Plant diversity and species selection improves green roof performance

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UTSC

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WGIC 2017 BERLIN

DESIGNING WITH NATURE

20 - 22 JUNE 2017

World Green Infrastructure Congress

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Opportunities and services

- Stormwater Management
- Energy Conservation
- Urban Heat Island Effect
- Aesthetics/Continuity
- Pollution Abatement
- Solar Panel Synergisms
- New Architecture
- Green Jobs
- Food Production
- Roof Longevity
- Educational Value
- Urban biodiversity

Carrot Common, Toronto (Year 3)

Green roofs in Toronto

Toronto
Green Roof
Construction
Standard

Supplementary Guidelines

Gross Floor Area * (Size of Building)	Coverage of Available Roof Space (Size of Green Roof)
2,000 - 4,999 m2	20%
5,000-9,999 m2	30%
10,000-14,999 m2	40%
15,000-19,999 m2	50%
20,000 m2 or greater	60%

Limitations

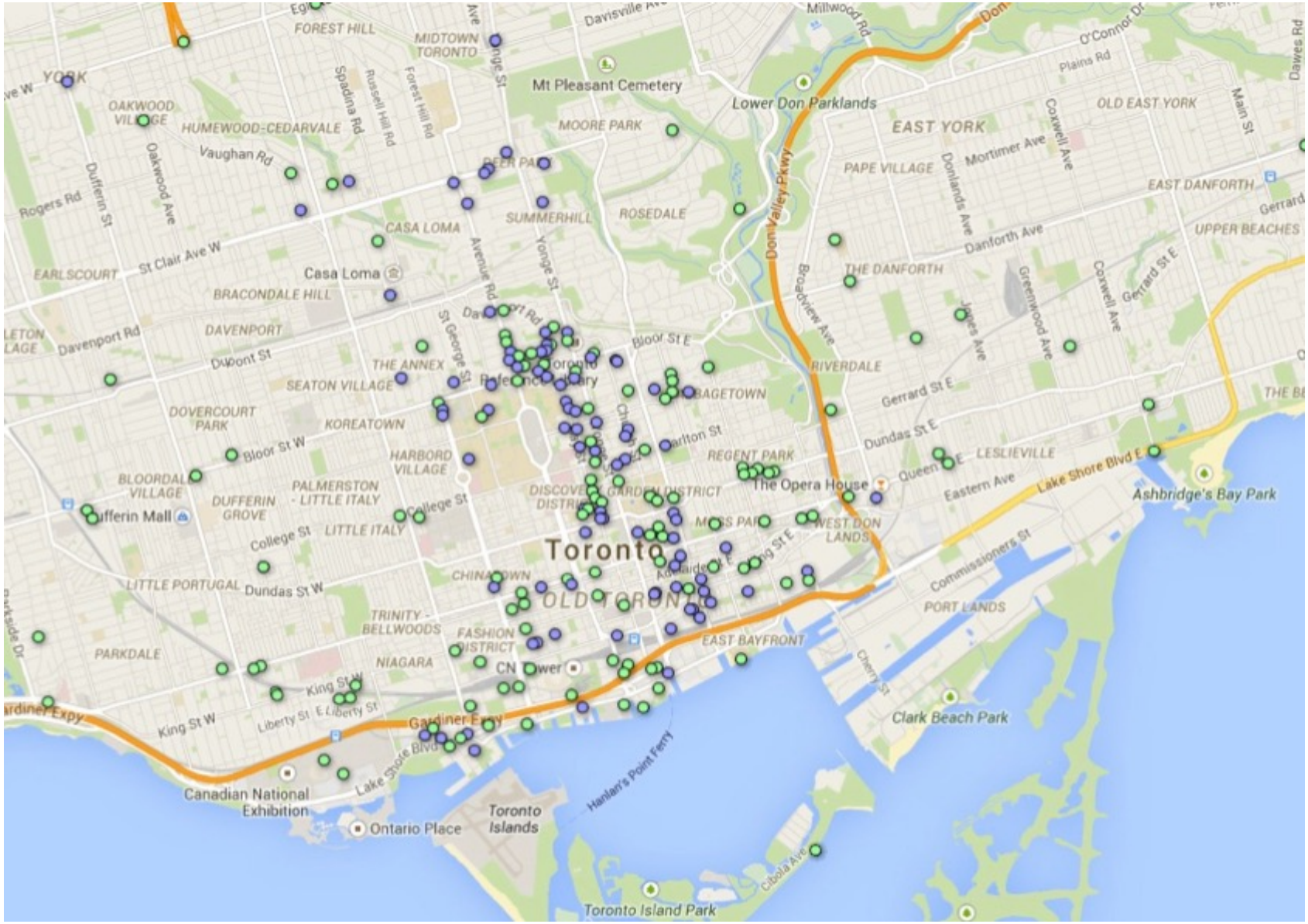
1. Substrate minimum
2. Little on plant selection
3. No requirement for irrigation

