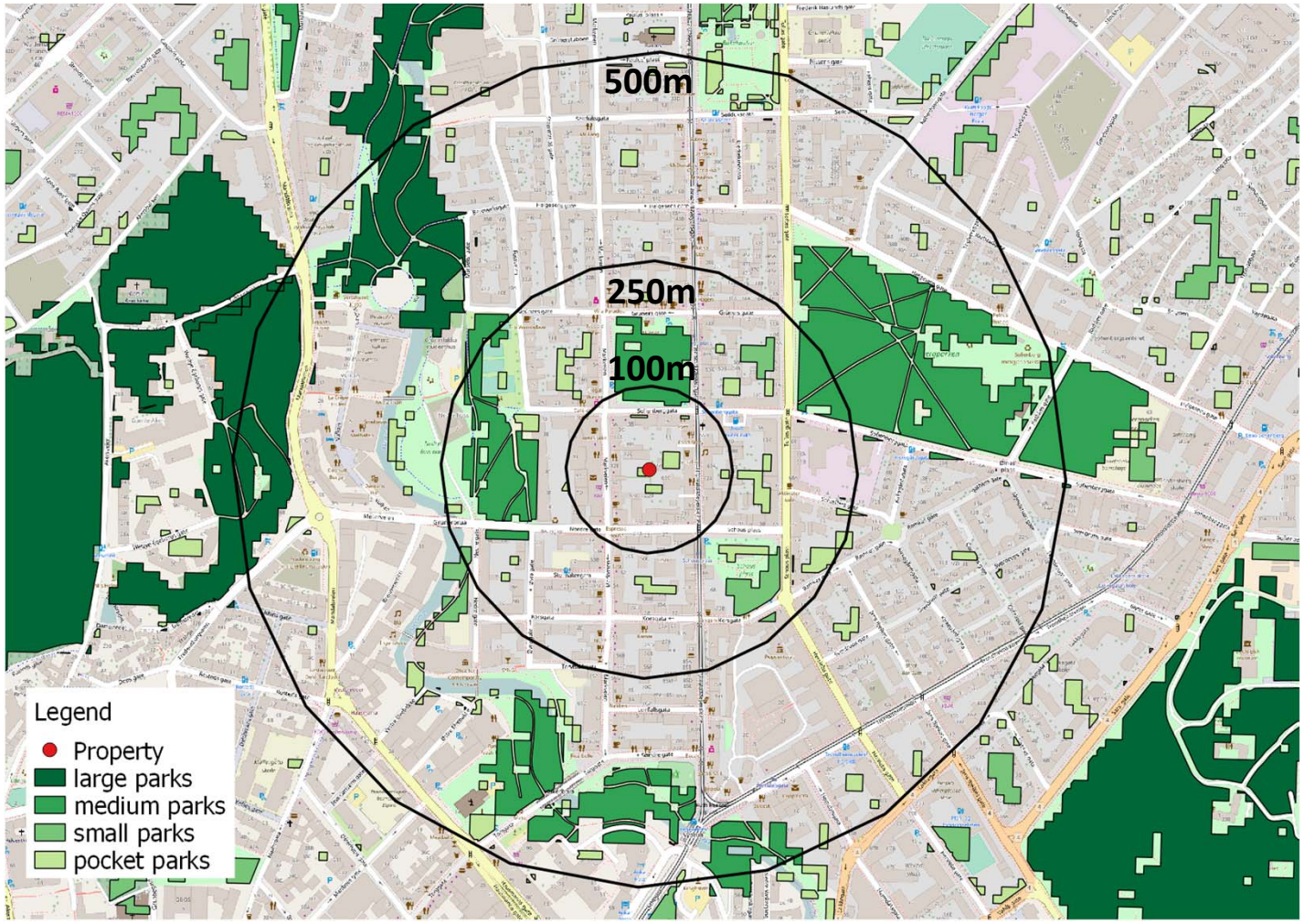


Source: adapted Barton (2016). Illustration transect: Duany Plater-Zyberk & Company. https://transect.org/ Icons Shutterstock Icons Shutterstock.

Outline

1. Describing the urban ecosystem, urban recreation services
2. **Measuring recreation service flow**
3. Measuring ecosystem condition / amenities
4. Valuation

Local outdoor recreation for daily use* in urban areas

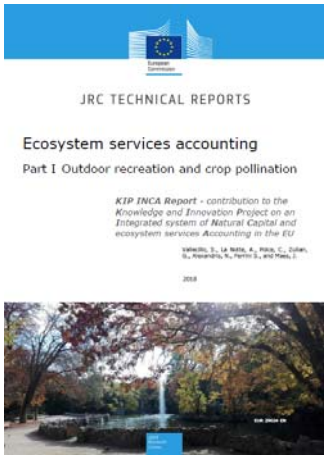


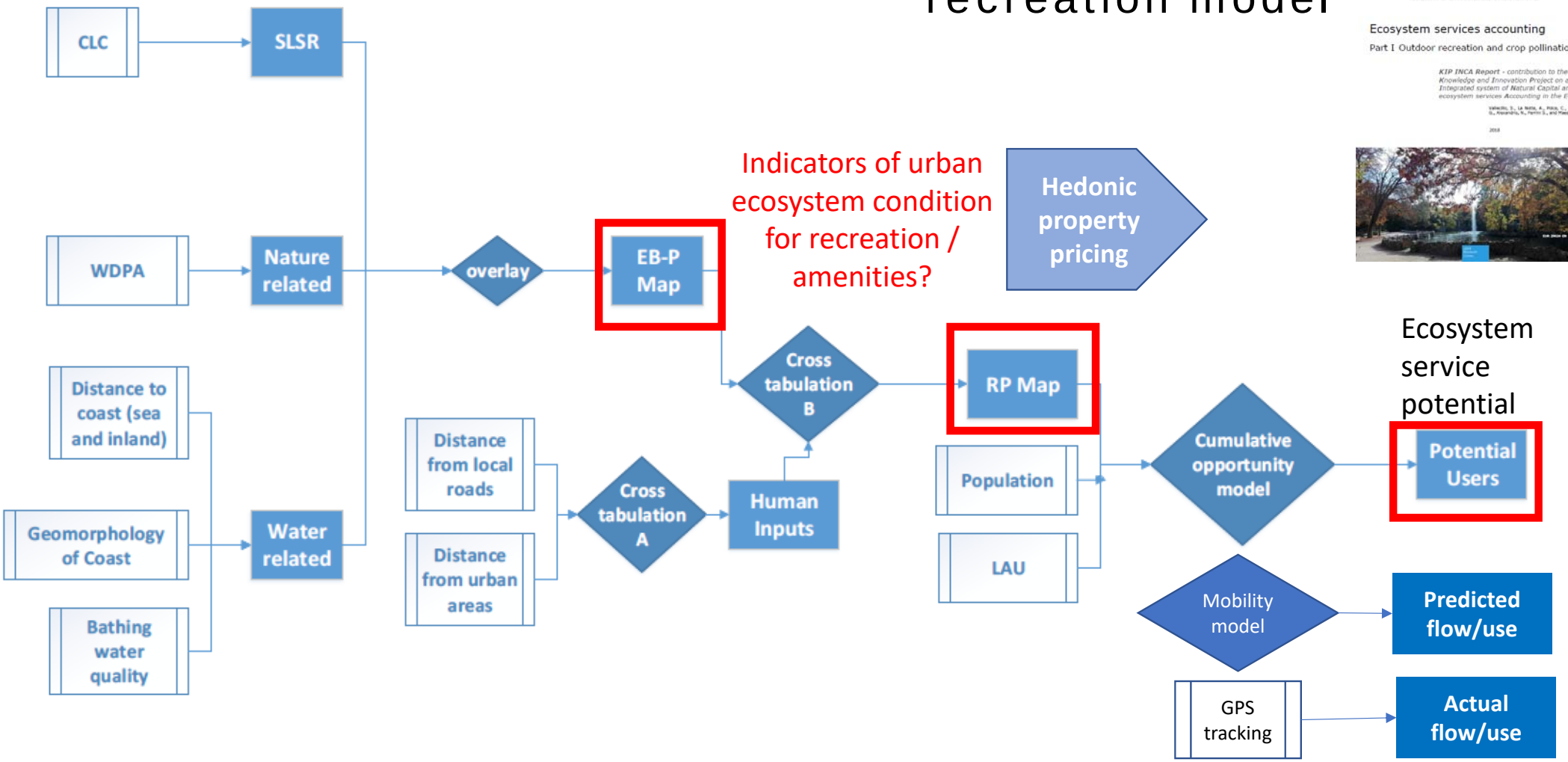
Map: Megan Nowell, NINA

Daily, local recreation:

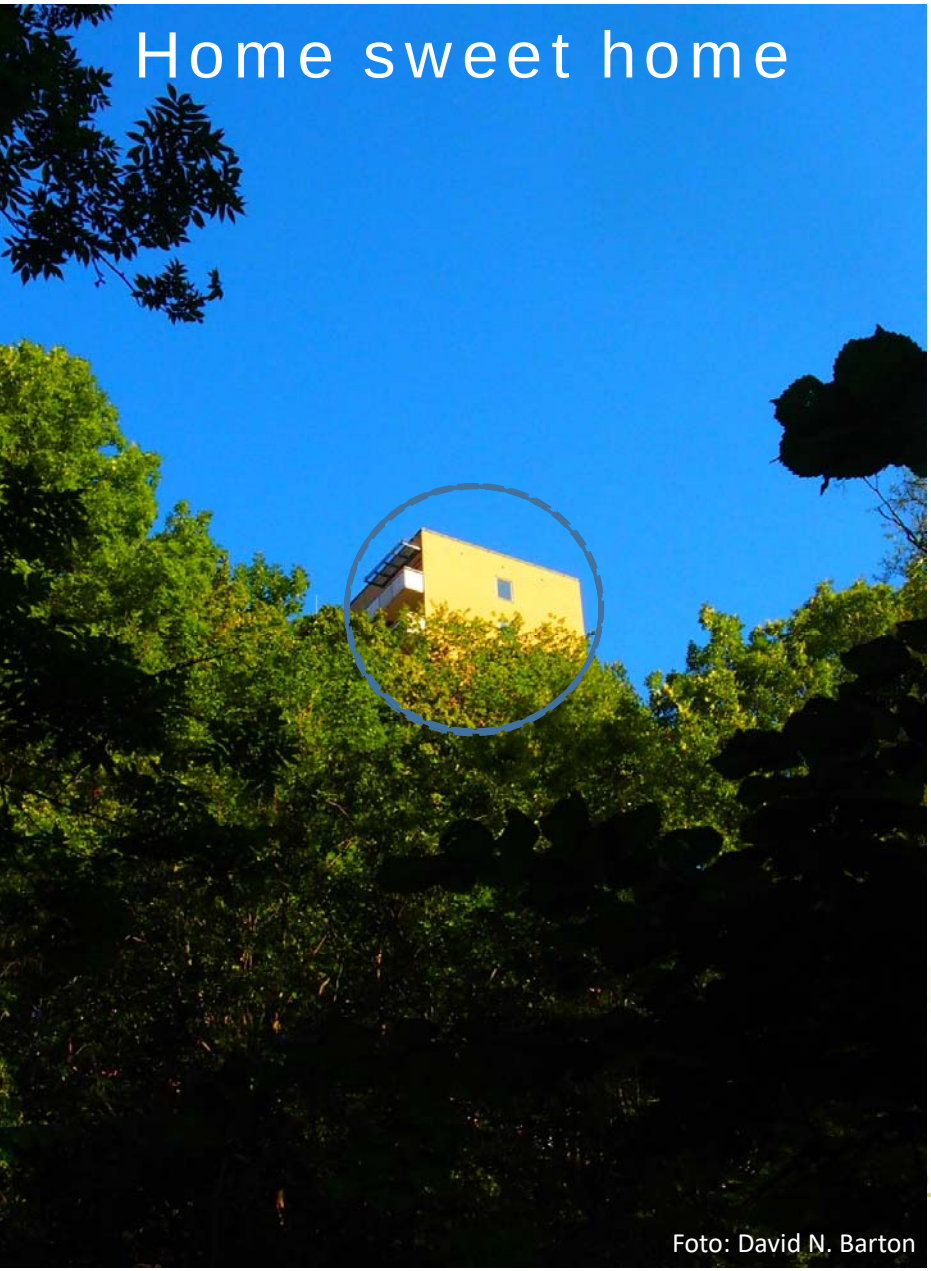
- **Capability –** recreation using own locomotion
- **Accessibility –** public rights of way, free of charge, not entailing direct travel expenses
- **Suitability –** facilitated for own mobility (paths..)
- **Condition** – «bluegreen space» (water, vegetation), «public open space» (people)

ESTIMAP daily outdoor recreation model





CLC=Corine Land Cover, WDPW=protected areas, SLSR= Suitability of land to support recreation. EB-P= Ecosystem-Based potential. RP=recreation potential. Source: Vallecillo et al. 2018.



