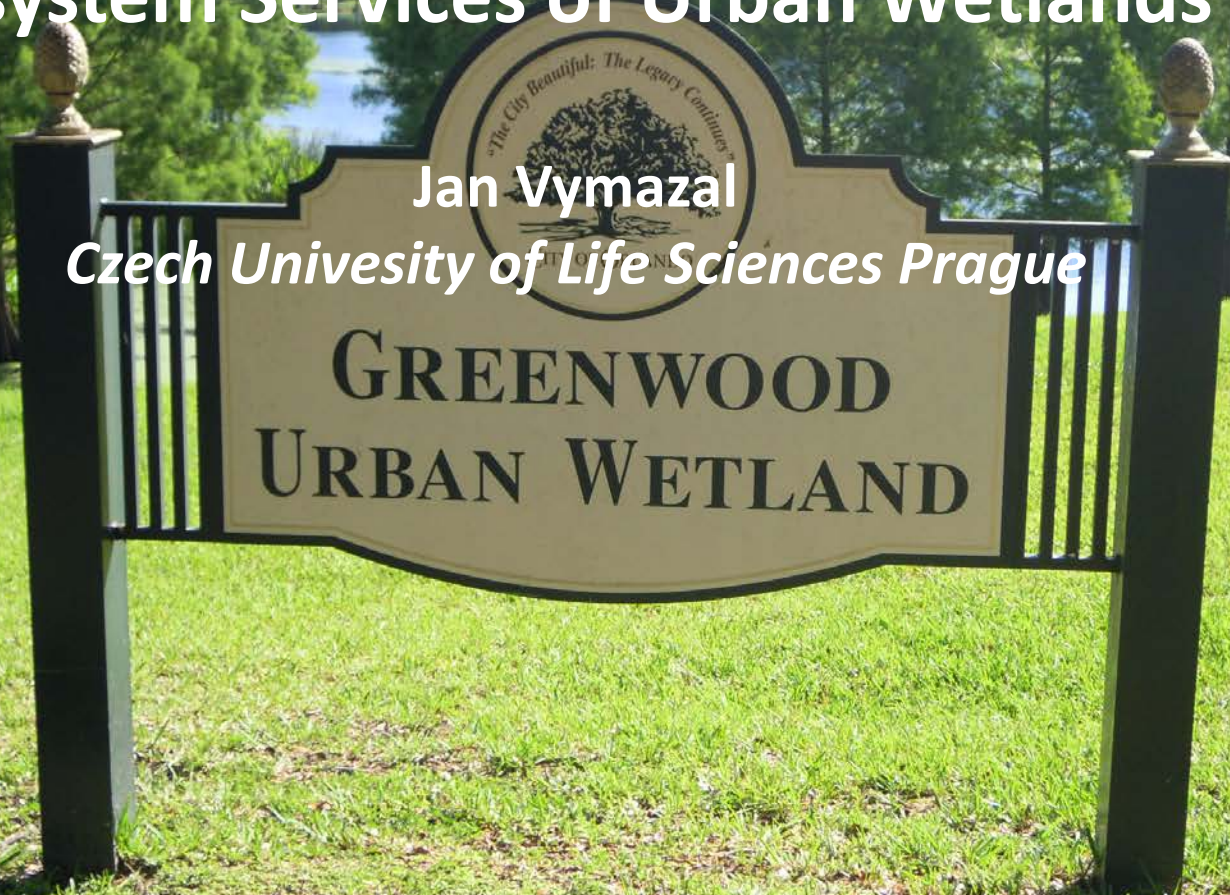


Ecosystem Services of Urban Wetlands

Jan Vymazal

Czech University of Life Sciences Prague

A large, ornate sign for the Greenwood Urban Wetland. The sign is light-colored with a dark border and is supported by two dark posts topped with decorative finials. It features a central emblem of a tree within a circular frame, surrounded by the text "The City Beautiful: The Legacy Continues". Below the emblem, the words "GREENWOOD" and "URBAN WETLAND" are written in large, bold, serif capital letters. The sign is set in a grassy field with a body of water and trees in the background.

GREENWOOD
URBAN WETLAND

Urban wetlands are wetlands which are found in and around cities or their suburbs.

Ramsar Convention

Wetland ecosystem services represent the benefits human populations derive, directly or indirectly, from wetlands.