TORONTO

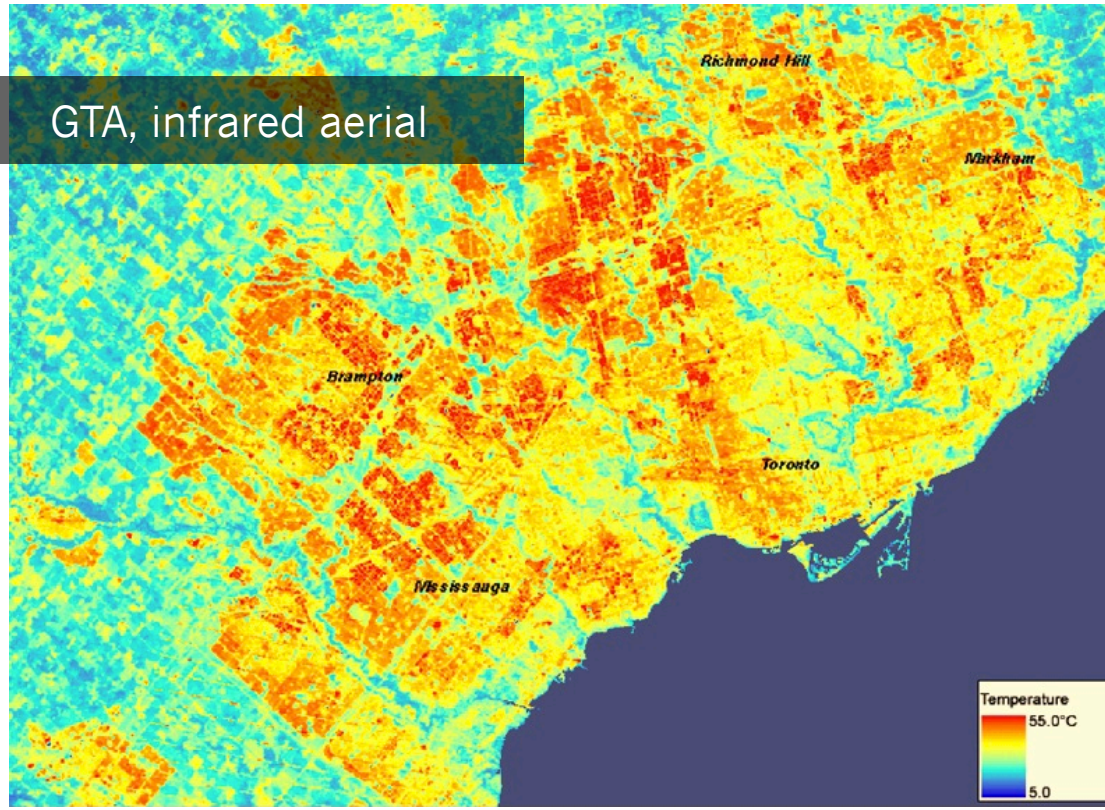
Livegreen Toronto

Green roofs in Toronto

Green roofs in Toronto

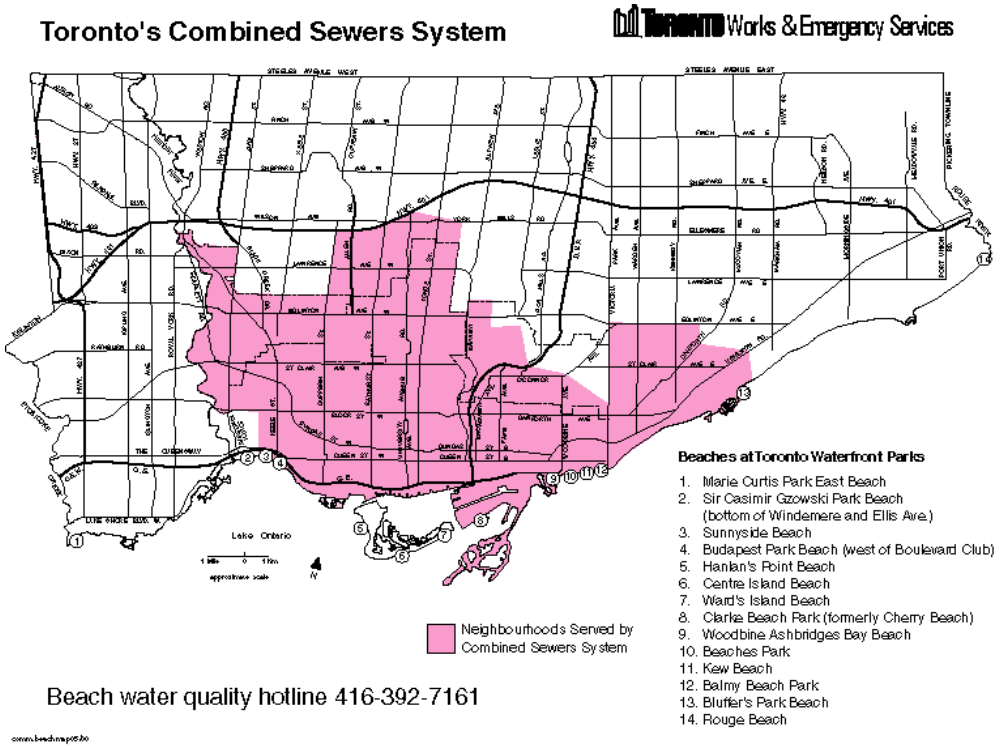


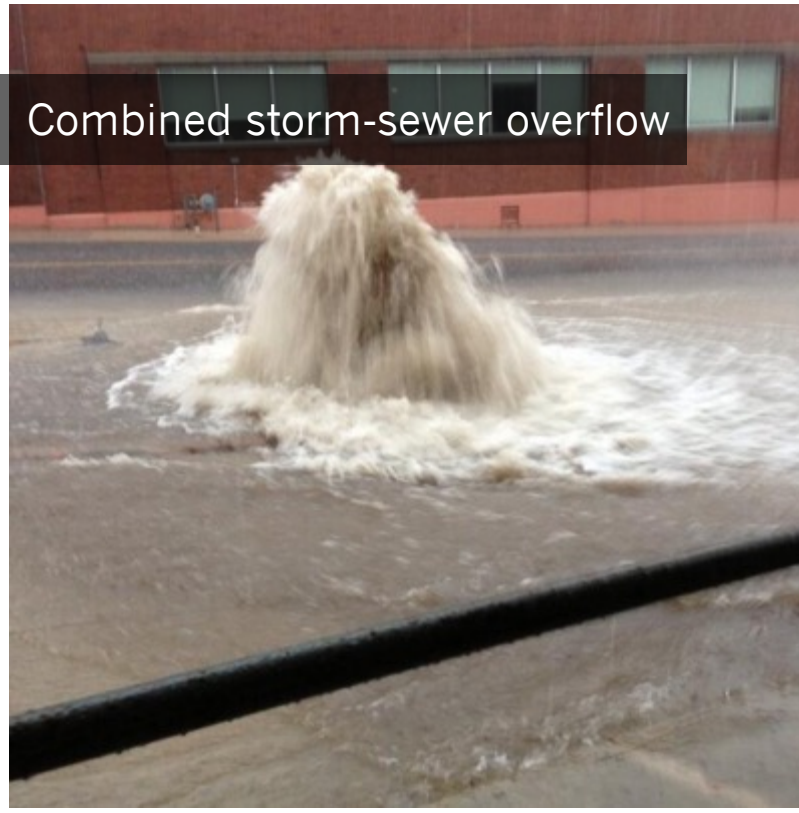
Toronto as a ‘hotspot’



- Low reflective surfaces (asphalt, concrete)
- Loss of vegetation and soil (evaporative cooling)
- Increase of energy use for cooling

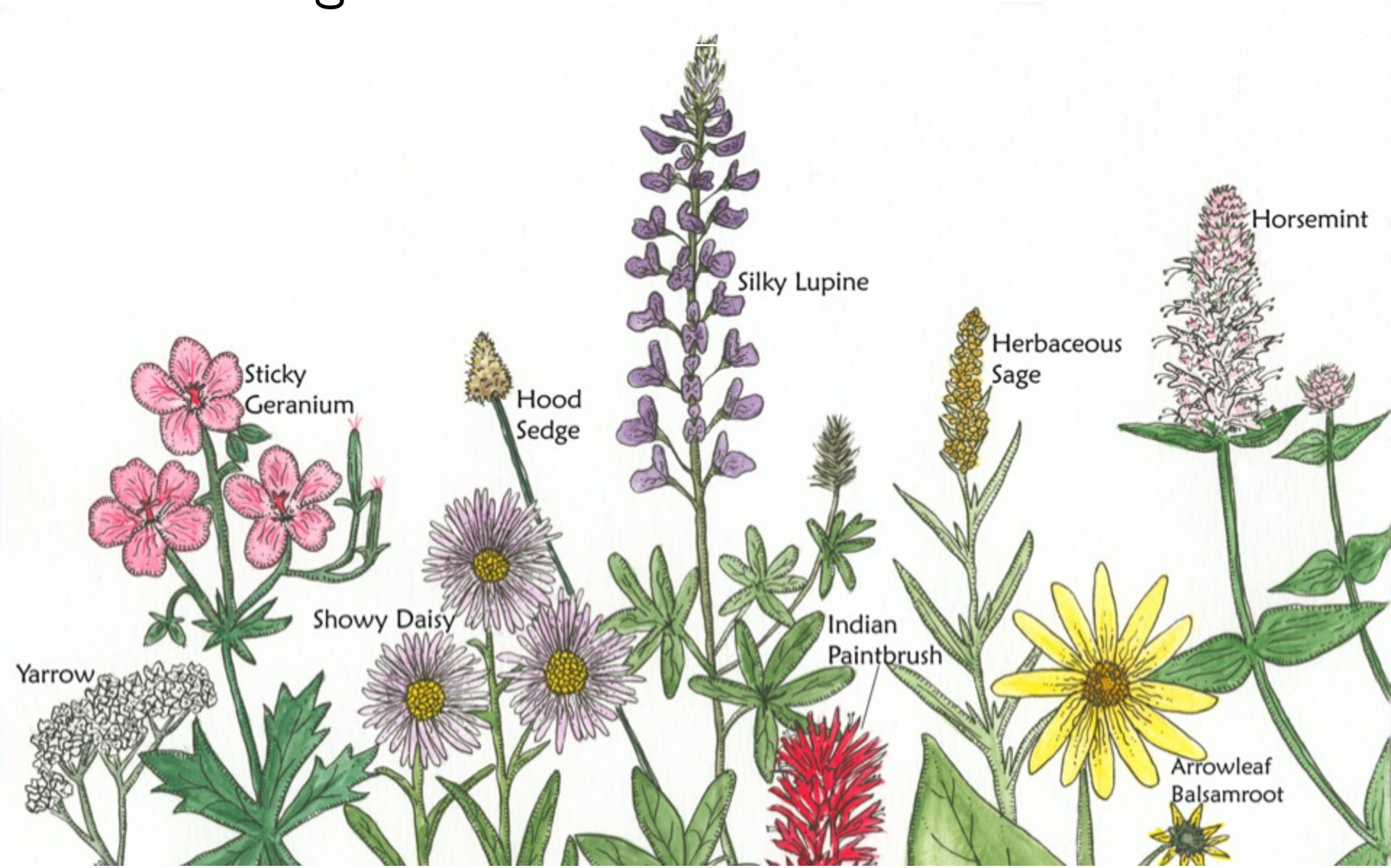
Urban water management





- Aging infrastructure
- Combined storm-sewer overflows
- Rapid urbanization and loss of ecosystem services
- Climate Change >> Climate extremes

Role of vegetation



Diversity matters!