«amenity services bundle»

FRAMTIDENS BYER

Oslo kommune

VISTA ANALYSE

OSLOpenness

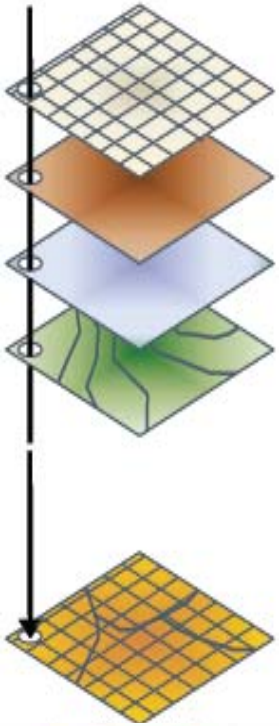


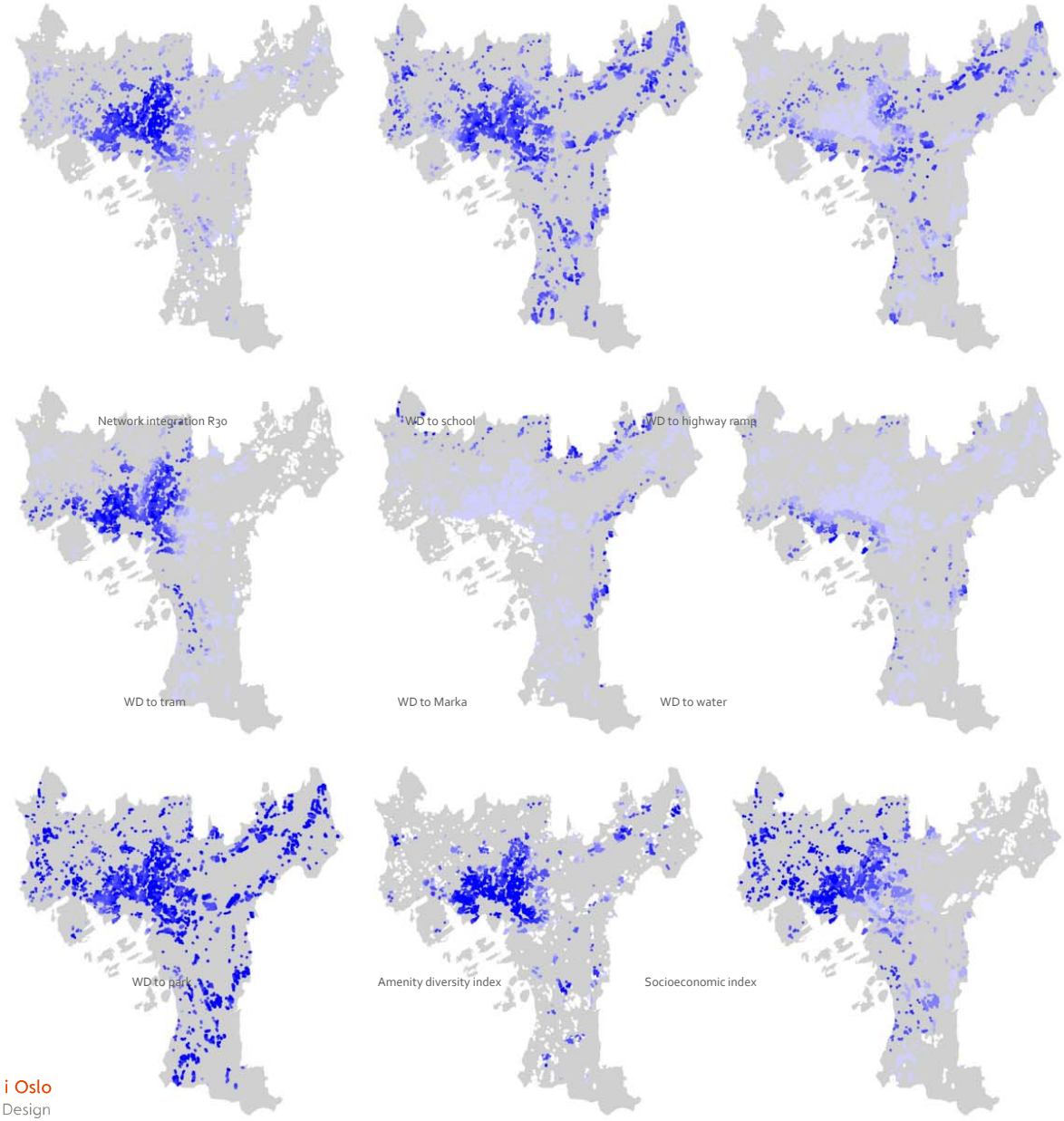
Foto: www.vendanvo.com

Foto: David N. Barton

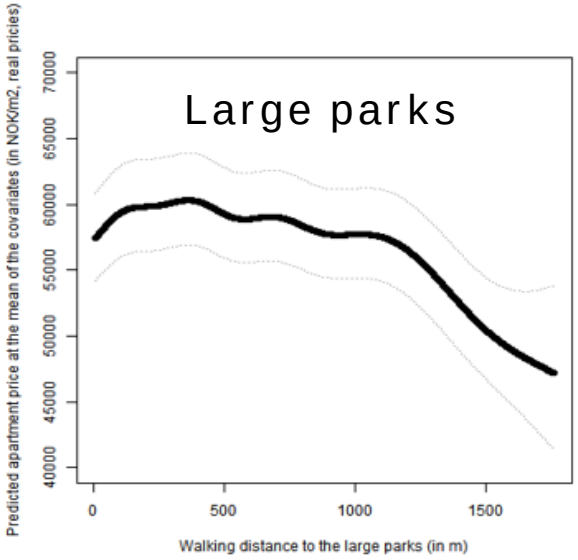
Hedonic property pricing (2017)

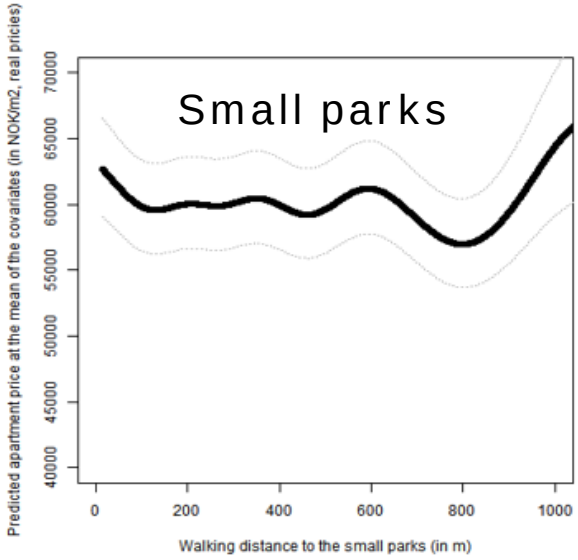
Significant variables

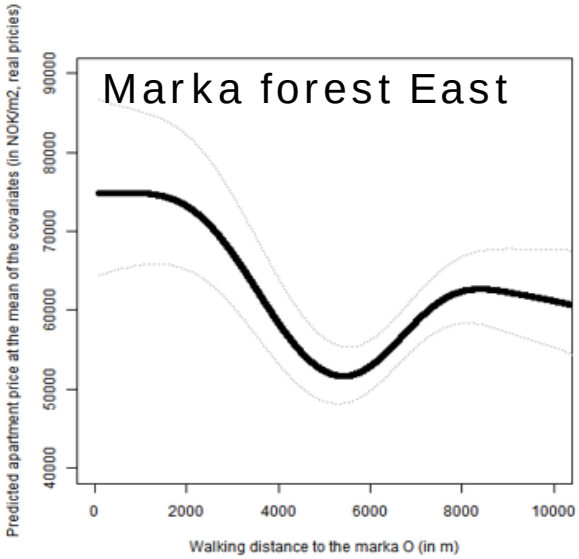
- spatial integration
- access to primary school
- access to highway ramps
- access to tram
- access to Marka peri-urban forest
- access to water
- access to park
- amenity diversity index
- socioeconomic index

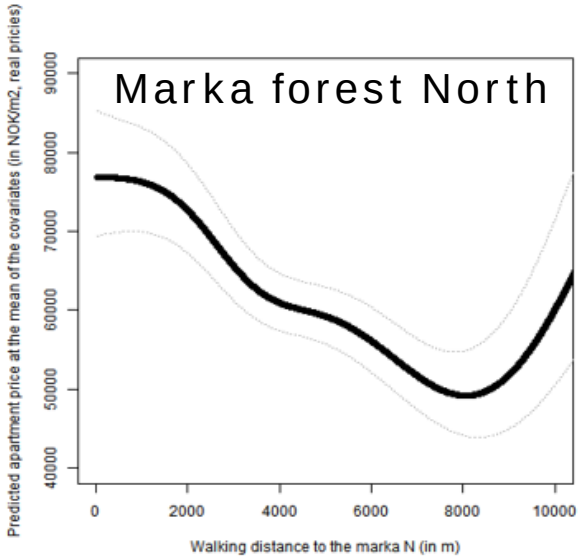


Source: Heyman et al. 2017









Hedonic pricing (2018)

Non-linear, marginal value of proximity to «green spaces» varies by type and direction (and unobserved condition variables)

Source: Heyman et al. (2018) A revealed preference study of Oslo apartment transactions (forthcoming)