Costanza et al., 1997, Nature 387: 253-260

- Food Production
- Water storage
- Wood and Fiber
- Fuel

Provisioning Services

- Nutrient Cycling
- Soil Formation
- Primary Production
- Habitat Provision

Supporting Services

- Spiritual
- Aesthetic
- Educational
- Recreational

Cultural Services

- Climate Regulation
- Flood Regulation
- Water Purification

Regulating Services

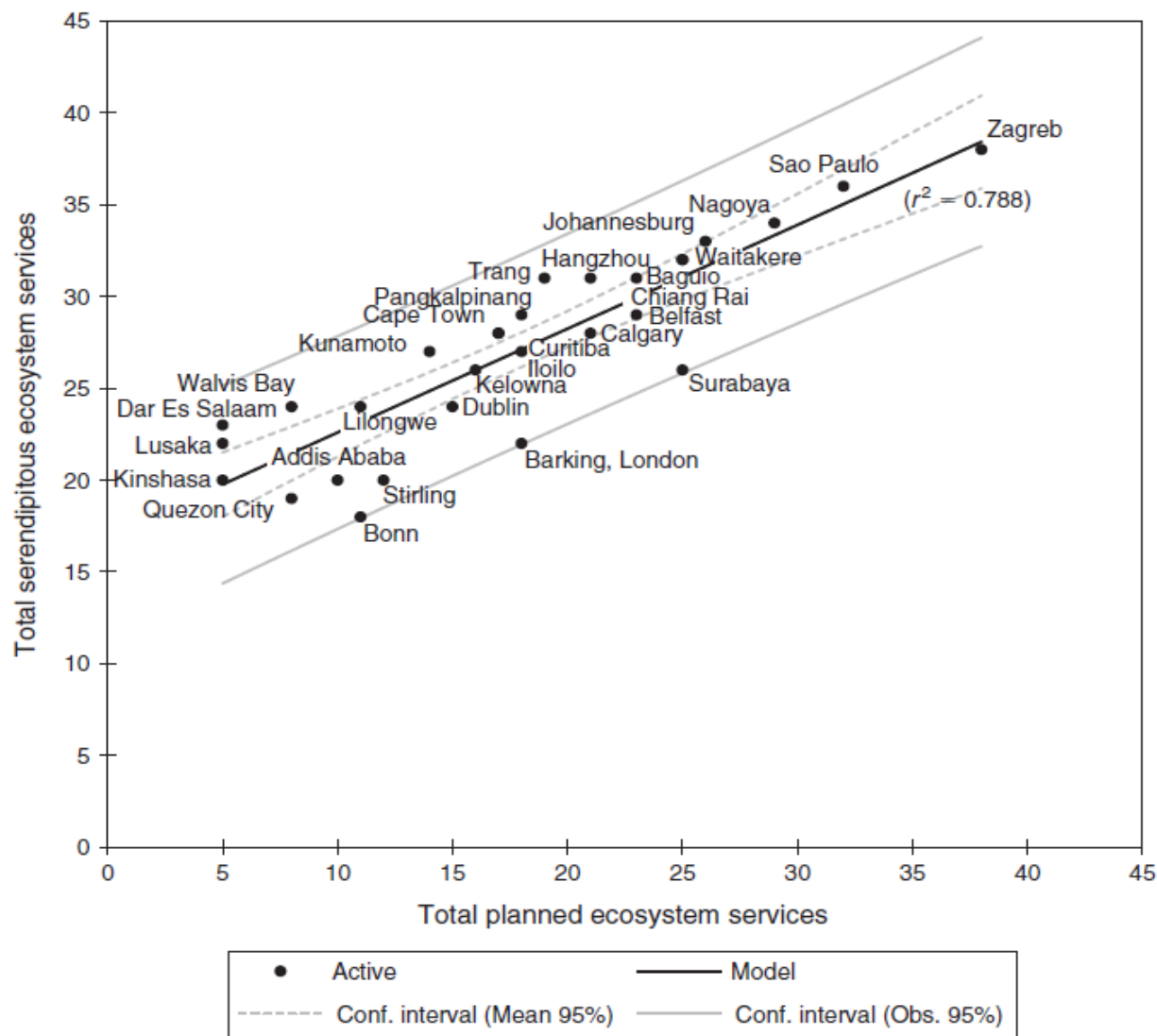


Fig. 3. Linear regression analysis of total planned and serendipitous ecosystem service for each case study.

McInnes, R.J., 2014. Recognising wetland ecosystem services within urban case studies. *Marine and Freshwater Research*, 65(7): 575-588.