GRASSES
+
TALL FORBS
+
SUCCULENTS
=

WATER CAPTURE +10%
WATER LOSS +25%
SURFACE TEMP -1C

] Over *Sedum* Only

Lundholm, **MacIvor**, et al. **(2010)** *PLoS one*

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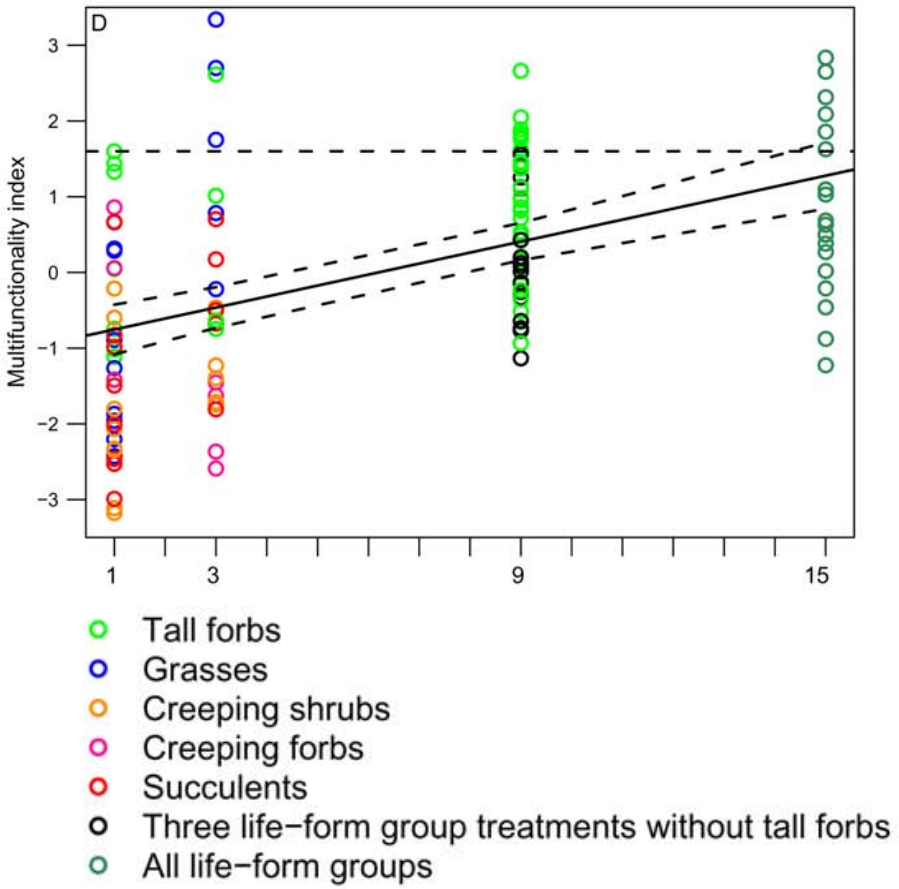

Over *Sedum*
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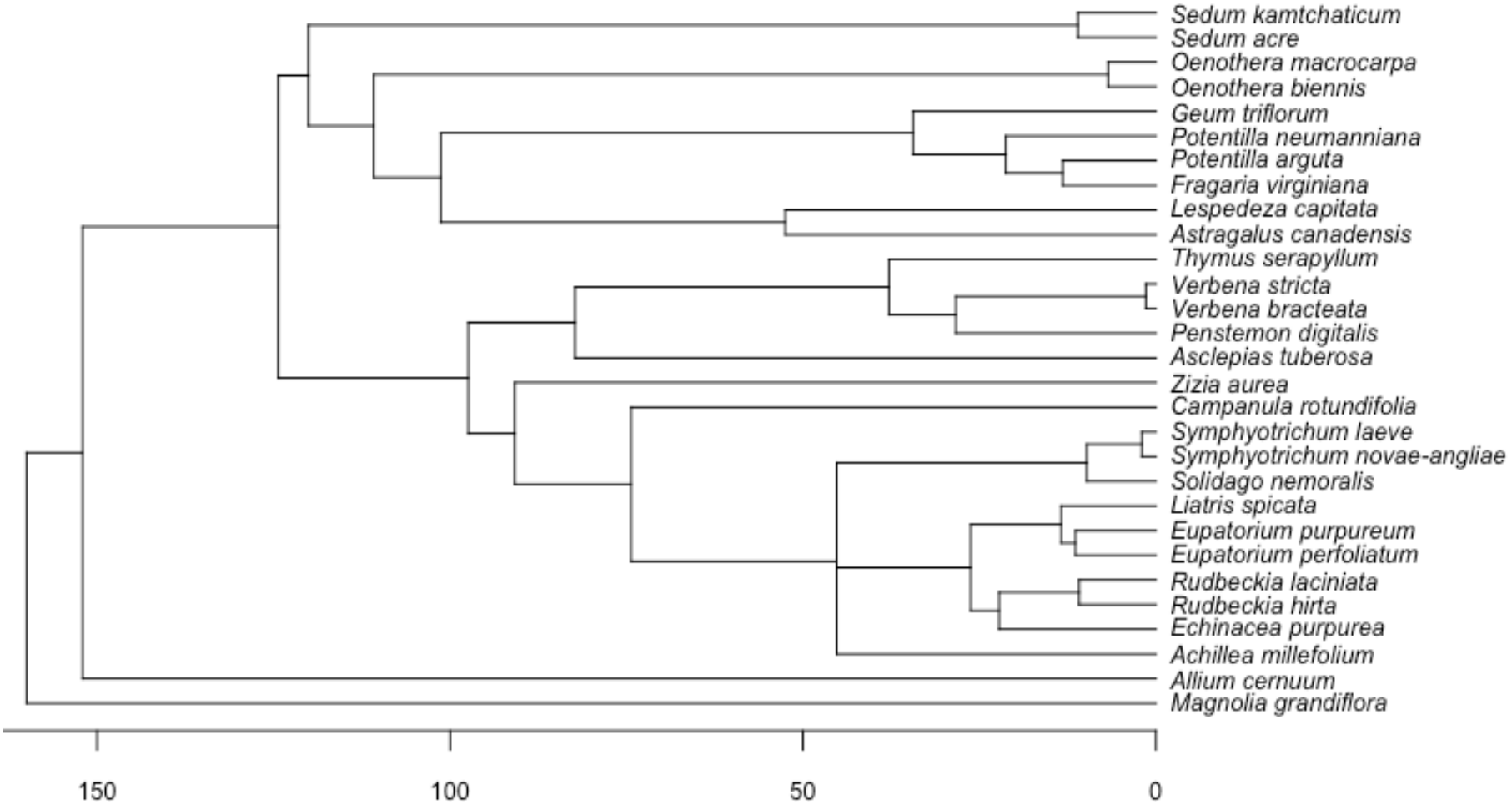
Lundholm, **MacIvor**, et al. **(2010)** *PLoS one*

Diversity matters

Role of functional and phylogenetic diversity?



MacIvor et al. (2016) *J Appl Ecol*

Diversity matters

Role of functional and phylogenetic diversity?