Outline

1. Describing the urban ecosystem and urban recreation services
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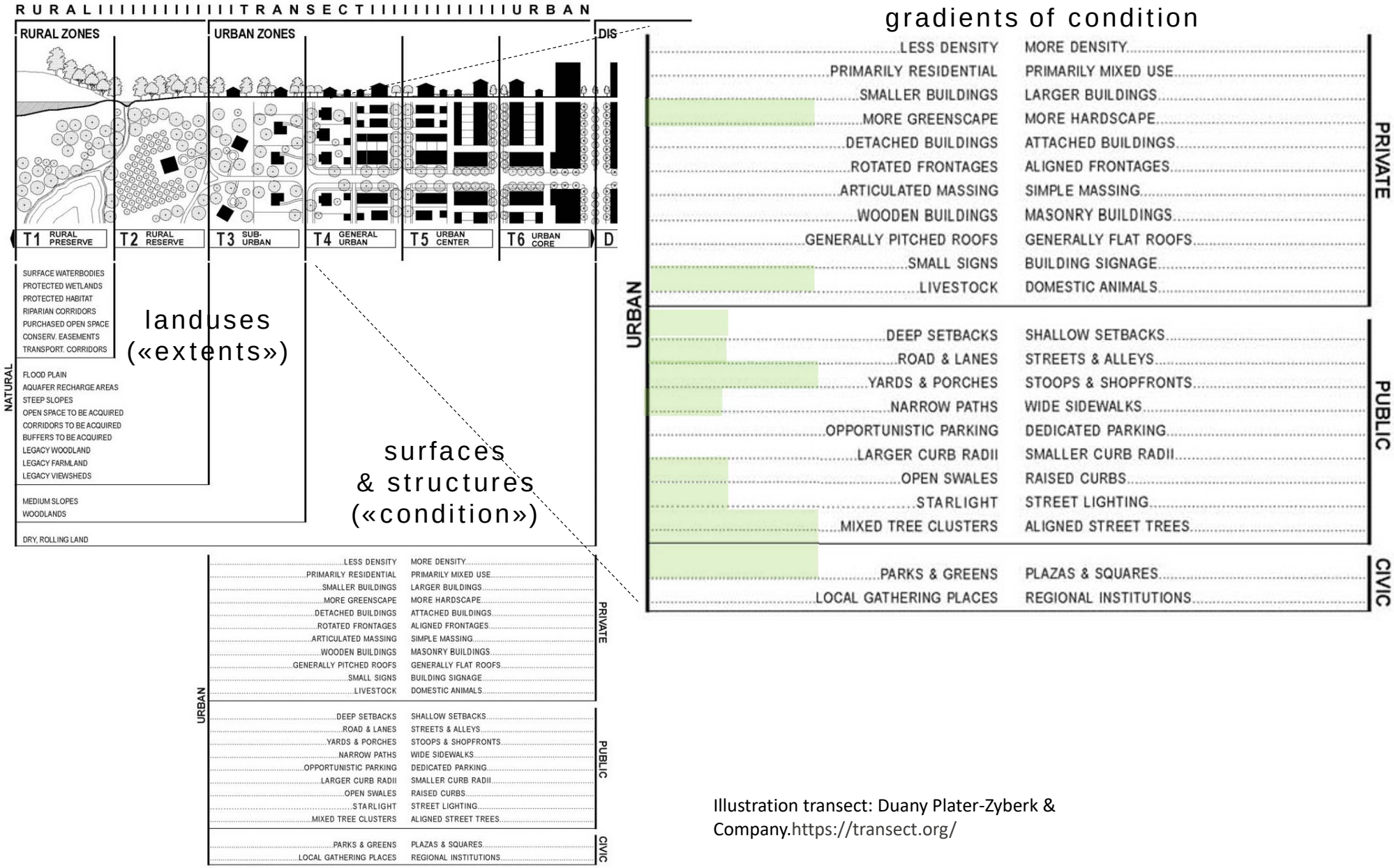


Illustration transect: Duany Plater-Zyberk & Company.https://transect.org/

Indicators of urban ecosystem extent-condition are nested, spatially autocorrelated and potentially double-counted in valuation

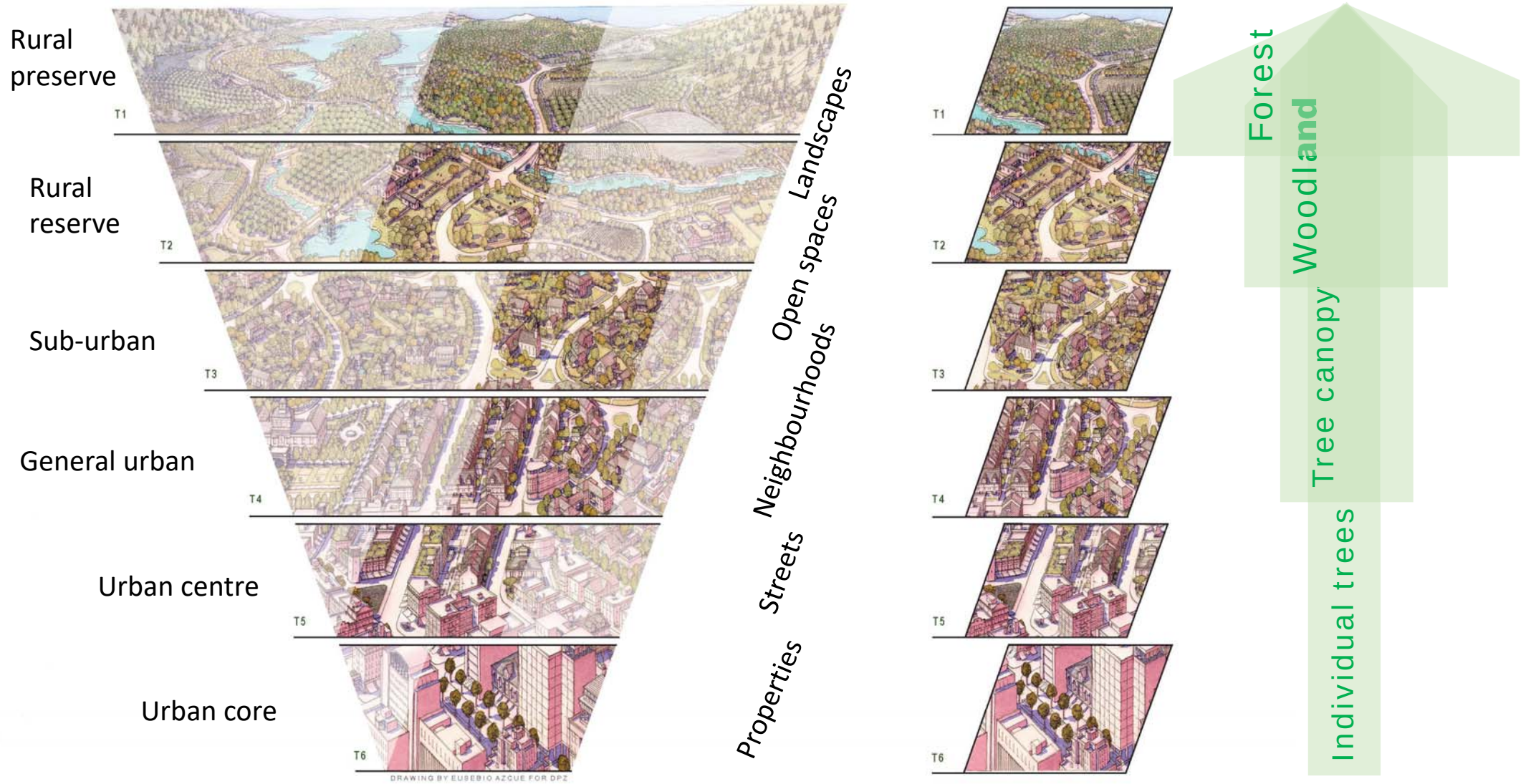


Illustration source: Duany Plater-Zyberk & Company. https://transect.org/

Ecosystem condition at landscape scale

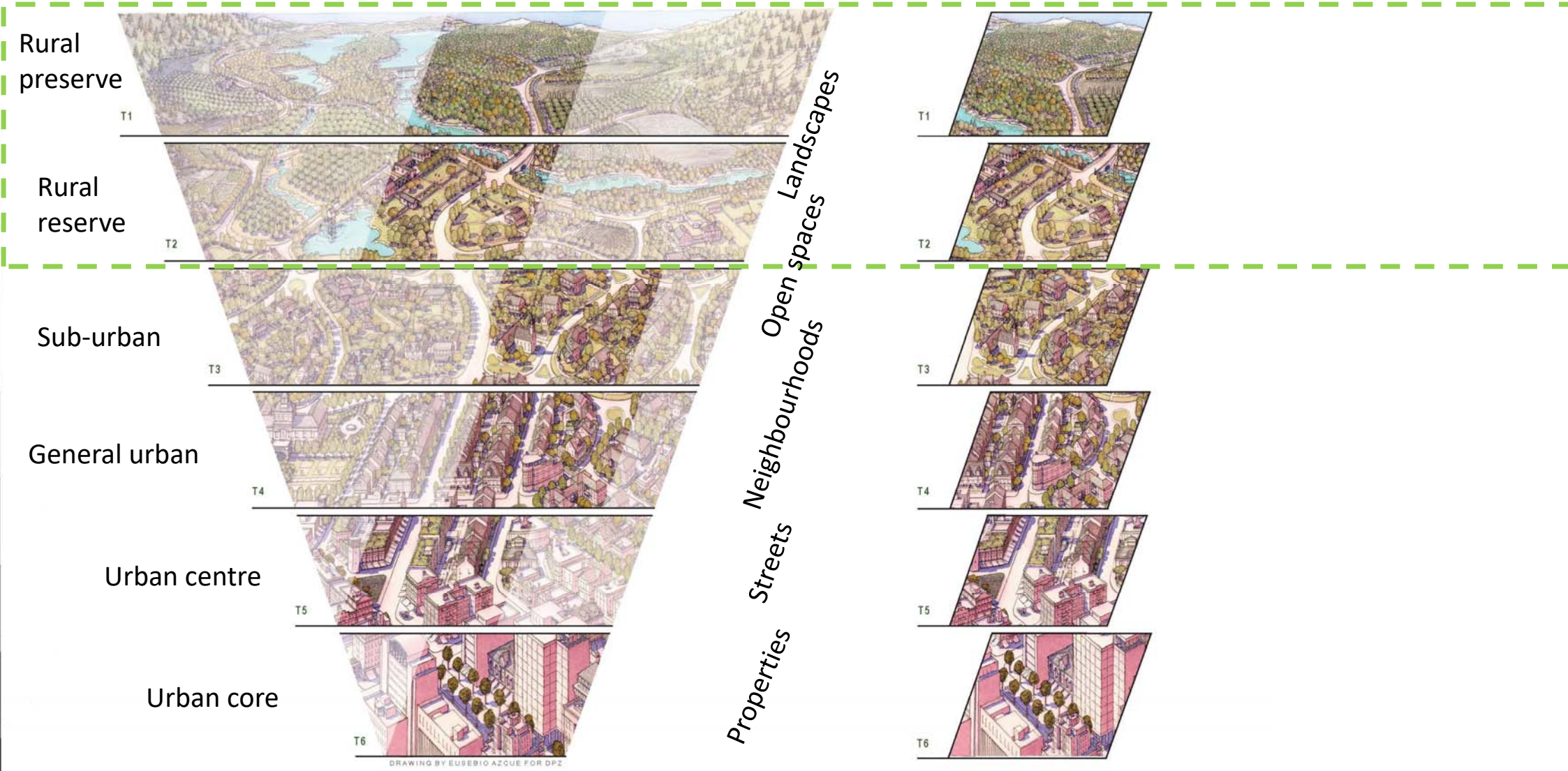
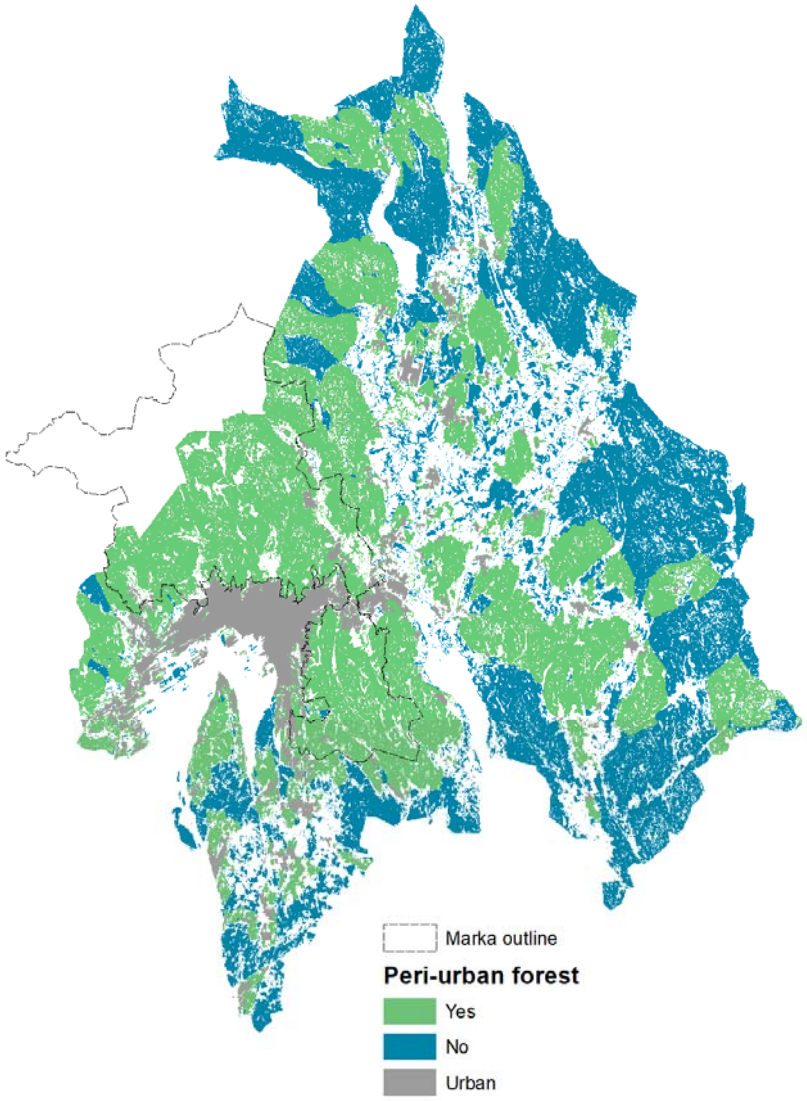