Table 3. Frequency of occurrence of planned and serendipitous ecosystem services

Type: P = provisioning, R = regulating, C = cultural, and S = supporting

Type	Planned service	n	%	Type	Serendipitous service	n	%
C	Educational activities and opportunities	26	89.66	R	Local climate regulation	29	100.00
S	Supports a variety of all life forms	25	86.21	R	Acts as a source for pollination	29	100.00
C	Picnics, outings, touring	24	82.76	C	Educational activities and opportunities	29	100.00
P	Sustenance for humans	22	75.86	S	Supports a variety of all life forms	29	100.00
R	Water purification/waste treatment	21	72.41	S	Storage, recycling, processing of nutrients	29	100.00
C	Nature observation/tourism	21	72.41	R	Soil, sediment and nutrient retention	28	96.55
C	Important knowledge and research	21	72.41	R	Water purification/waste treatment	28	96.55
R	Soil, sediment and nutrient retention	19	65.52	C	Aesthetic and 'sense of place' values	28	96.55
R	Flood control, flood storage	19	65.52	S	Sediment retention	28	96.55
C	Aesthetic and 'sense of place' values	18	62.07	R	Flood control, flood storage	27	93.10
R	Local climate regulation	17	58.62	S	Carbon storage/sequestration	27	93.10
C	Recreational hunting and fishing	17	58.62	R	Regulation of climatic processes	26	89.66
R	Shoreline, riverbank stabilisation	16	55.17	C	Picnics, outings, touring	26	89.66
C	Long-term monitoring site	16	55.17	P	Sustenance for humans	25	86.21
R	Water for agriculture and industry	14	48.28	S	Accumulation of organic matter	25	86.21
S	Sediment retention	14	48.28	C	Recreational hunting and fishing	24	82.76
P	Timber	13	44.83	C	Nature observation/tourism	24	82.76
R	Regulation of climatic processes	13	44.83	C	Important knowledge and research	24	82.76
C	Contemporary cultural significance	13	44.83	R	Water for agriculture and industry	23	79.31
P	Drinking water for humans/livestock	12	41.38	C	Inspiration	23	79.31
C	Water sports and activities	12	41.38	C	Long-term monitoring site	22	75.86
C	Inspiration	12	41.38	R	Shoreline, river bank stabilisation	21	72.41
C	Cultural heritage	12	41.38	P	Drinking water for humans/livestock	20	68.97
P	Water for irrigated agriculture	10	34.48	P	Timber	18	62.07
P	Fuel wood	10	34.48	C	Water sports and activities	18	62.07
P	Livestock fodder	9	31.03	P	Water for irrigated agriculture	17	58.62
P	Other	9	31.03	P	Livestock fodder	16	55.17
C	Major scientific study site	9	31.03	P	Fuel wood	15	51.72
S	Storage, recycling, processing of nutrients	9	31.03	C	Contemporary cultural significance	15	51.72
R	Groundwater recharge and discharge	8	27.59	C	Cultural heritage	13	44.83
S	Carbon storage/sequestration	8	27.59	P	Other	12	41.38
S	Accumulation of organic matter	7	24.14	C	Major scientific study site	11	37.93
C	Spiritual and religious values	6	20.69	R	Groundwater recharge and discharge	8	27.59
P	Reeds and fibre	5	17.24	P	Ornamental species (live and dead)	7	24.14
R	Acts as a source for pollination	5	17.24	C	Spiritual and religious values	7	24.14
P	Medicinal products	4	13.79	P	Reeds and fibre	6	20.69
P	Genes for tolerance to certain conditions	4	13.79	P	Medicinal products	5	17.24
P	Ornamental species (live and dead)	4	13.79	P	Genes for tolerance to certain conditions	5	17.24
P	Water for industry	3	10.34	C	'Type location' for a taxon	4	13.79
C	'Type location' for a taxon	3	10.34	P	Water for industry	3	10.34
P	Genes for resistance to plant pathogens	2	6.90	P	Peat	3	10.34
R	Support of predators of agricultural pests	2	6.90	P	Genes for resistance to plant pathogens	2	6.90
P	Water for energy production	1	3.45	R	Support of predators of agricultural pests	2	6.90
P	Peat	0	0.00	P	Water for energy production	1	3.45
P	Extraction of material from biota	0	0.00	P	Extraction of material from biota	0	0.00

Food production



Ricefields, southern Taiwan

Ricefields, Valencia, Spain





Fish harvesting in fishponds, Czech Republic



Constructed wetland for stormwater runoff retention and water reuse, Perth, Australia



Constructed wetland for stormwater runoff storage and water reuse

Perth, Australia



Duke University campus, runoff treatment/birdwatching, Durham, North Carolina





it, Hangzhou, China

**Plumpton Park, Western Sydney, Australia,
stormwater treatment/reuse**



Porthsmouth, UK, urban drainage/treatment







Parking lot runoff treatment, Charleston, South Carolina, USA

**Golfcourse, stormwater water treatment/irrigation, Charleston, South
Carolina, USA**



Shenzhen, China stormwater runoff/recreation



Beijing Olympic Park, stormwater/lake water treatment/recreation





Floodplain as protection area



Flood prevention



Ghent, Belgium – River Scheldt (during high tide water rises by up to 4 meters)



Kaoshiung, Taiwan, educational wetland





洲仔重要濕地(國家級)

Jhouzai Important Wetland (Wetland of National Importance)

有關洲仔重要濕地(國家級)

本區域為國家級重要濕地(紅色範圍處)，為確保濕地天然滯洪功能，維護生物多樣性以及促進濕地生態保育及明智利用，非經主管機關許可，禁止從事下列行為：

- ① 擅自抽取、引取、截斷或排放濕地水資源及改變原有水資源系統。
- ② 挖掘、取土、埋填、堆置或變更濕地地形地貌。
- ③ 破壞生物迴游通道及野生動植物繁殖區或棲息環境。
- ④ 於重要濕地或其上游、周邊水域投放化學物品、排放或傾倒污(廢)水、廢棄物或其他足以降低濕地生態功能之污染物。
- ⑤ 騷擾、毒害、獵捕、虐待、宰殺野生動物。
- ⑥ 未經目的事業主管機關許可之砍伐、採集、放生、引入、獵捕、獵捕、獵殺生物資源。



面積：9公頃
行政區：高雄市長官區
地址：高雄市長官區
圖例：洲仔重要濕地 Jhouzai Important Wetland

About Jhouzai Important Wetland (Wetland of National Importance)

This region is the Wetland of National Importance (red zone). To ensure the natural flood control and related functions of the wetland in order to maintain biodiversity, and promote wetland ecological conservation and wise use, the following acts are banned unless with the competent government authorities' permit.

- ① Willfully pumping, drawing, cutting off or discharging the wetland's water resource and altering the initial water resource system.
- ② Digging, soil excavating, filling, stockpiling or altering the wetland's terrain and topography.
- ③ Sabotaging biological organisms' migratory paths and wildlife's mating areas or habitat environment.
- ④ Discharging chemicals, discharging or dumping wastewater, waste or other pollutants in the Wetland of Importance, their upstream and surrounding water areas that is sufficient in undermining the wetland's ecological function.
- ⑤ Disturbing, poisoning, hunting, abusing, or killing wildlife.
- ⑥ Logging, gathering, setting free captured animal, introducing, fishing, hunting for biological resources without permission by competent government authorities holding the purview of the industry.



嚴禁擅自抽取、引取、截斷或排放濕地水資源
No pumping, drawing, cutting off or discharging the wetland's water resource.



嚴禁破壞迴游通道及野生動植物繁殖區
No sabotaging biological organisms' migratory paths or wildlife's mating areas.