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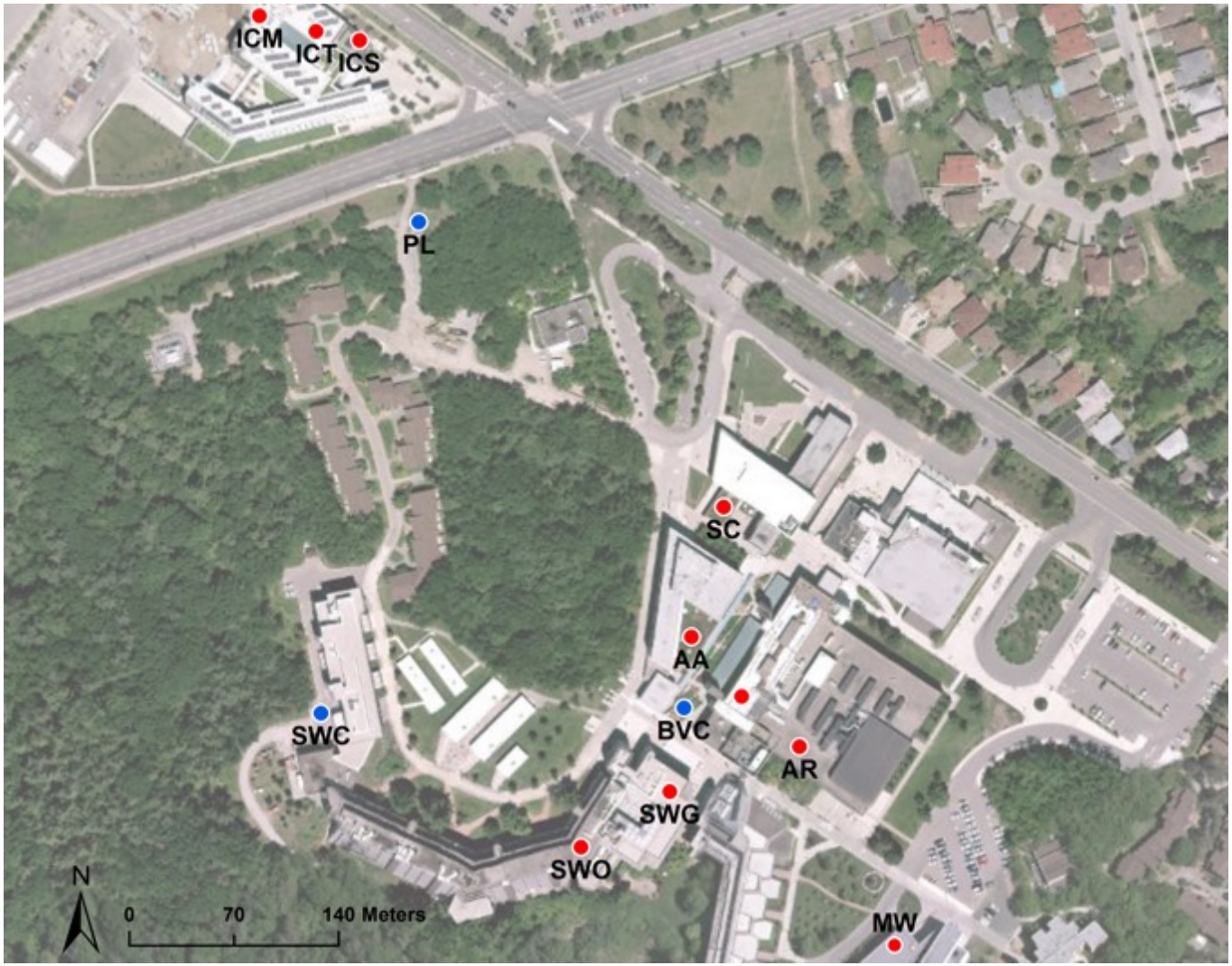
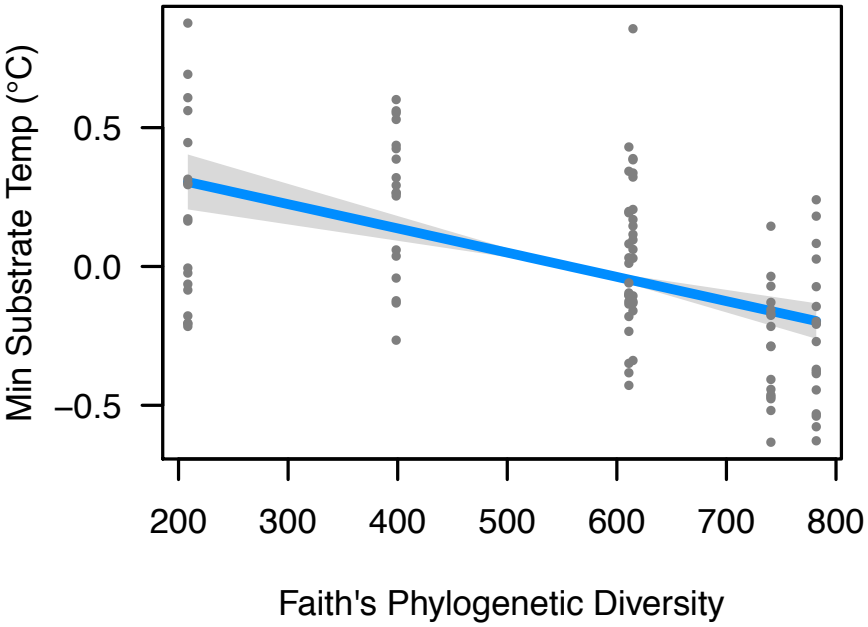
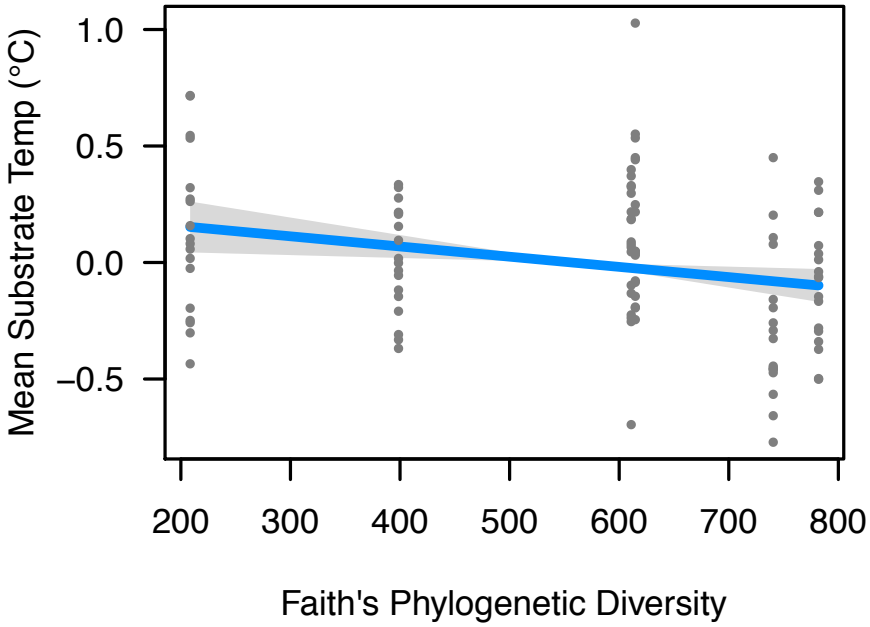


Diversity matters

Phylogenetic signal in green roof performance





MacIvor et al. (*in prep)*

Diversity matters

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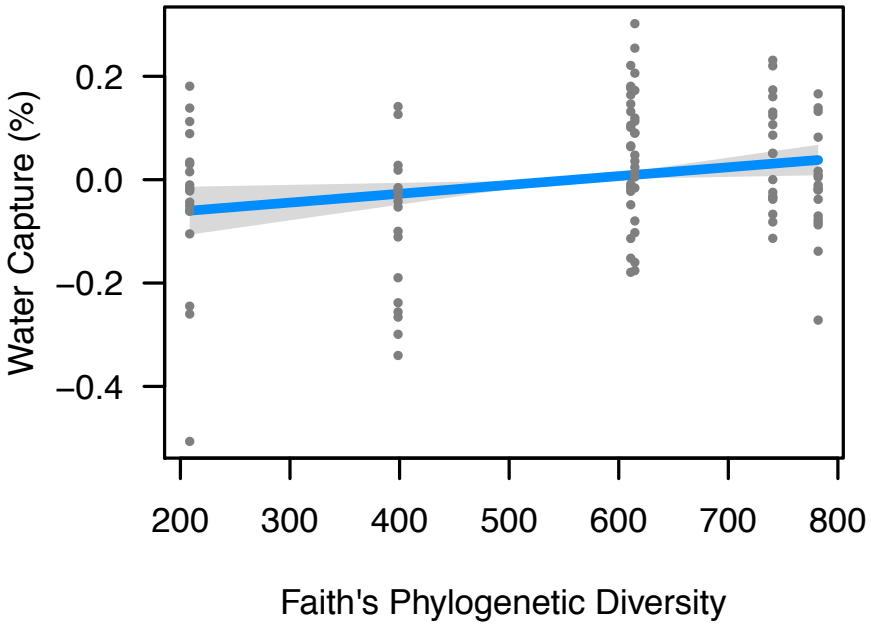

