

# Colorado Native Plants on Green Roofs?

By Jen Boussetot, CoNPS and CSU

## Plants on Rooftops?

- Rooftops are overlooked as available space in our landscapes
- Green roof systems have been researched over decades
- Green roofs are viable in all climates, including Colorado
- CO native plants are native to shallow, well drained conditions

## Historical Context of Green Roofs

- Hanging Gardens of Babylon
  - Ancient Wonder of the World (~600 B.C.)
- Early European
- 'Modern' European
- North America
  - Chicago, Portland

## Green Roof Rational

- As urbanization consumes more land, impervious surfaces also increase
  - Issues emerge which *were* insignificant:
  - The need to manage stormwater, The urban heat island effect, and Loss of arable land
  - Mitigation? Vegetation

## Types of Green Roofs

- Intensive or Rooftop Garden
  - Deep substrate (>6")
  - More like raised beds
  - Diverse
- Extensive or Ecoroof
  - Shallow (<6")
  - Lightweight
  - Retrofit

## Green Roof Basics

- Substrate
  - Engineered
  - Rarely any 'real' soil
  - Mostly expanded aggregate
- Plants
  - Succulent groundcovers
  - Predominantly *Sedum* spp.
  - Many experimental

## Plant Details

- Growth habit
  - Groundcover
  - Accent plant
- Plant Categories
  - Annuals
  - Herbaceous perennials
  - Succulents
  - Grasses
- Evergreen/winter interest
- Shallow, fibrous rooted
  - Not tap rooted
- Drought tolerant

## Less Common Plants

- Anti-sedum undercurrent
- 'Experimental' plants
- Irrigation
- Maintenance
- Native plants
- Shallow roots
- Adaptive
- Intensive roofs

## **Colorado Native Plants on Green Roofs?**

By Jen Boussetot, CoNPS and CSU

### **Benefits of Green Roofs**

- Managing stormwater
- Urban Heat Island Effect
- Energy conservation
- Air pollution reduction
- Carbon sequestration
- Roof membrane life span
- Noise mitigation
- LEED points
- Property value
- Aesthetics

### **Ecosystem Services**

- The benefits people obtain from ecosystems
- Provisioning: water filtration, food
- Supporting: nutrient cycling, pollination
- Regulating: climate control
- Cultural: recreational benefits
- Green roofs can provide these in urban areas
- Both public and private benefits

### **Increased Biodiversity**

- Urban habitat for:
- Insects and arachnids
- Pollinators
- Birds, especially rare
- Rare plants and lichens
- Collections of native plants
- Next worldwide research
- Germany was first
- Now UK, Canada, US

### **Museum of Contemporary Art**

**Boulder Residence**

**Nederland Residence**

**Community College of Denver**

**Colorado State University**

**Denver Botanic Gardens Children's Garden**

### **How can Rooftops Help CO Flora?**

- Ideal places for rare plants
- Designed for specific species
- Invasive weed issues are rare
- Little predation or foot traffic
- Several models exist in Europe
- Urban corridors for pollinators
- Designed as habitats for fauna
- Increase natives in landscapes

### **Rooftop Conservation Citations**

- Boussetot, J., Klett, J. and Koski, R.D., 2010. Extensive green roof species evaluations using digital image analysis. *HortScience*, 45(8), pp.1288-1292.
- Brenneisen, S. 2006 Space for urban wildlife: designing green roofs as habitats in Switzerland. *Urban Habitats* 4.1: 27-36.
- Köhler, M. 2006. Long-term vegetation research on two extensive green roofs in Berlin. *Urban Habitats* 4, no. 1: 3-25.
- MacIvor, J.S., and J. Lundholm. 2011. Insect species composition and diversity on intensive green roofs and adjacent level-ground habitats. *Urban ecosystems* 14.2: 225-241.
- Oberndorfer, E., et al. 2007. Green roofs as urban ecosystems: ecological structures, functions, and services. *BioScience* 57.10: 823-833.
- Schneider, A., Fusco, M., Boussetot, J. 2014. Observations on the survival of 112 plant taxa on a green roof in a semi-arid climate. *Journal of Living Architecture* 1(5), 10-30.
- Sutton, R., et al. 2012. Prairie-based green roofs: literature, templates, and analogs. *Journal of Green Building* 7(1), 143-172.

## **Colorado Native Plants on Green Roofs?**

By Jen Boussetot, CoNPS and CSU

### **Denver Botanic Gardens Green Roof**

- *Penstemon pinifolius*, pineleaf penstemon
- *Phacelia campanularia*, California bluebell
- *Eriogonum umbellatum*, sulfur flower buckwheat
- *Physaria bellii*, Bell's twinpod
- *Ipomopsis aggregata*, scarlet gilia
- *Opuntia phaeacantha*, tulip prickly pear
- *Sedum lanceolatum*, lanceleaf stonecrop
- *Antennaria parvifolia*, pussytoes
- *Artemisia frigida*, fringed sage

### **DBG Green Roof Conclusions**

- Succulent lifeforms = greatest survival
- Woody shrubs and graminoids performed well
- Upright and creeping forbs = less success
  - Tap rooted plants should be avoided
- Individual species within each lifeform thrived
- Similar to German research (Köhler 2006)

### **Denver Green Roof Ordinance**

- Denver Green Roof Initiated Ordinance 300
  - Ballot issue on November 2017 Denver election
- The ordinance was based on Toronto's policy
  - But added existing buildings at expansion/reroof
- Rewrite by Denver Green Roof Task Force

### **Green Roofs and Water**

- Denver Water on the Denver Green Roof Task Force
  - Primary concern was potable water use on green roofs
  - Denver Water ran an in depth independent analysis
- Using irrigation data from CSU/EPA research
  - Assumed 1,000 acres of new green roofs
  - Assumed 95% succulents/natives, 5% turf/ag
- Only increased water use by 1.15% at peak season!

## **Colorado Native Plants on Green Roofs?**

By Jen Boussetot, CoNPS and CSU

### **Denver Green Roof Task Force Final Products**

#### New Buildings

- Cool roof + 1 of 8 options
- Green roof or green space
- Finance off-site green space
- Combo green space + solar
- Combo green space + energy efficiency
- A solar array on 70% of roof
- 12% more efficient than code
- LEED Gold
- Enterprise Green Communities Certification

#### Existing Buildings

- Cool roof + 1 of 5 options
- Small green roof or green space on site
- On-site solar
- LEED Silver certification
- Finance off-site green space
- Enrollment in a flexible Energy Program

### **Green Roof References**

- Green Roofs for Healthy Cities: [greenroofs.org](http://greenroofs.org)
- [greenroofs.com](http://greenroofs.com)
- *The Green Roof Manual* by Snodgrass & McIntyre
- *The Professional Design Guide to Green Roofs* by Dakin, Benjamin, and Pantiel
- *Planting Green Roofs and Living Walls* by Dunnett & Kingsbury
- *Green Roof Plants* by Snodgrass & Snodgrass

### **Questions?**

Jennifer.Boussetot@colostate.edu