嚴禁未經目的事業主管機關許可之獵捕
No hunting without permission.



嚴禁未經目的事業主管機關許可之砍伐、採集
No logging or gathering without permission.



嚴禁挖掘、變更濕地地形
No digging or altering the wetland's terrain and topography.



禁止虐待、宰殺野生動物
No abusing or killing wildlife.



禁止獵捕野生動物
No hunting wildlife.



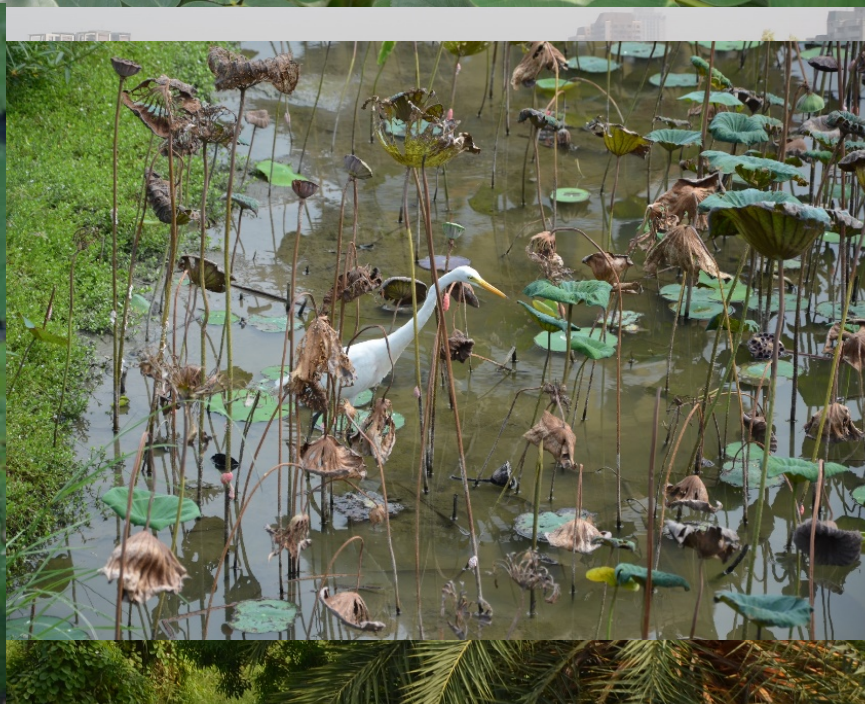
嚴禁傾倒污(廢)水
No discharging waste water.



國家重要濕地
保育計畫網站
Taiwan's Wetland



內政部 Ministry of the Interior, Republic of China



Nature Reserve Tamsui District near Taipei, Taiwan
(education/recreation)





Fredriksborg, Norway (recreation)