Illustration source: Duany Plater-Zyberk & Company. https://transect.org/

"MARKA" PERI-URBAN FOREST AS EXTENTS FOR OUTDOOR RECREATION



Oslo-Akershus counties

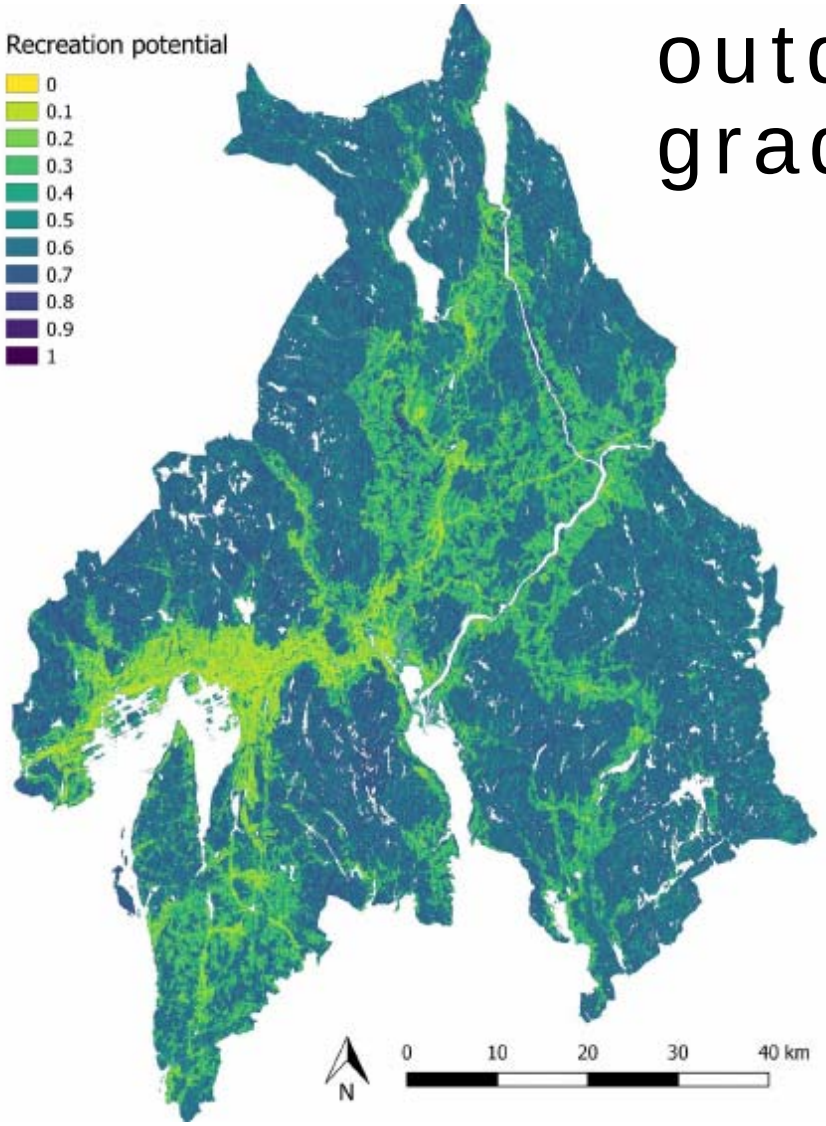
Peri-urban forest > 5000m^2

Relevant classification for properties within peri-urban areas who do not have these surrounding forests as recreational destinations?

Does the size and quality of the forest patch matter?

Slide: Megan Nowell, NINA

Landscape condition for outdoor recreation as gradients



- Degree of naturalness
- Tree density
- Proximity to rivers and streams
- Proximity to lakes and sea
- Size of continuous forests
- Diversity of trees
- Terrain variation
- Proximity to roads
- Traffic noise

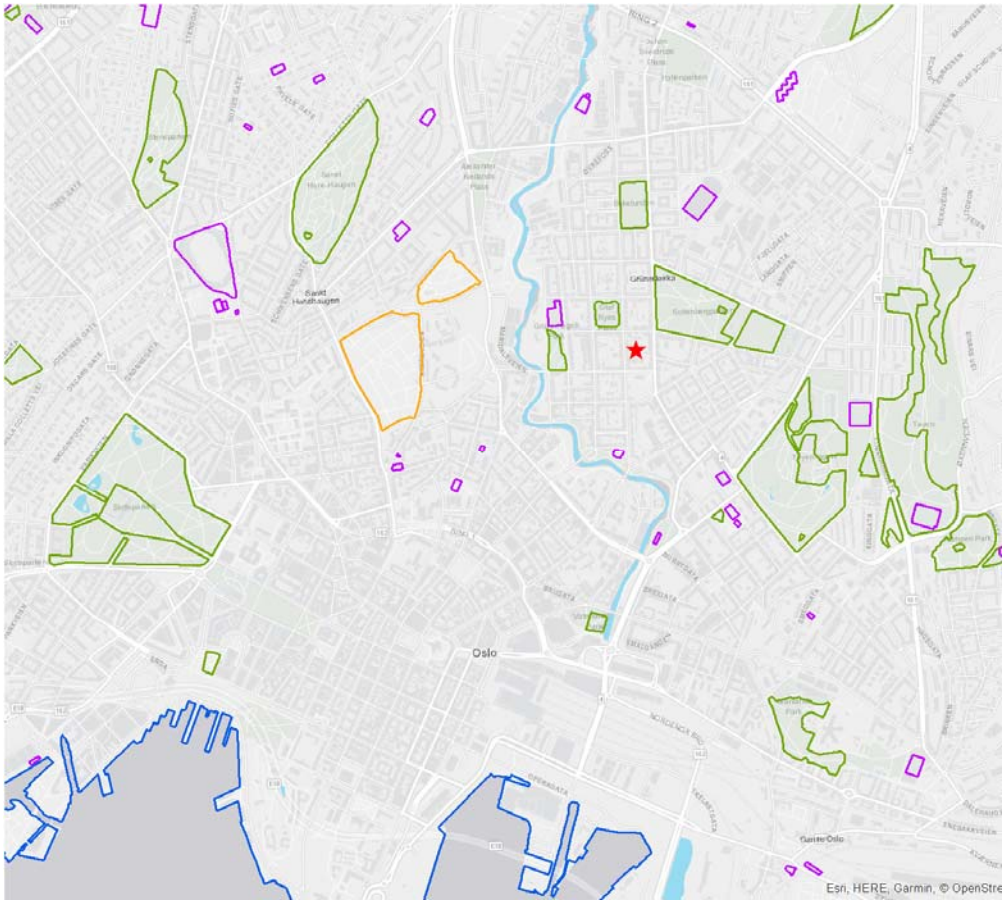
ESTIMAP model terminology:

RECREATION POTENTIAL

«condition» for recreation (at landscape scale?)

Source: Suarez, M. (forthcoming) *Mapping nature-based outdoor recreation opportunities considering dimensions of equity and justice: A case study in Greater Oslo, Norway, UNESCO Chair in Sustainable Development and Environmental Education, University of the Basque Country (UPV/EHU).*

RECREATION AREA DESTINATIONS WITHIN THE BUILT ZONE



DISTANCE TO:

- Green spaces
- Sport facility
- Park
- Cemetery
- Friområde
- Marka forest
- Lakes
- Rivers
- Fjord