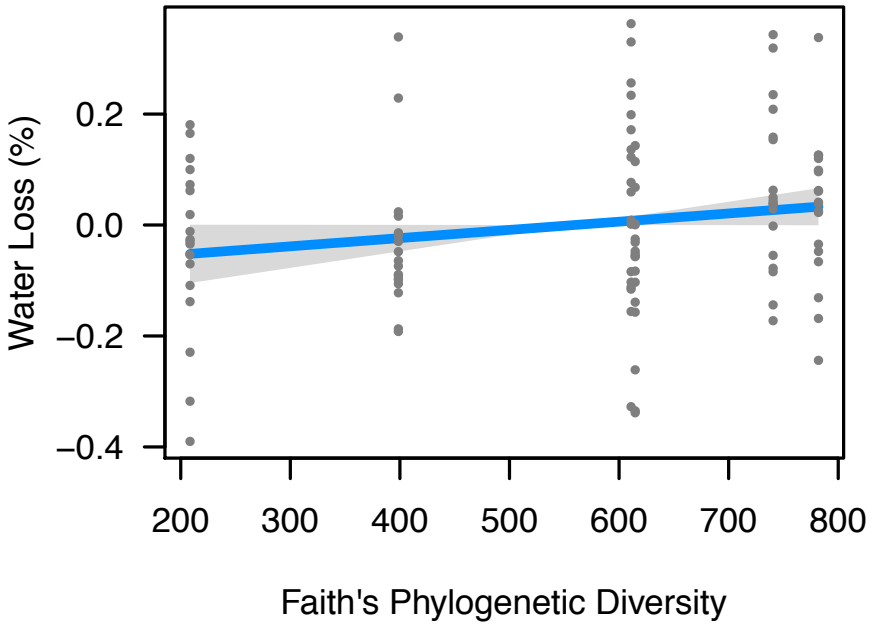

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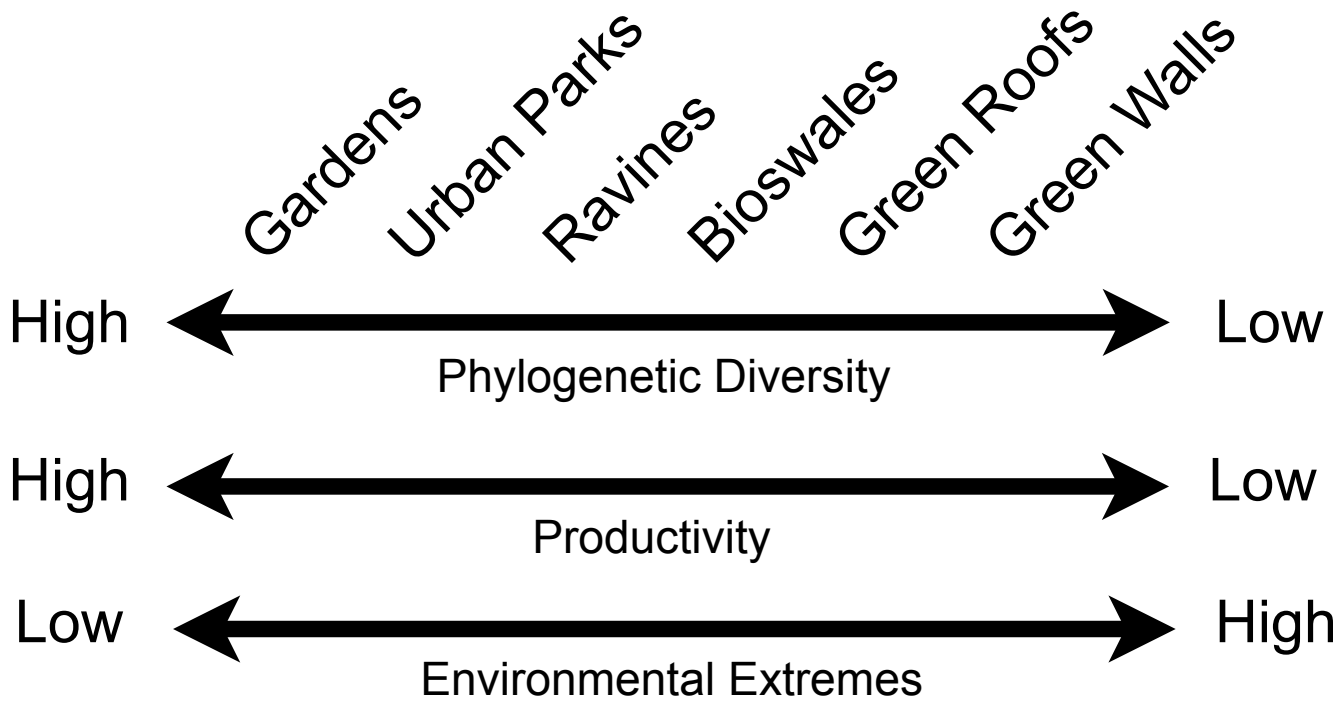


Aronson, …, **MacIvor** et al. (2016) *Frontiers*

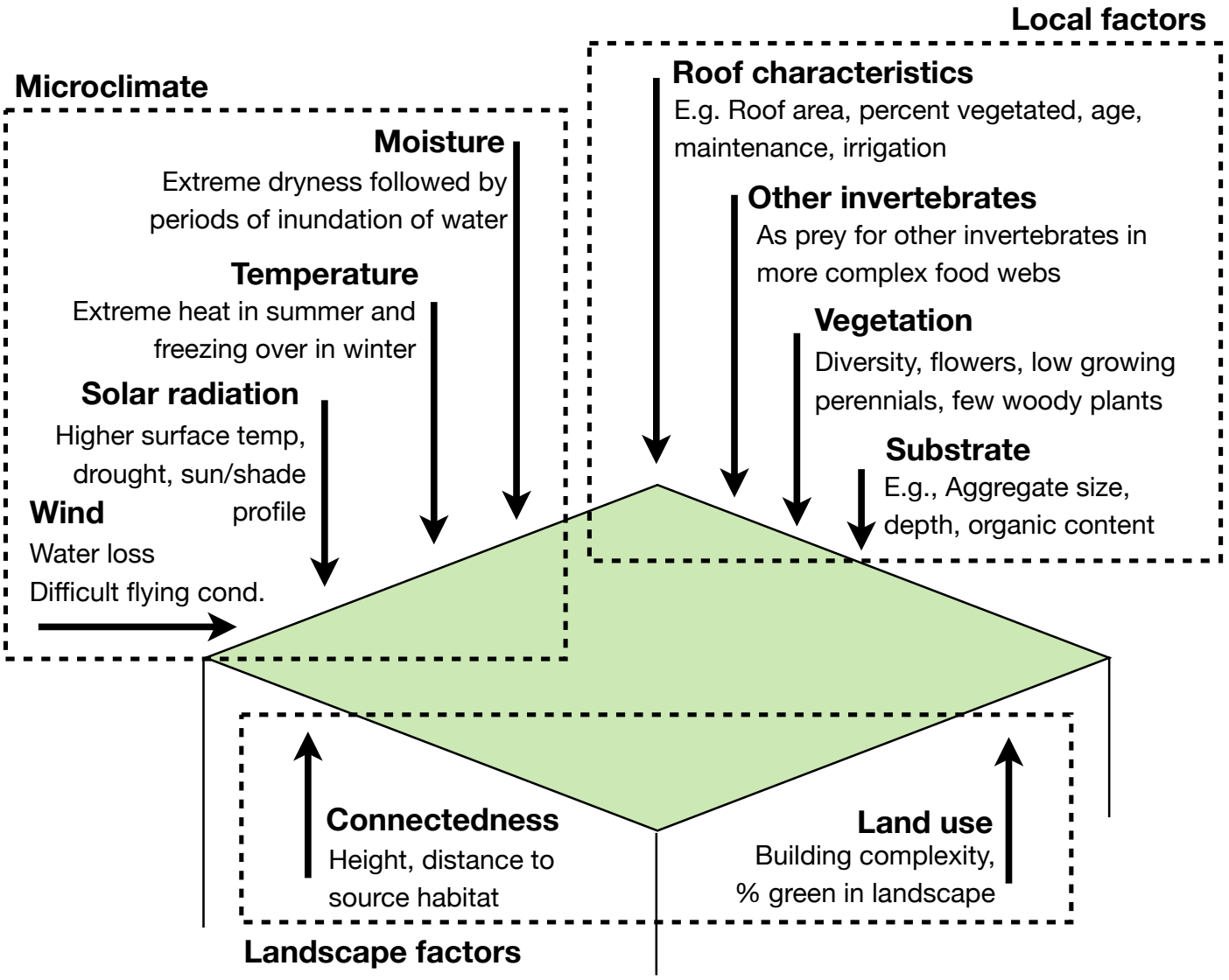
Summary

- Green roofs are living systems and require an evidence-based, **multidisciplinary** approach
- Green roofs are **designed experiments**; new knowledge of urban ecosystems
- **Toronto** has leading policy, guidelines, incentives that support green roofs
- **gritlab** and **UTSC** research links plant cover, type, and irrigation to green roof performance
- **Diverse plant communities can improve green roof functioning**

Wildlife habitat?