University of Life Sciences, Aas, Norway



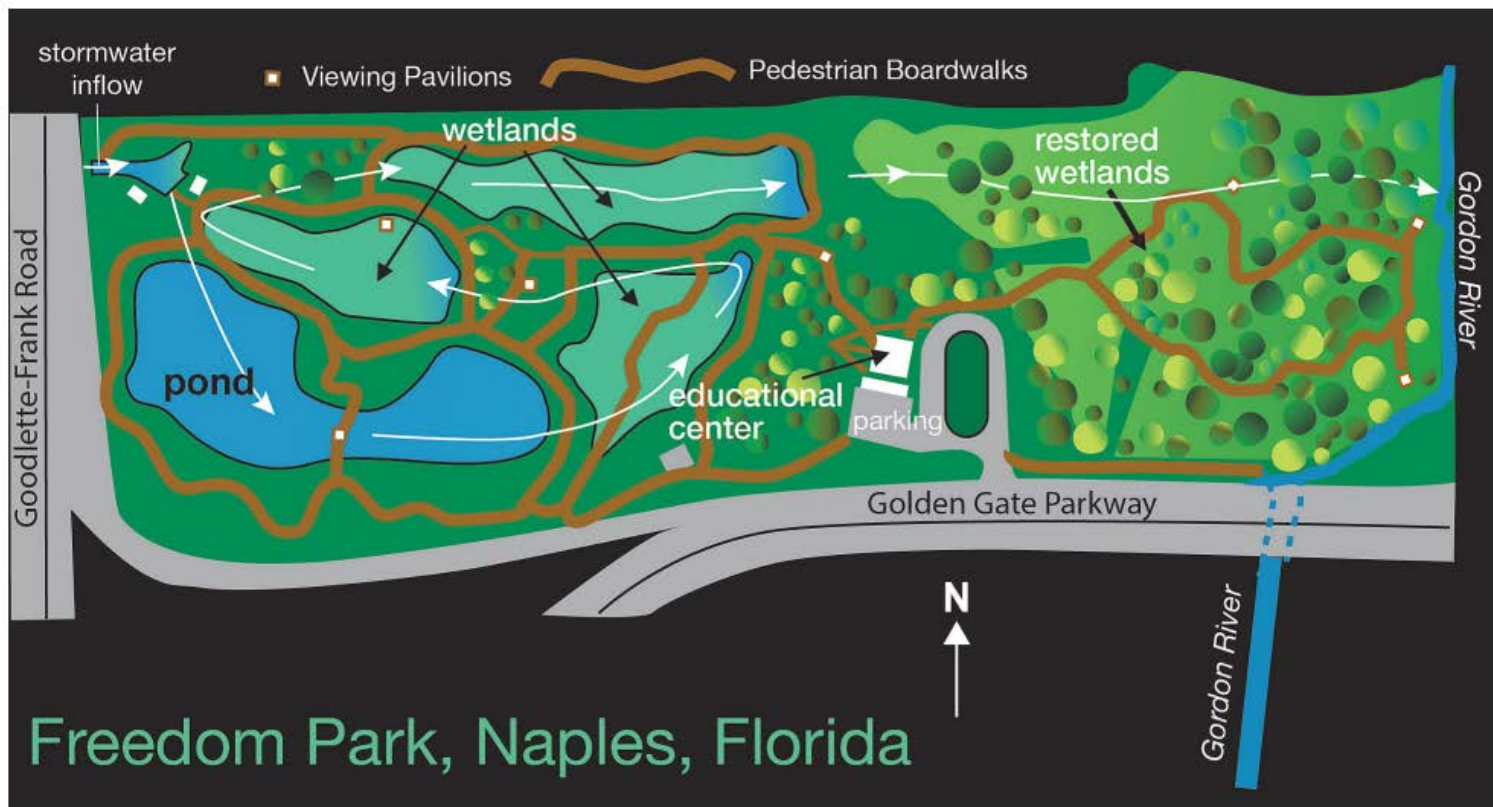


Mall of the World wetland, Guangzhou, China



**Freedom Park, Naples,
Florida, USA
(Mitsch et al., 2023)**

**Stormwater treatment
Birdwatching
Education
Recreation**





華江雁鴨自然公園

Huajiang Wild Duck Nature Park



Between Taipei City and New Taipei City





Guandu Nature Park, Taiwan







Overall view of the Guandu Nature Park



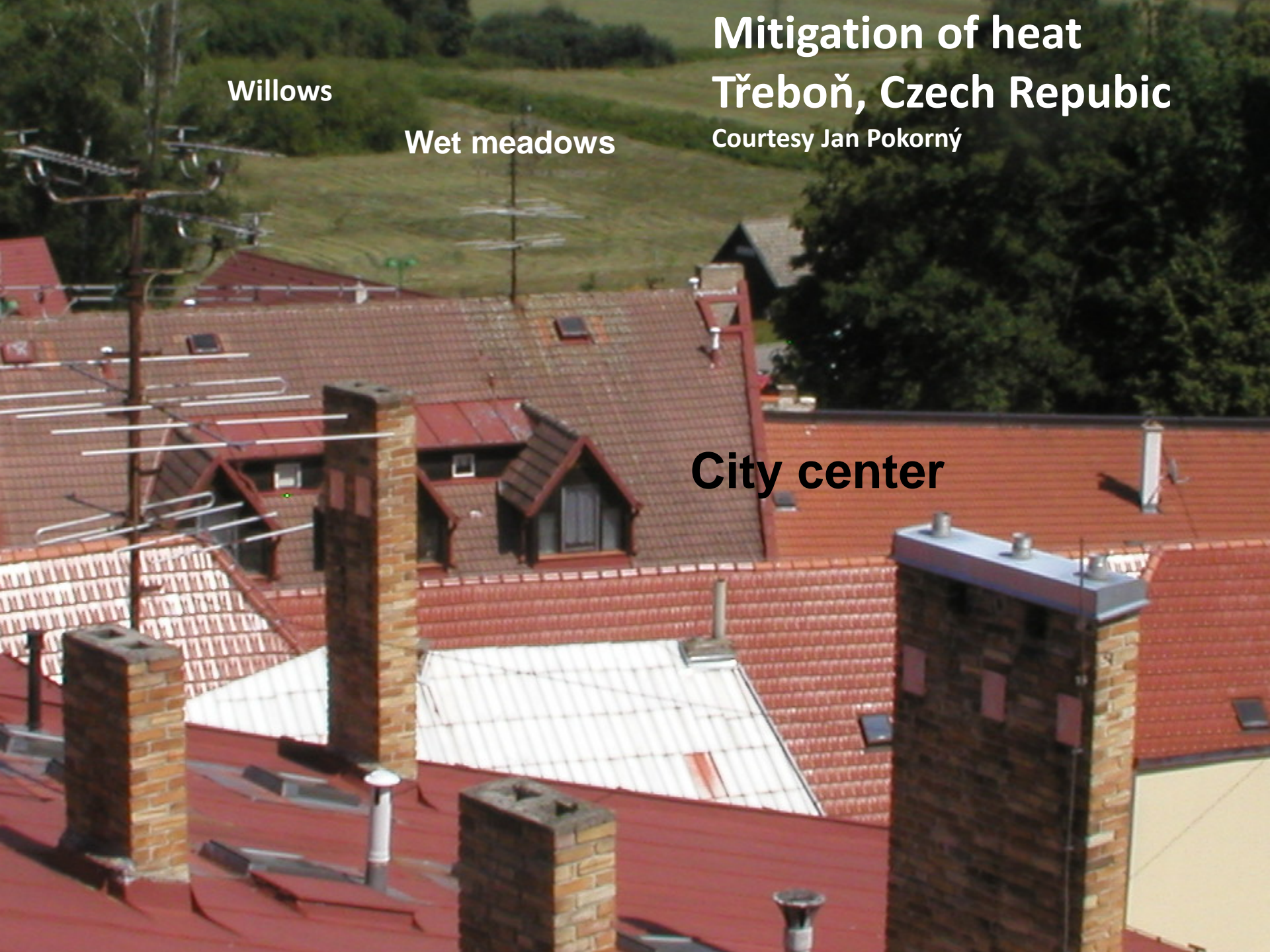
Mitigation of heat Třeboň, Czech Republic