Slide: Megan Nowell, NINA

Ecosystem condition at neighbourhood scale

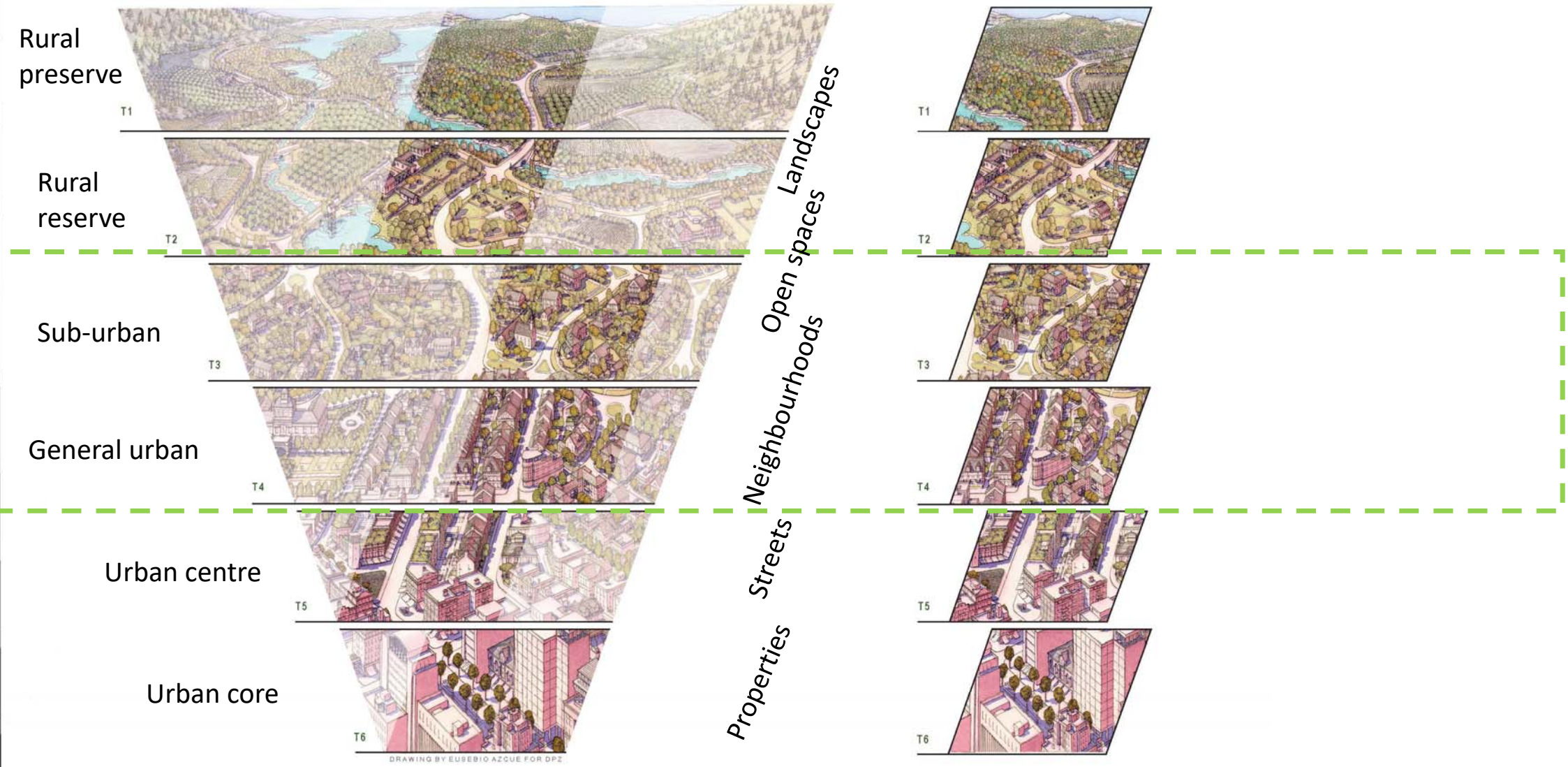
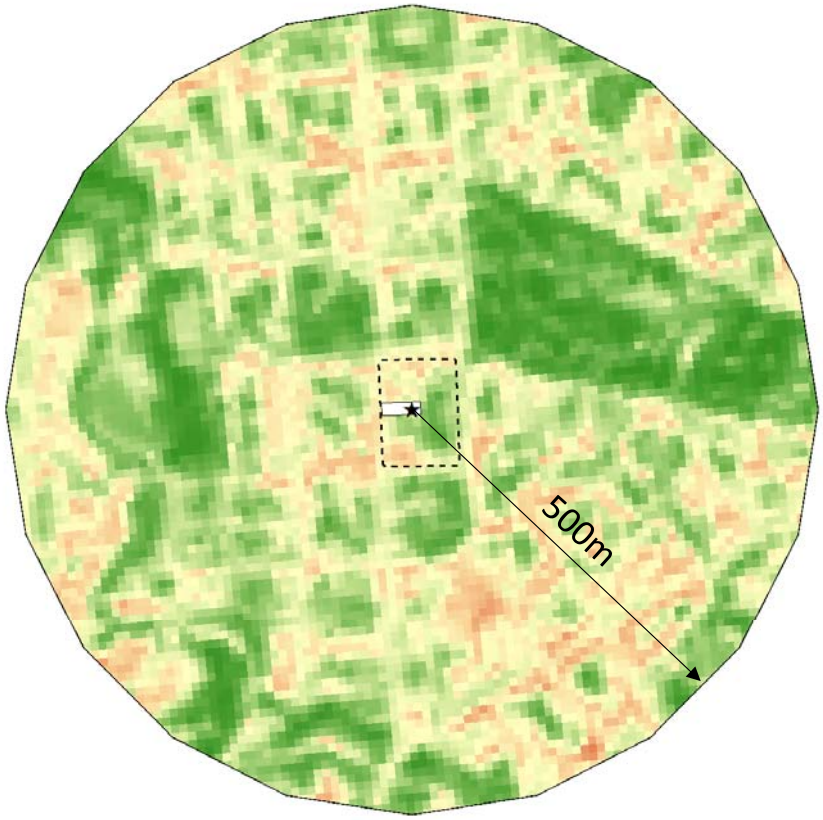
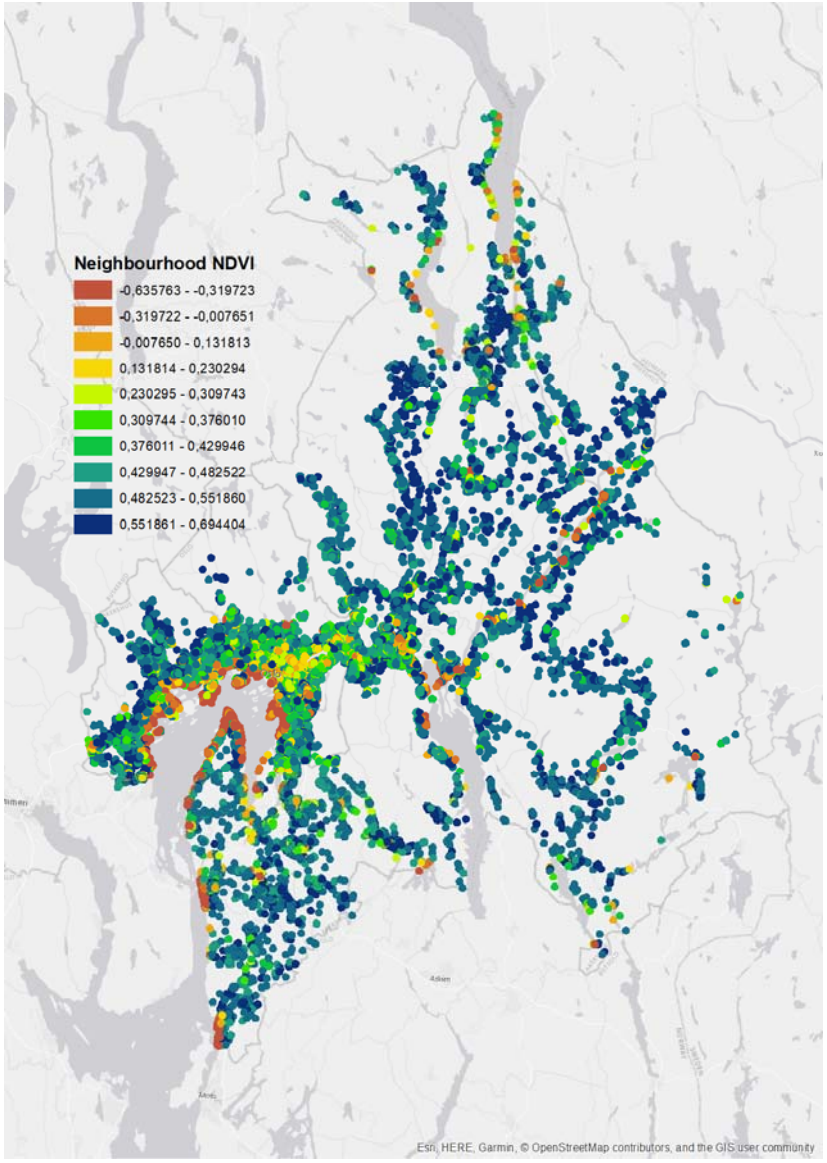


Illustration source: Duany Plater-Zyberk & Company. https://transect.org/

NEIGHBOURHOOD GREENNESS



Sentinel-2 Normalized difference vegetation index (NDVI)

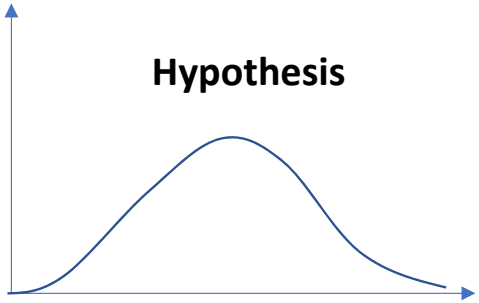


Slide: Megan Nowell, NINA

Tree canopy density (extent or condition?)

Structural diversity index (SDI) of public green spaces

Outdoor recreation preference



SDI: Voigt et al. (2014)

Table 2
Structural elements included in the mapping exercise of the green spaces in Oslo.

Biotic elements	Abiotic elements	Man-made elements	
Forest dominance	Fountain	Public transport access	Swimming area
Grass dominance	River/water course/stream	Sitting facility	Silence/tranquility area
Balanced forest/grass	Lake/pond	Grill/Picnic	Cultural/art element
Old/big tree	Varied terrain	Fishing area by the fjord	Urban agriculture area
Tree species diversity		Dog facility	High presence of people
Shrub		Playground	Low presence of people
Fruit tree		Walking/Cycle path	High intensity lighting
Flowerbed		Sport equipment	Low intensity lighting
Wild plants and animals		Bars/restaurant	

Table 3
Biotic, abiotic and man-made elements. Structural diversity index – SDI – across 5 categories of green spaces according to their size. Mean and 95% confidence interval.

GREEN SPACE SIZE	BIOTIC ELEMENTS Mean SDI	95%CI	ABIOTIC ELEMENTS Mean SDI	95%CI	MAN-MADE ELEMENTS Mean SDI	95%CI
Pocket (<0.1ha)	0.170	0.145 - 0.196	0.106	0.040 - 0.173	0.071	0.047 - 0.096
Pocket (<0.3ha)	0.205	0.184 - 0.226	0.129	0.083 - 0.175	0.083	0.069 - 0.097
Small (0.1-0.5ha)	0.208	0.185 - 0.232	0.163	0.110 - 0.216	0.105	0.086 - 0.124
Medium (0.5-10ha)	0.226	0.215 - 0.236	0.274	0.249 - 0.300	0.146	0.135 - 0.156
Big (>10ha)	0.326	0.285 - 0.368	0.531	0.456 - 0.605	0.255	0.211 - 0.299

Note: partially overlapping definitions of pocket green spaces are used for comparability with definitions in Oslo Municipality (2009) and Nordh and Østby (2013). Green spaces include parks, cementaries and unmanaged public open spaces.