MacIvor & Ksiazek (2015) *Green Roof Ecosystems*

Limitations?



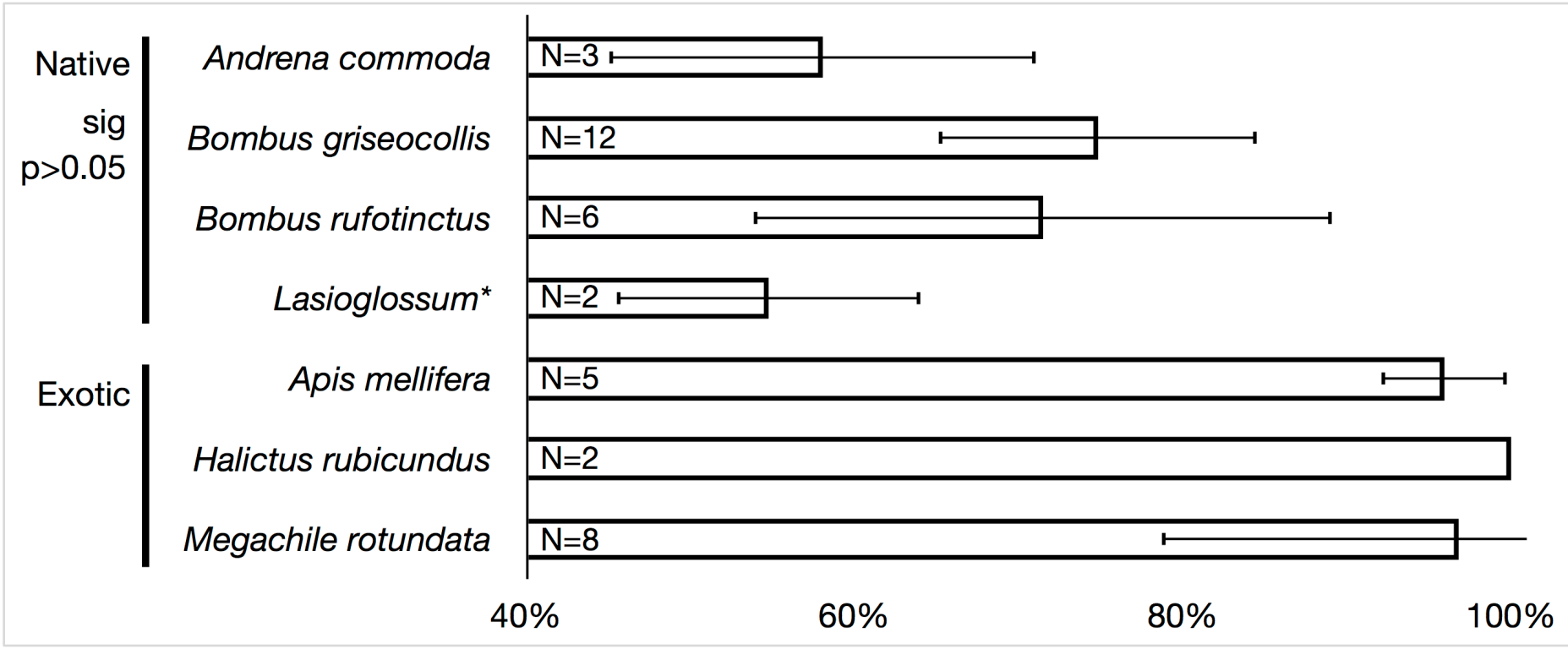
MacIvor & Ksiazek (2015) *Green Roof Ecosystems*

Limitations?

Non-indigenous species

MacIvor et al. (2015) *Urb Ecosyst*

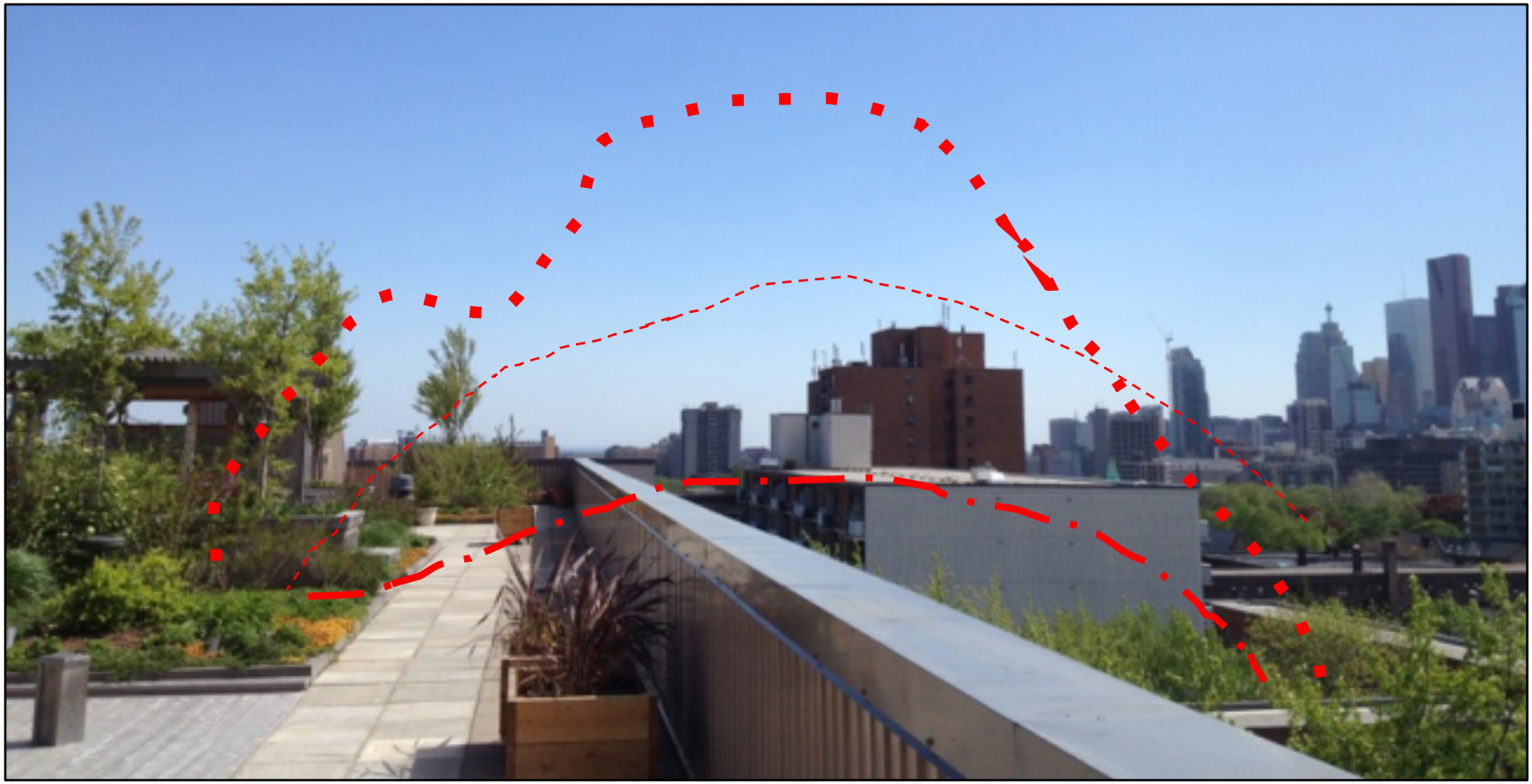
Green roofs as habitat for bees?