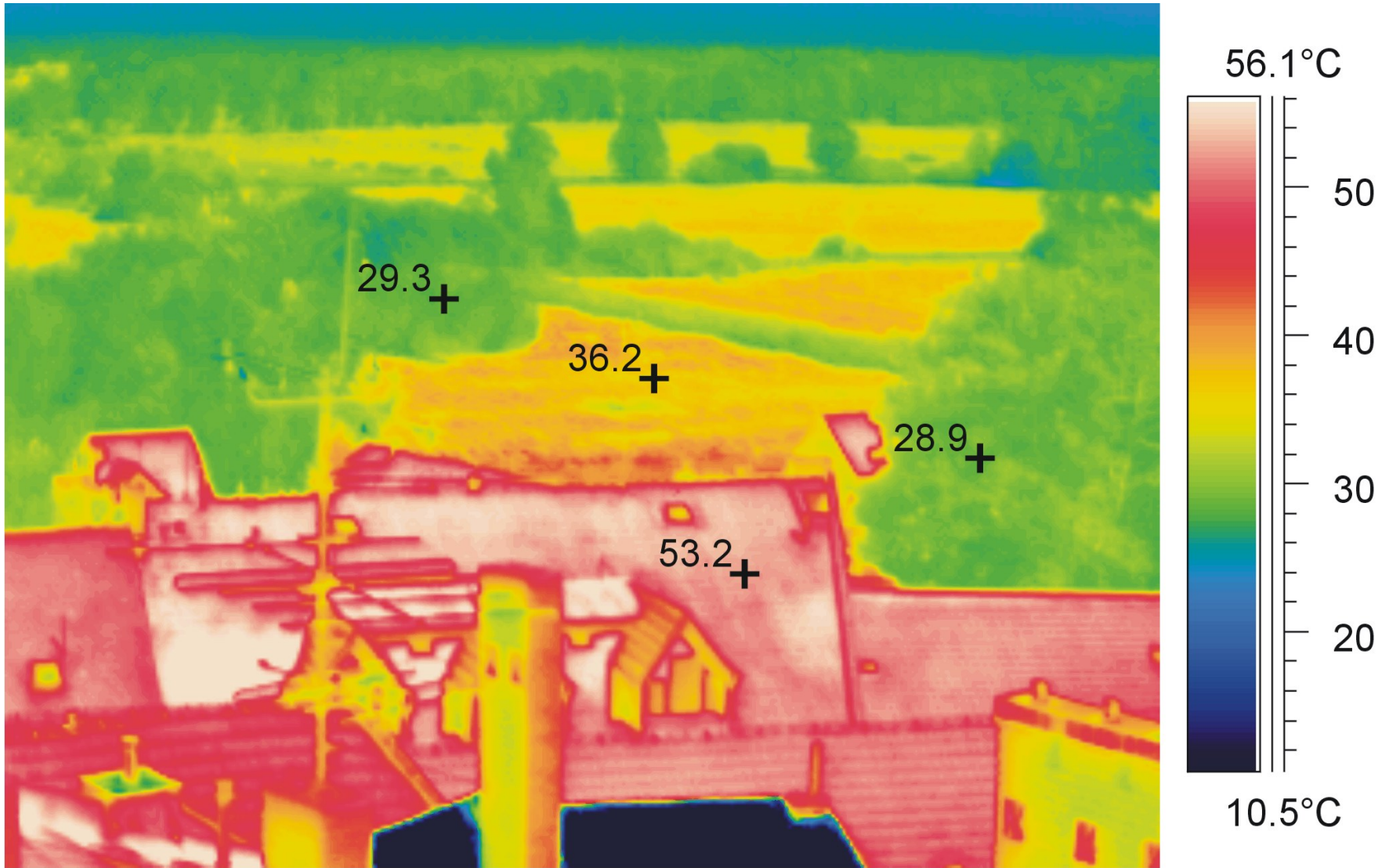
Courtesy Jan Pokorný

Willows

Wet meadows

City center





Wetlands for Water Quality

**Green roof, Likos Slavkov,
Czech Republic**



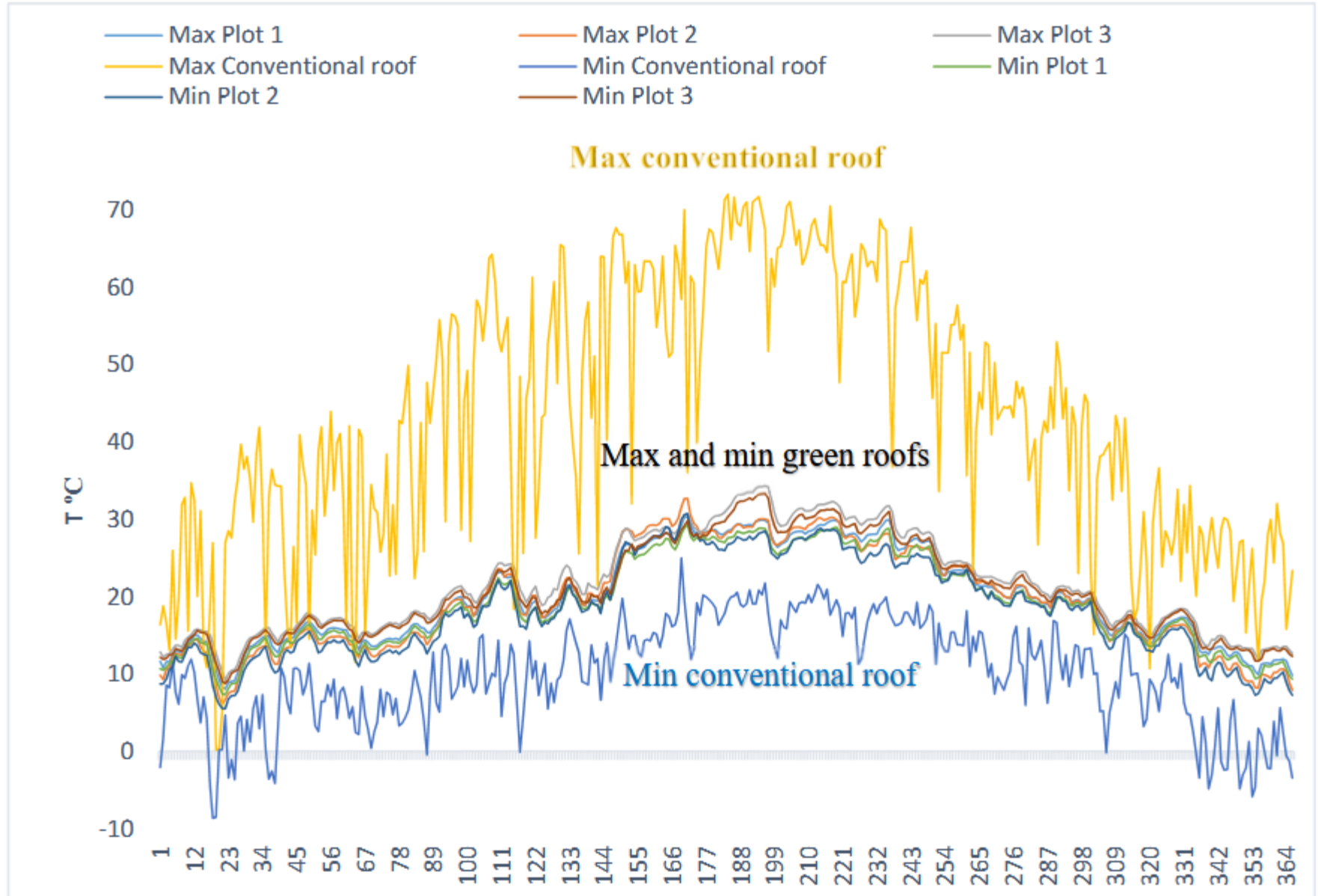


Figure 10. Maximum and Minimum Daily Temperature Differences between the Conventional Roof and Green Roof, 2016.