Ecosystem condition at streetscape scale

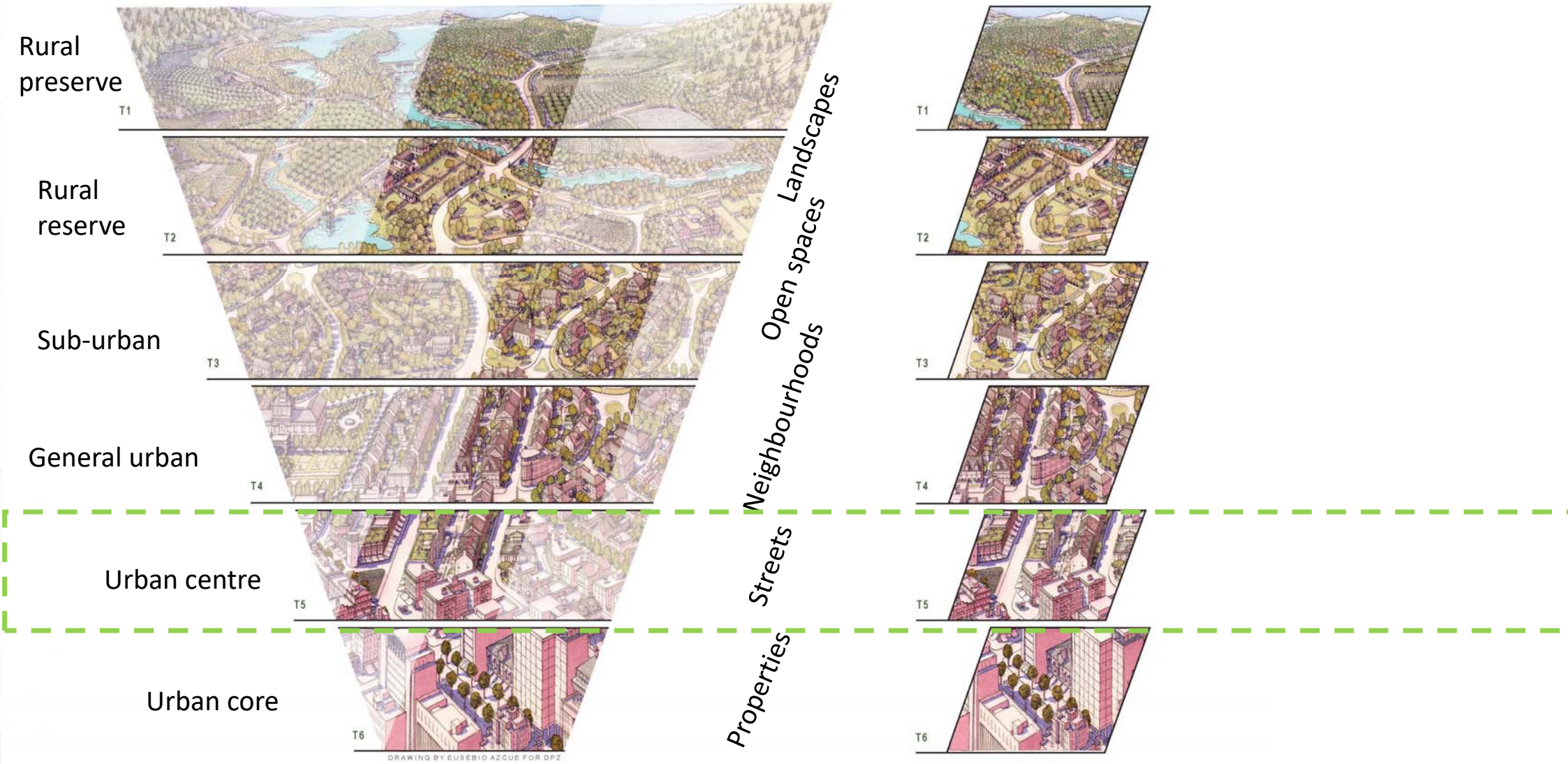
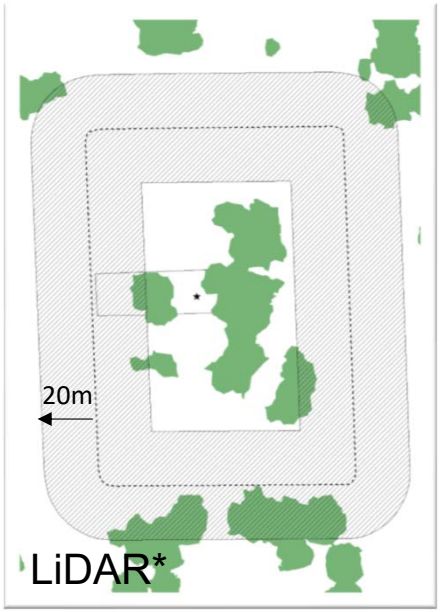
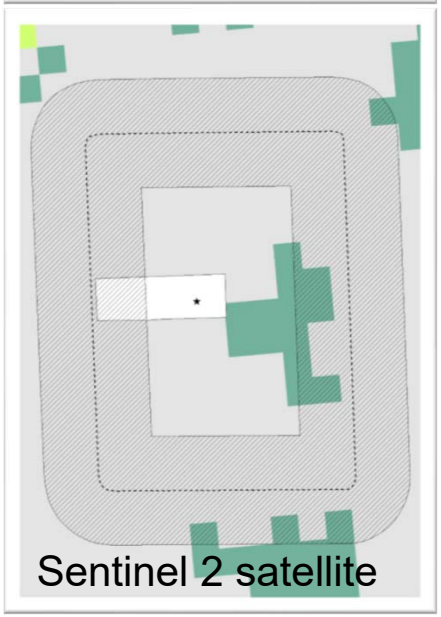


Illustration source: Duany Plater-Zyberk & Company. https://transect.org/





STREET SEGMENT

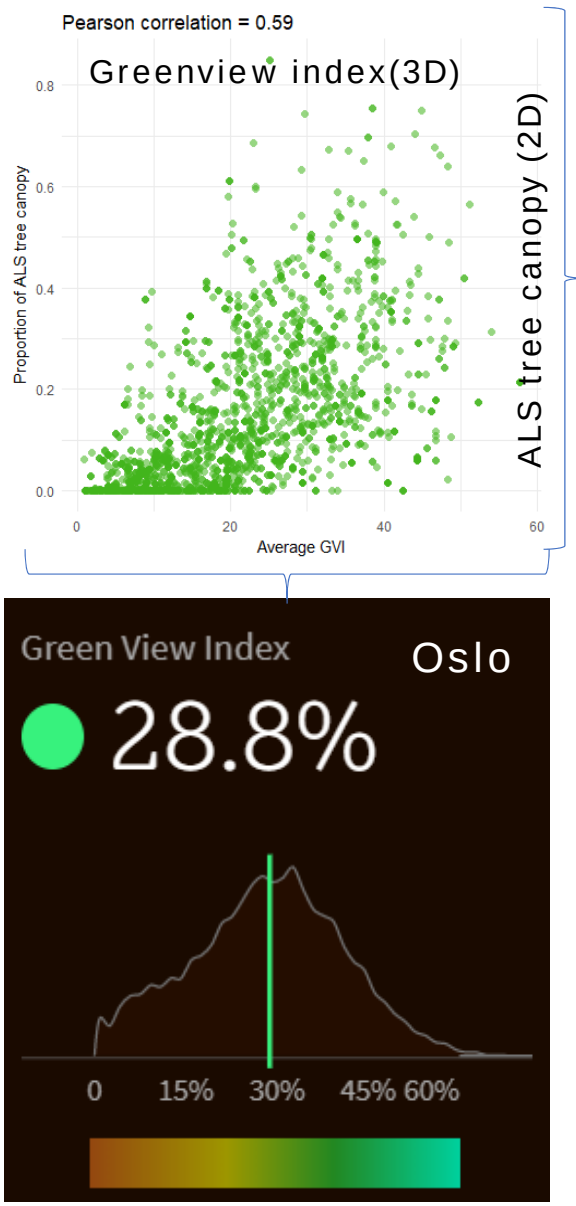
- Tree canopy density
- Green View Index*

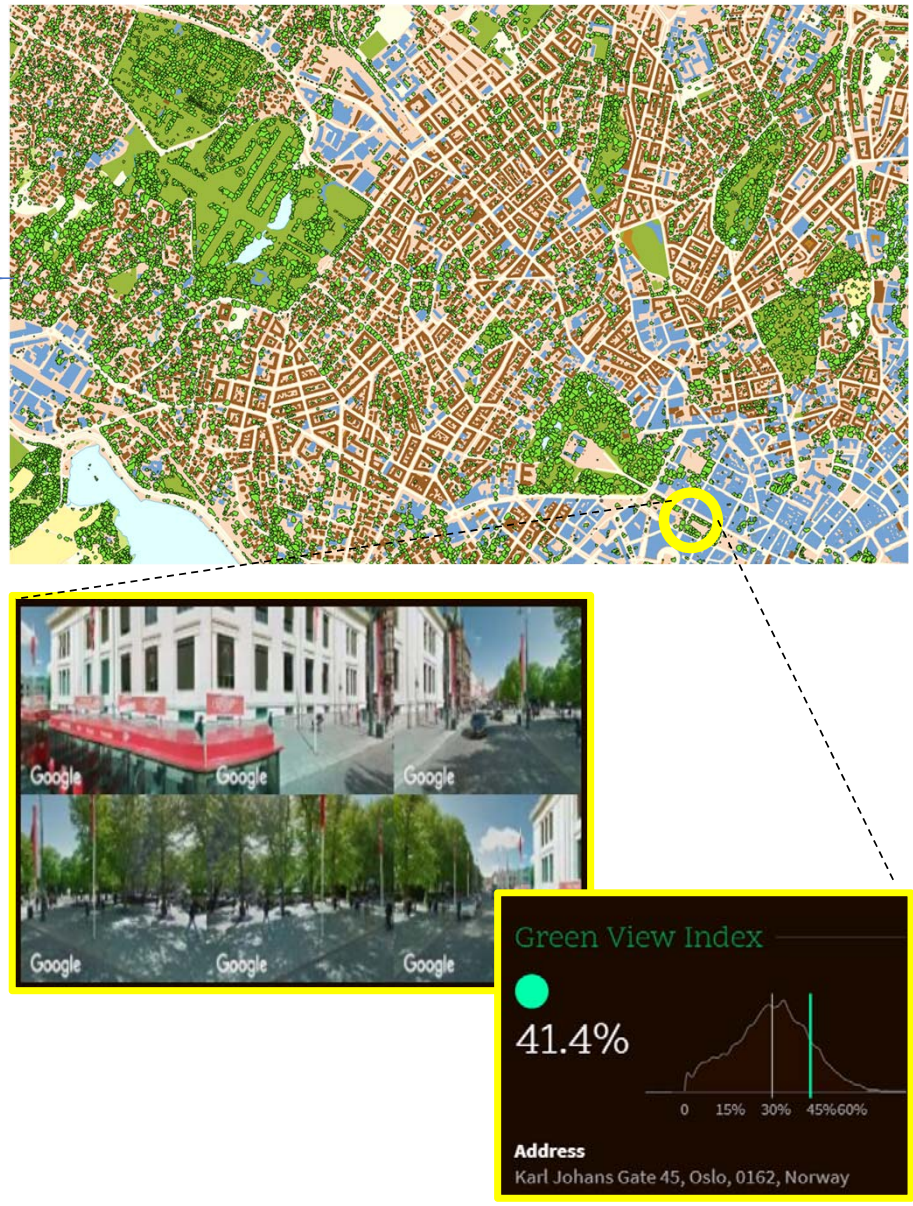
*Oslo only

http://senseable.mit.edu/treepedia/cities/oslo

Maps: Megan Nowell, NINA

Correlation remote sensing and human sensing?