MacIvor, Ruttan, Salehi (2014) *Urban Ecosystems*

Limitations?

Height: Vertical isolation from ground

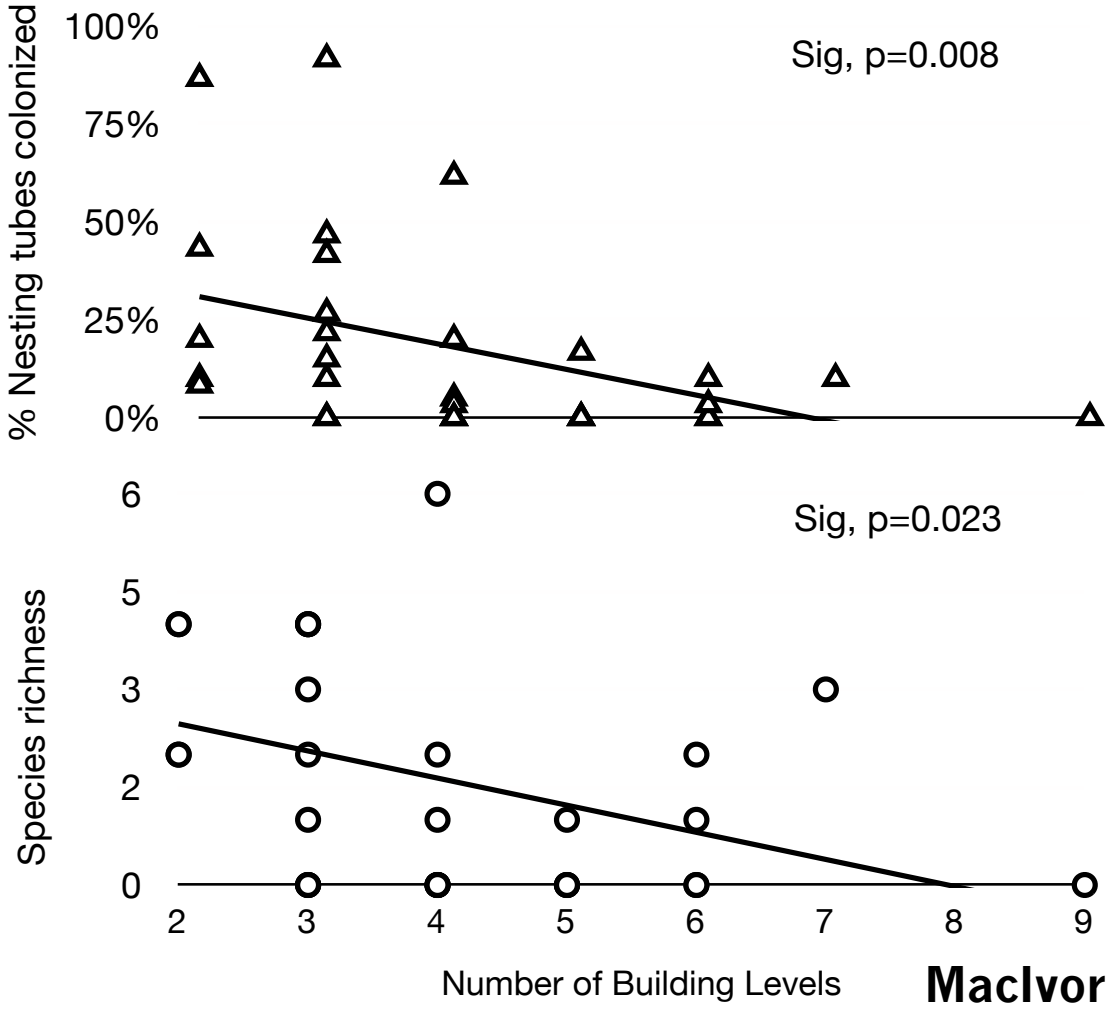


Hugh Garner Housing Co-Op, Toronto (7th year)

MacIvor (2016) *IJEE*

Limitations?

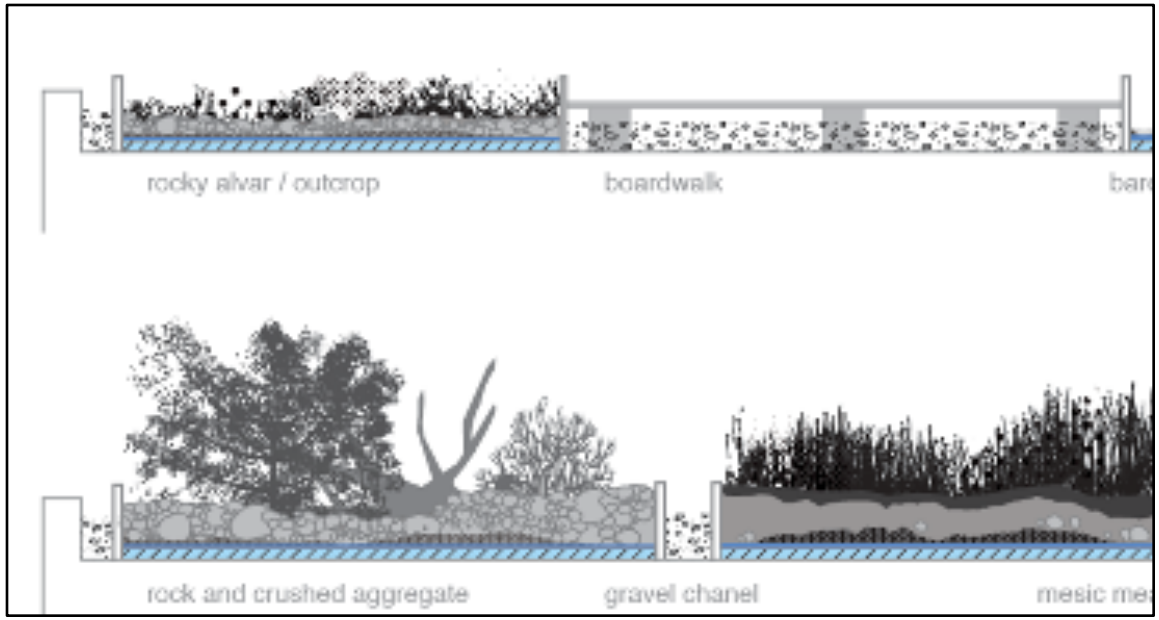
Vertical isolation from ground: Are green roofs habitat sinks?



MacIvor (2016) *IJEE*

Green roofs as habitat for bees: Nesting

Ground nesters: Bare soil, but limited by depth.



Bees are **important.** Bees are **diverse.**

Green roofs as habitat for bees

Honey bees?

UofT New College, Toronto

Royal Fairmont Hotel, Toronto

Crops dependent on diversity of bee visits, not frequency

(Garabaldi et al. 2013, Science)

Cities as a refuge?