Sand Creek, North Carolina

**Stormwater runoff
discharge from the Duke
University campus**

**Restoration project aimed
at biodiversity and water
quality improvement**



Spring 2004 before restoration started



**Sediment
accumulation**



Deep streambed

Spring 2005
Streambed cleaning and
creation of various levels for
flooding

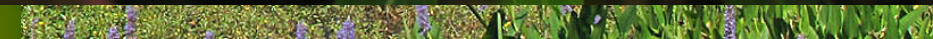






**Water reservoir at the
end of restored
stream**





September 2010

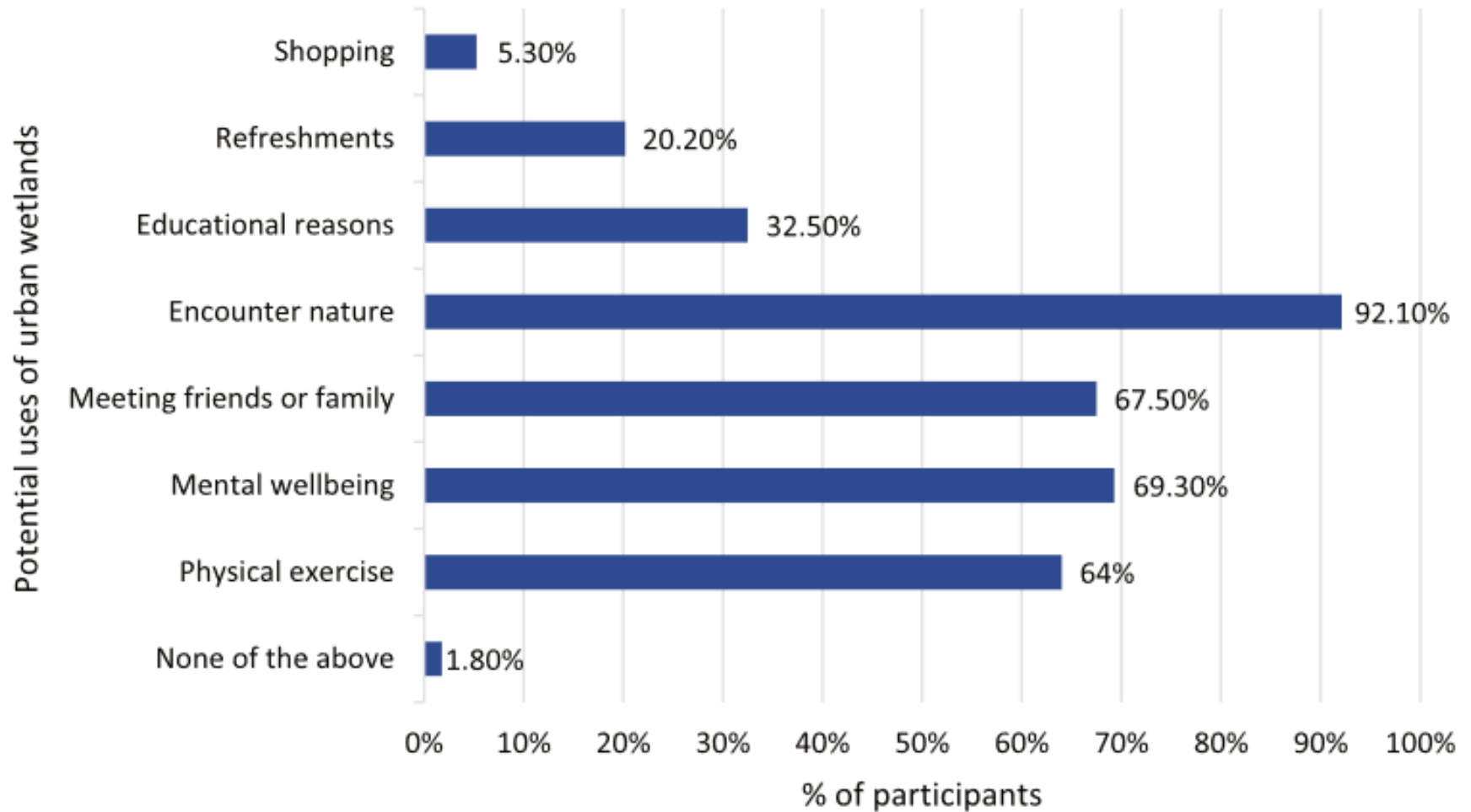




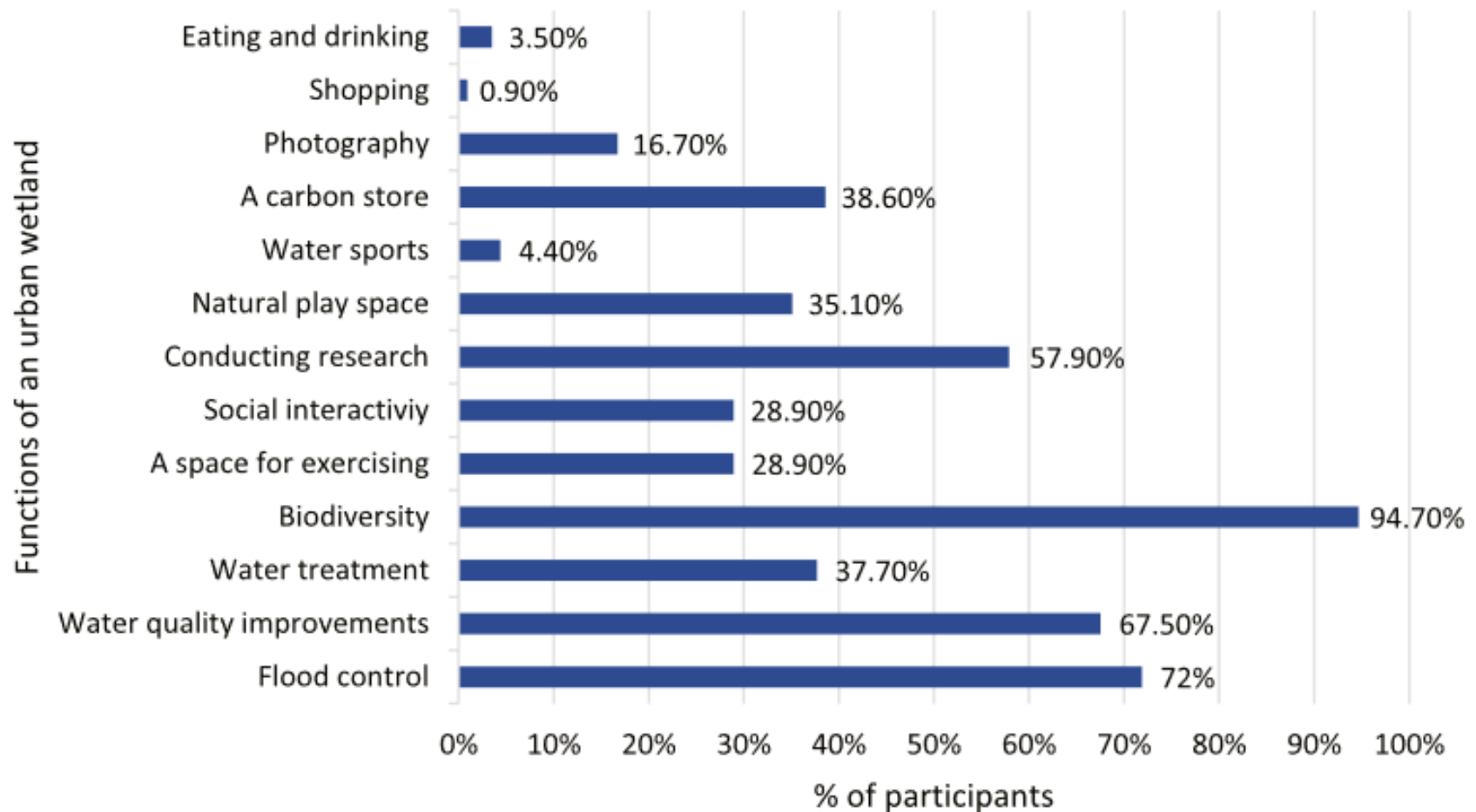
153 plant species in the flood zone

Photo Mengchi Ho

Survey on potential uses of urban Wetlands in the United Kingdom



Survey on functions of urban wetland in the United Kingdom



Andrews and Russo, 2022, Wetlands 42, 93



Thank you for your attention