Source: Greenview index. MIT Senseable City Lab

Ecosystem condition at plot scale

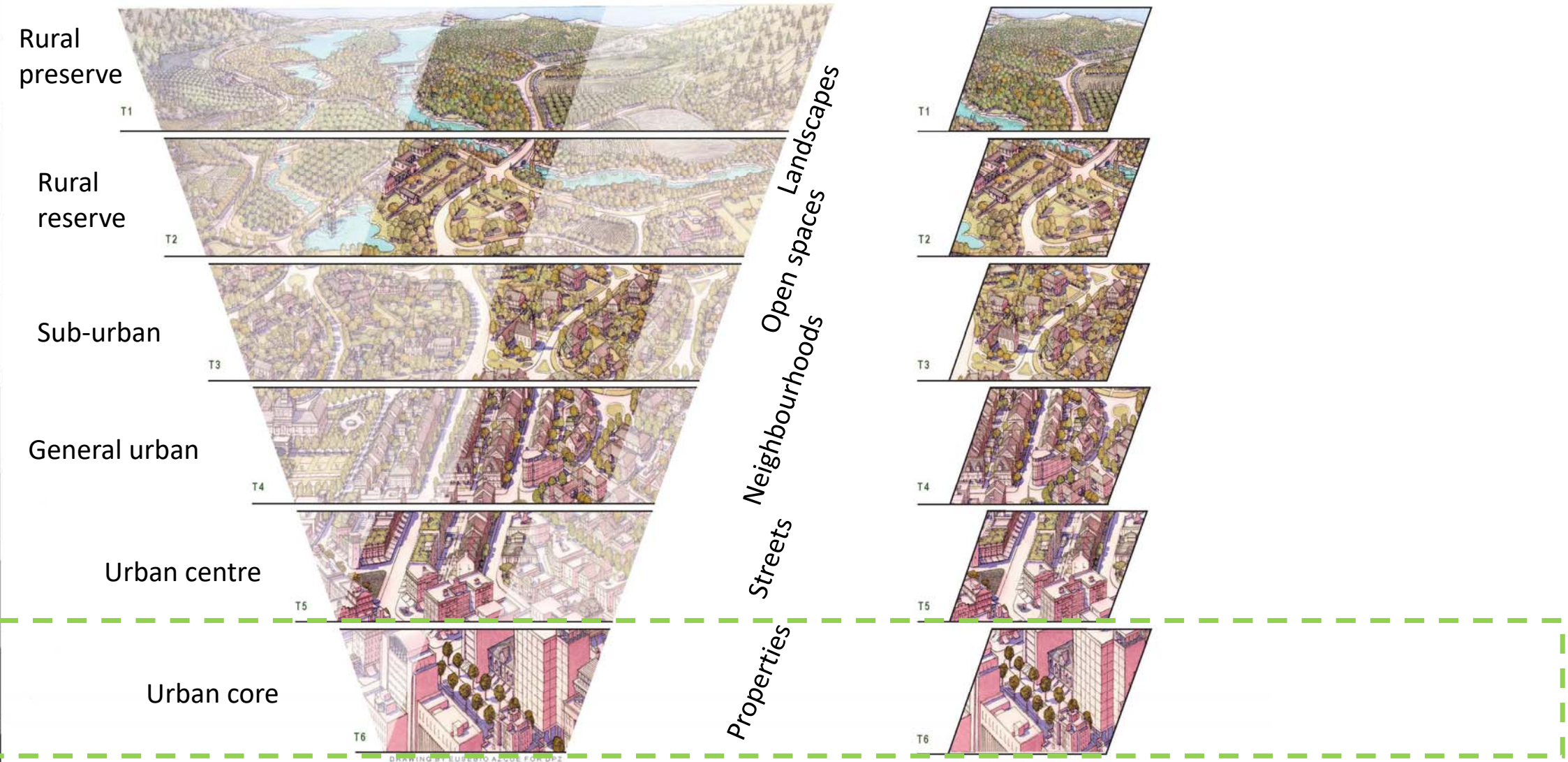
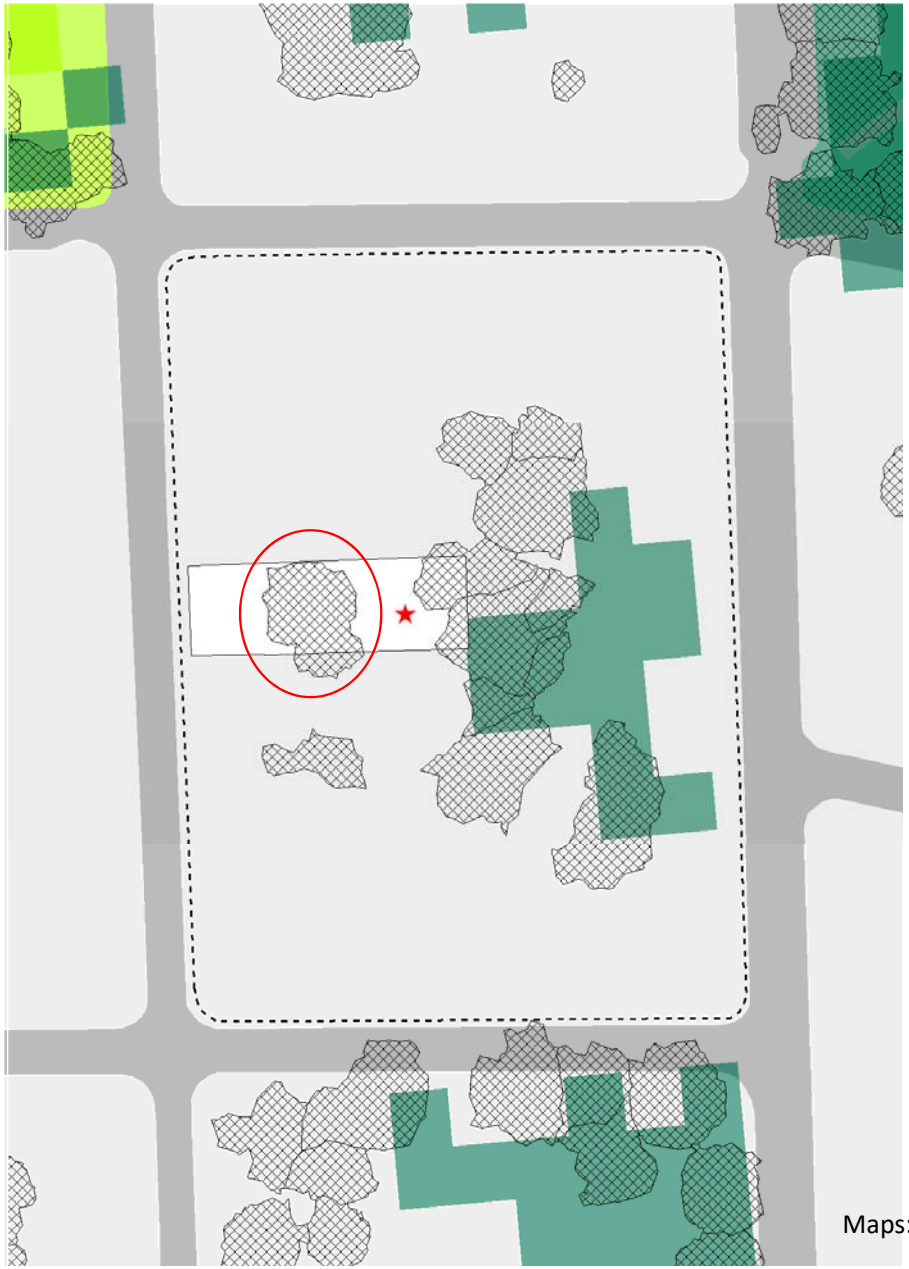


Illustration source: Duany Plater-Zyberk & Company. https://transect.org/

PLOT / PROPERTY

- Water edge?
- % Grass
- % Tree canopy



Maps: Megan Nowell, NINA

Built blue-green structures on developed land

Source ES icons: Future Cities Project, Oslo Municipality
Source BGF icons: BGF norm 2018, PBE, Oslo Municipality

Source: matrix own elaboration

			Ecosystem services referred to in the BGF norm								
		Physical indicator	Stormwater management	Biodiversity	Good city life - recreation, mental and physical health	Good city life - aethetics	Cleaning of water	Cleaning of air	Better sound environment	Urban agriculture	BGF values in the PBE 2018 norm
	Overall relative importance in BGF norm		1	1	1	1	0.5	0.5	0.5	0	
Icon	**Blue green surfaces and structures:**										
	GREEN TERRAIN	area	1	1	1	1	0	0	0	1	1
	GREEN ROOF 2-20cm	area	1	1	1	1	1	1	0	0	0.9
	GREEN ROOF 20-60cm	area	1	1	1	1	1	1	0	0	0.7
	GREEN ROOF >60cm	area	1	1	1	1	1	1	0	0	0.4
	GREEN WALL	area	1	1	0	1	0	0	0	0	0.4
	TERRAIN DEPRESSION	area	1	0	1	0	0	0	0	0	1
	RAINBED	area	1	1	0	1	1	0	0	0	4
	WADI	area	1	1	0	1	1	0	0	0	1
	PERMANENT WATER SURFACE	area	1	1	0	1	0	0	0	0	2
	PARTIALLY PERMEABLE SURFACES	area	1	0	1	0	0	0	0	0	0.3
	IMPERMEABLE SURFACE DRAINING TO RAINBED	area	1	0	0	0	0	0	0	0	0.2
	EXISTING TREES > 90cm dbh	number	1	1	1	1	0	1	1	0	25
	EXISTING TREES < 90cm dbh	number	1	1	1	1	0	1	1	0	12,5
	NEW TREES >10m height	number	1	1	1	1	0	1	1	0	10
	NEW TREES <10m height	number	1	1	1	1	0	1	1	0	5
	BUSHES	area	1	1	1	1	0	1	1	0	0.4
	STRENGTHEN BLUE GREEN STRUCTURE CONNECTIVITY	connections	1	1	1	0	0	0	0	0	0.05

Outline

1. Describing the urban ecosystem and urban recreation services
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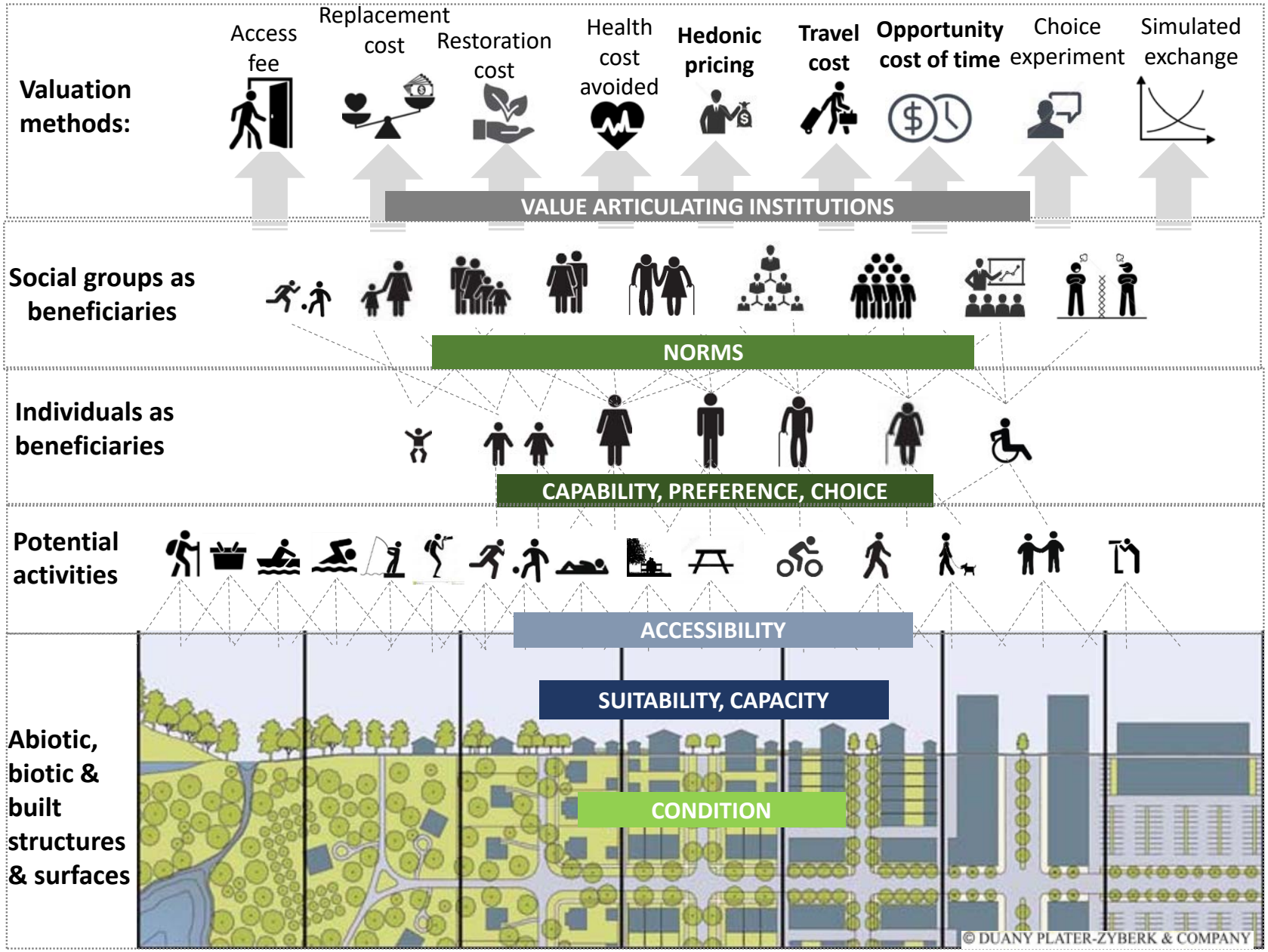
Institutional context of use accounts at municipal level

How closely are **use** accounts aligned with **beneficiaries** (as institutions, organised interests)?