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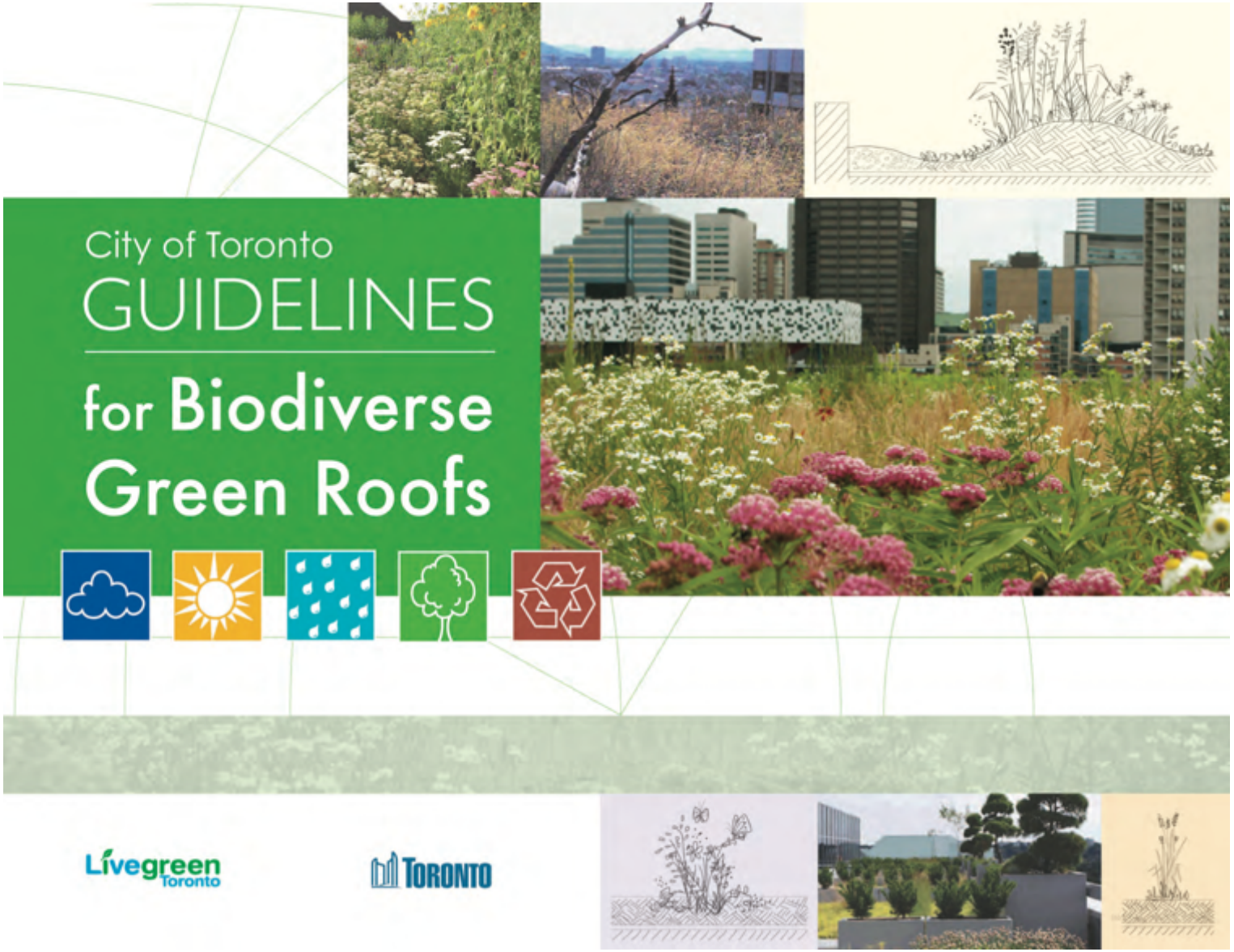
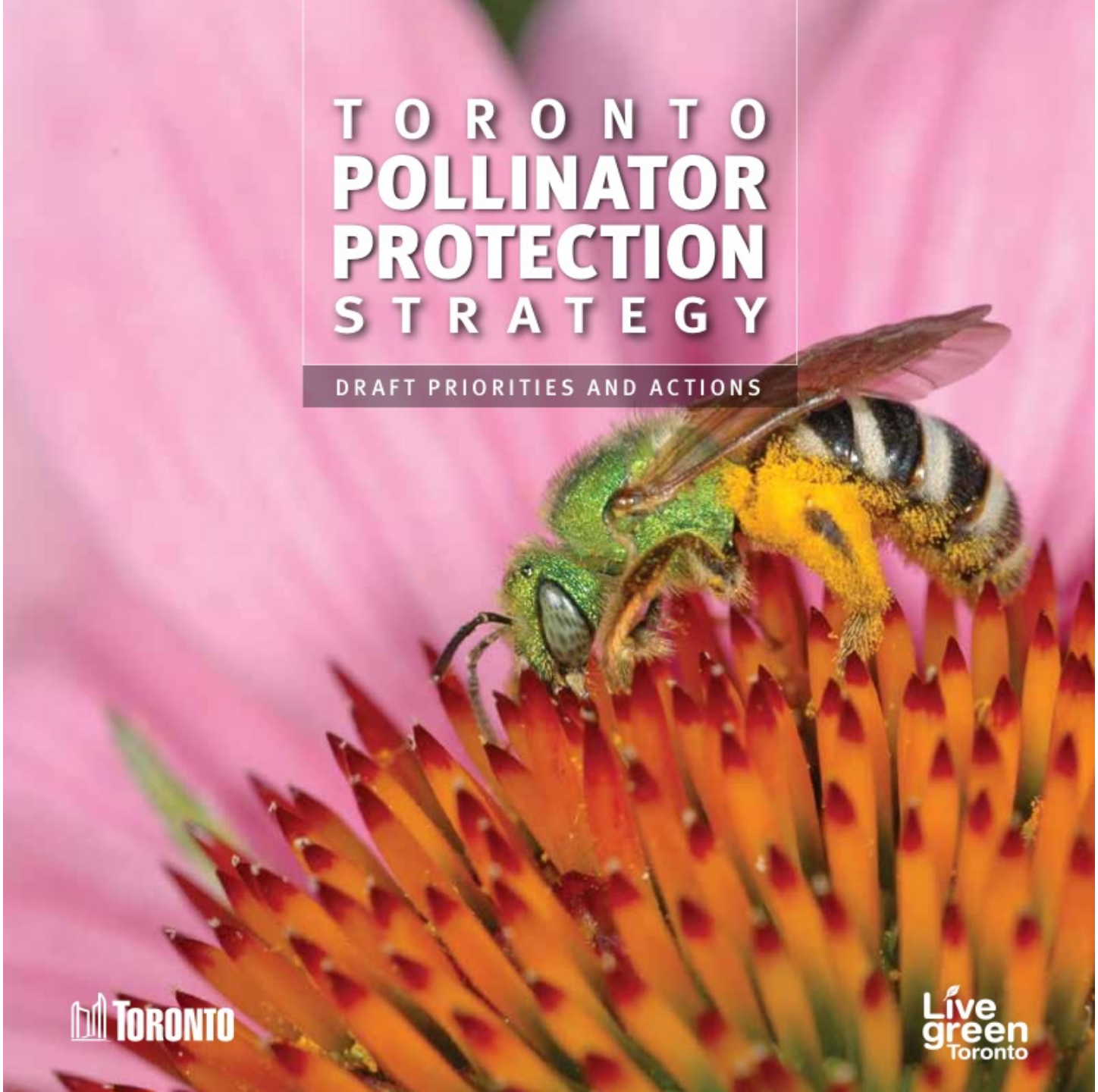


Torrance, **MacIvor** et al. (2013)

Packer, **MacIvor** et al. (2016)



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DRAFT PRIORITIES AND ACTIONS

TORONTO

Live green Toronto

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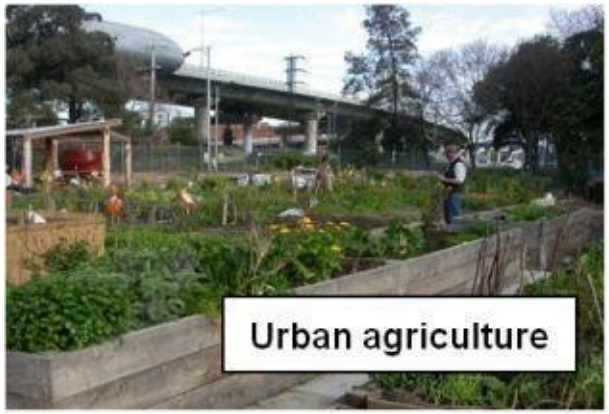

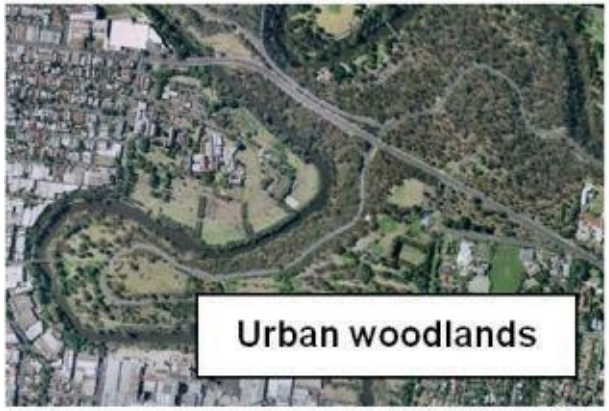

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Thank you. Questions?