Table 4.3.1 Biophysical ecosystem service use account 2013 for the Netherlands, with total biophysical use per economic user (ISIC)

Ecosystem service \ Economic users (ISIC)	Unit	A - Agriculture, forestry and fishing	B,C - Mining and manufacturing	D - Electricity	E - Water supply	F-H - Contruction, wholesale and transportation	I,R - Accommodation and food service, culture, sports and recreation	Other sectors	Export	Households	Government	Investments	Inventories	Environment (Global goods)	Total
Crop production	ktons	16,259													16,259
Fodder production	ktons	16,039													16,039
Wood production	1000 m3	1,085													1,085
Biomass production	ktons			360											360
Drinking water production	mln m3				413										413
Carbon sequestration in biomass	ktons													975	975
Pollination	ktons	534													534
Natural pest control	-	x													x
Erosion control	ktons soil	1,880	30	0	26	158	129	60		277	2,328				4,888
Air filtration	tons PM10									23,843					23,843
Protection against heavy rainfall	mln ltr in 1 hour	505,633	2,001	43	689	13,665	22,352	12,255		59,861	286,629				903,127
Nature recreation (hiking)	mln hikers									24,060					24,060
Nature tourism	1000 stays						12,916								12,916

Source: CBS and WUR (2018) **The SEEA EEA biophysical ecosystem service supply-use account for the Netherlands**



Alternative disaggregation of ecosystem service **use accounts** at local level?

city districts/neighbourhoods
public/private owners

high/low income households
households with children

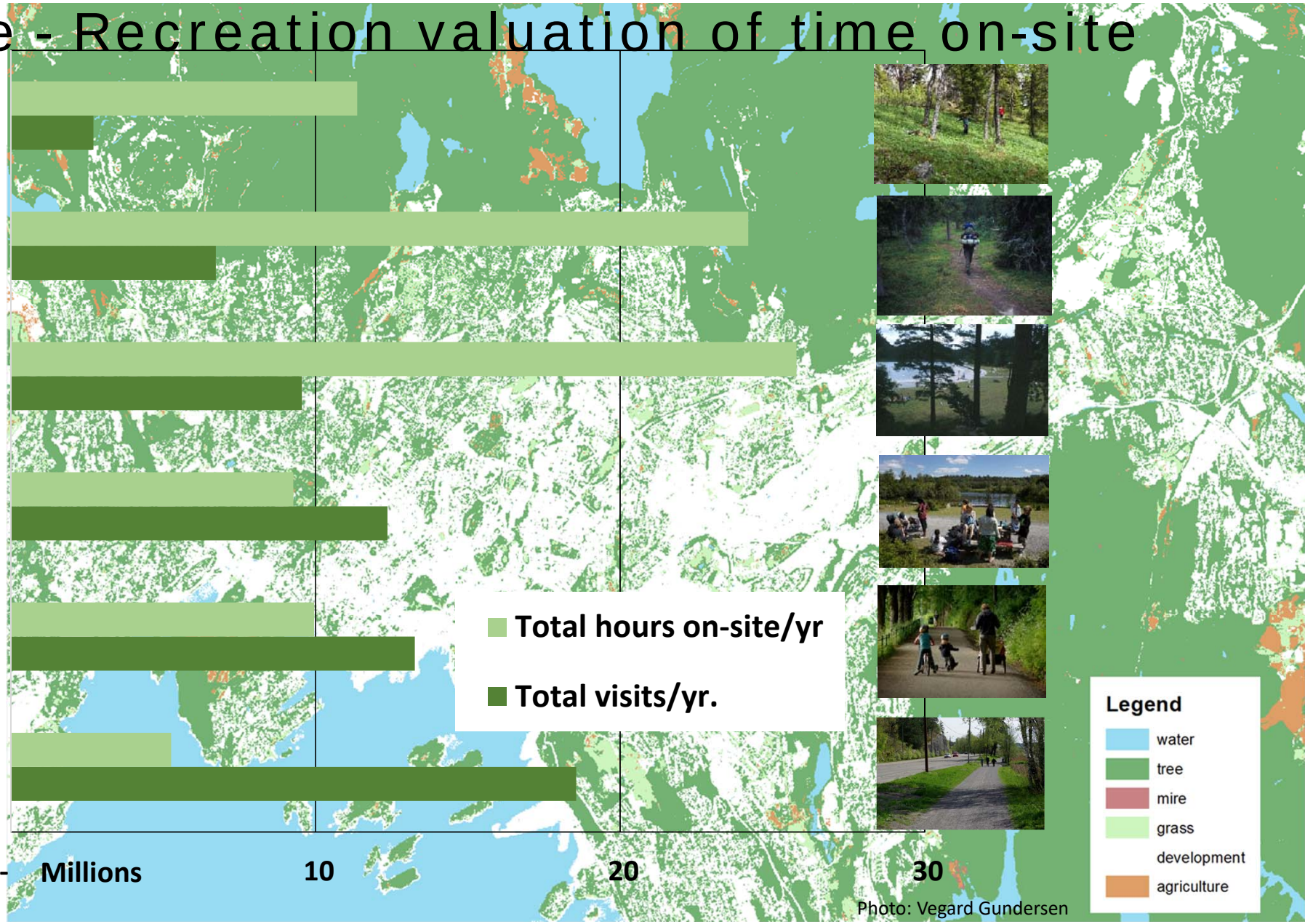
young/old

Special interest:
Hiking,walking dog, biking, skiing, boating

Source: adapted Barton (2016)

Illustration transect: Duany Plater-Zyberk & Company.https://transect.org/ Icons Shutterstock.

Alternative - Recreation valuation of time on-site



Source: Barton in Cole et al. (2018)

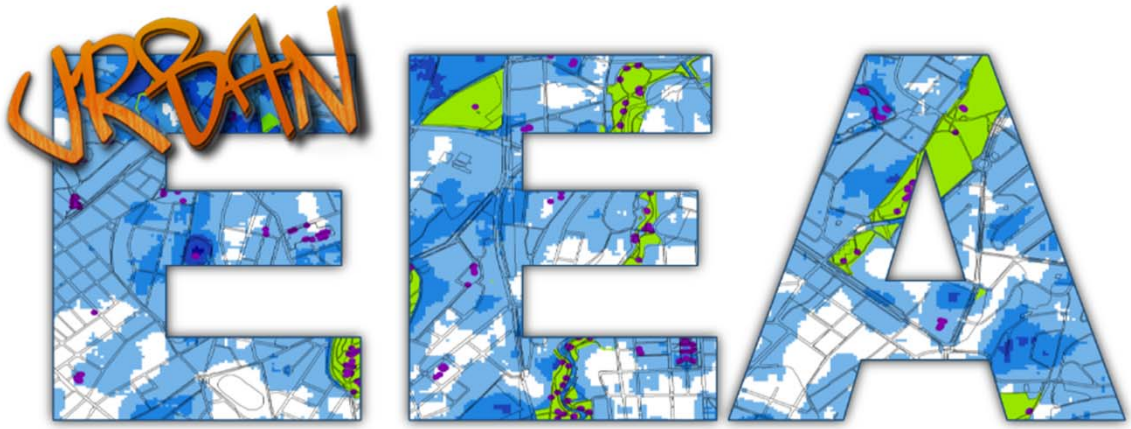
Data: OSLOpenNESS web-survey 2016

Photo: Vegard Gundersen

Final thoughts & questions

1. Mapping of **ecosystem condition** is key to valuation of urban recreation and amenities
2. Valuation methods depend on different **political constituencies** within the general sector **«households»** >> specify use accounts?
3. Recreation and amenity values are **tripple counted**, but each are useful for different aspects of **municipal planning**
4. Further work on valuation of **time on-site** needed
5. Urban ecosystem accounts as **parallel thematic accounts** because of issues with *extent-condtion confounding* and *plural, diverse double counted values*?

go raibh maith agat!



Forskningsrådet

Statistics Norway
Statistisk sentralbyrå

NINA
Norwegian Institute for Nature Research

AHO
Arkitektur- og designhøgskolen i Oslo
The Oslo School of Architecture and Design

References

Barton, D. N. (2016). Monetary valuation of urban ecosystem services-operationalization or tragedy of well-intentioned valuation? An illustrated example. Ecosystem services : concepts, methodologies and instruments for research and applied use / Sergi Nuss-Girona, Mita Castañer (eds.). – Girona : Documenta Universitaria, 2015. -- p. ; cm. – (Quaderns de medi ambient ; 6) ISBN 978-84-9984-308-7.

CBS and WUR (2018) The SEEA EEA biophysical ecosystem service supply-use account for the Netherlands

Cole, S., et al. (2018). Nordic urban nature recreation. How to practically integrate economic values in decision-making. TemaNord 2018:529.

Heyman, A. V., et al. (2017). Attributes of location and housing prices in Oslo: A monetary valuation with spatial configuration in mind. Proceedings of the 11th Space Syntax Symposium 68.61-68.15.

Heyman, A., et al. (2018). "A revealed preference study of Oslo apartment transactions (submitted)." Land.

Massoni, E. S., et al. (2018). "Bigger, more diverse and better? Mapping structural diversity and its recreational value in urban green spaces." Ecosystem Services 31: 502-516.

Suarez, M. (forthcoming) *Mapping nature-based outdoor recreation opportunities considering dimensions of equity and justice: A case study in Greater Oslo, Norway, UNESCO Chair in Sustainable Development and Environmental Education, University of the Basque Country (UPV/EHU).*

Vallecillo S, La Notte A, Polce C, Zulian G, Alexandris N, Ferrini S, Maes J. 2018. Ecosystem services accounting: Part I - Outdoor recreation and crop pollination, EUR 29024 EN; Publications Office of the European Union, Luxembourg, doi:10.2760/619793, JRC110321.

Voigt, A., et al. (2014). "Structural diversity: A multi-dimensional approach to assess recreational services in urban parks. ." Ambio 43(4): 480-491.